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Research Article

Structured Scientific Methodologies in Maritime Product and Service Innovation: Enhancing Evidence-Based Decision-Making

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Abstract: The maritime industry is undergoing rapid transformation, requiring systematic, evidence-based methodologies to improve product and service innovation success rates. Traditionally, maritime businesses have relied on intuition-based decision-making, leading to inefficiencies, increased risks, and inconsistent innovation outcomes. This study investigates the role of structured scientific methodologies in maritime innovation management, emphasizing how systematic approaches enhance decision accuracy, minimize risk, and improve long-term sustainability. This research provides original value by evaluating the effectiveness of structured scientific approaches in maritime innovation, an area where limited studies have explored the intersection of philosophy, leadership, and evidence-based decision-making. The study addresses the following research questions: To what extent do structure scientific methodologies improve product and service innovation success? How do industry leaders, lecturers, and students perceive the role of evidence-based decision-making in innovation? Using qualitative research methods, the study collected data from maritime experts, lecturers, and postgraduate students through semi-structured interviews and document analysis, followed by thematic and comparative analysis. Results indicate that structured methodologies significantly improve innovation outcomes, but barriers such as industry reluctance and lack of competency development hinder adoption. The study concludes that integrating scientific reasoning into maritime leadership training can enhance innovation success, mitigate risk, and foster a culture of evidence-based strategic management.

Keywords: Maritime Innovation, Scientific Methodologies, Evidence-Based Decision-Making, Risk Reduction, Strategic Leadership.

1. Introduction

In an era of rapid technological advancements and market evolution, innovation in product and service development has become a key driver of competitive advantage, sustainability, and customer satisfaction (Laghari et al., 2021; Plaza-Hernández et al., 2021). Businesses that fail to adopt structured methodologies in innovation management often face high failure rates, inefficiencies, and strategic misalignment with industry needs. Nowhere is this more critical than in maritime leadership and management, where the development of new technologies, operational strategies, and customer-focused services must adhere to both economic and regulatory constraints. While intuition and experience have historically played dominant roles in product and service innovation, reliance on trial-and-error methods without scientific validation poses significant risks. A structured, evidence-based scientific methodology provides a framework for reducing uncertainty, improving decision-making accuracy, and ensuring that product and service innovations align with industry needs and long-term strategic goals. This research investigates the role of philosophical scientific methods in maritime product and service innovation, emphasizing the importance of systematic, evidence-based approaches in enhancing managerial decision-making, reducing risks, and fostering sustainable innovation strategies.

Despite substantial advancements in innovation methodologies, many industries, including maritime transportation and logistics, struggle to fully integrate structured scientific

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approaches into their product and service development processes. Industries such as healthcare and technology have successfully implemented systematic innovation frameworks, utilizing philosophical scientific methods that ensure decision-making is rooted in empirical evidence, structured experimentation, and data-driven insights. However, the maritime sector often relies on traditional decision-making frameworks, where intuition and past experiences play a central role in innovation management (Issa et al., 2022; Selkou & Roe, 2022). This lack of structured methodologies contributes to inefficiencies, increased financial risks, and slower adoption of technological advancements. While some maritime businesses have adopted digitalization and automation, the systematic application of scientific methodologies in product and service innovation remains an area of limited exploration (Akpinar & Ozer-Caylan, 2021; Zaderei, 2020). Given the increasing complexity of global supply chains, environmental regulations, and customer demands for efficiency and sustainability, there is an urgent need to transition from intuition-based innovation to structured, evidence-driven product and service development methodologies.

The research problem addressed in this study is the lack of a structured scientific approach in product and service innovation in maritime leadership. While intuition-based decision-making has historically contributed to business success, it remains prone to errors, inefficiencies, and inconsistencies. Without structured methodologies to validate new products and services, businesses risk misallocating resources, launching unsuccessful innovations, and failing to meet evolving industry demands. The study seeks to answer the central research question: To what extent do philosophical scientific methods influence product and service innovation in maritime leadership, and how can structured methodologies improve decision-making in innovation management?

This research builds upon four specific objectives: (1) To analyze how maritime leaders balance experience-based and scientific approaches in product and service innovation, (2) To examine the philosophical assumptions guiding structured decision-making in innovation management, (3) To assess the role of epistemological literacy in reducing risk and improving strategic accuracy in innovation, and (4) To identify the challenges and opportunities in integrating structured methodologies in maritime leadership. These objectives provide a comprehensive foundation for evaluating the effectiveness of structured methodologies in product and service development, ensuring that innovation strategies are systematically validated and strategically aligned with long-term industry needs.

The rationale and motivation for this study stem from the increasing complexity and competitiveness of maritime business operations, requiring greater precision, efficiency, and sustainability in innovation management. The maritime industry operates within a dynamic global landscape, where technological disruptions, regulatory changes, and shifting customer expectations necessitate structured, evidence-based decision-making (Cicek et al., 2019; Pantouvakis & Vlachos, 2020; Toriia et al., 2023). However, without a systematic scientific approach to innovation, maritime businesses risk lagging behind industries that have successfully integrated structured methodologies. This study is particularly relevant in the context of digital transformation, smart shipping technologies, and sustainability initiatives, all of which require methodical research, testing, and validation before widespread implementation.

This research adopts a qualitative approach with a descriptive analysis framework, engaging five to six respondents from three key groups: maritime industry experts, lecturers in applied management, and postgraduate students specializing in marketing, innovation, and leadership. The study collects data through semi-structured interviews, document analysis, and comparative assessments of product and service innovation strategies. The interviews explore how decision-makers conceptualize structured methodologies in product and service innovation, the role of epistemology in guiding innovation decisions, and the challenges faced

in implementing scientific approaches in real-world maritime business environments. The document analysis component evaluates industry case studies on successful and failed product and service innovations, identifying patterns in structured vs. intuition-based decision-making. The data analysis involves thematic categorization, cross-group comparisons, and narrative synthesis, ensuring that findings provide a cohesive understanding of how structured methodologies influence innovation success and risk reduction.

The conceptual framework guiding this research consists of three primary variables:

a. Independent Variable: The Scientific Method in Innovation Management (positivist, constructivist, or hybrid models).

b. Mediating Variable: Leadership Decision-Making Approaches (structured vs. intuition-based decision-making).

c. Dependent Variable: The Success Rate and Sustainability of Product and Service Innovation in Maritime Business.

This framework enables a structured evaluation of how scientific methodologies contribute to decision-making effectiveness in product and service development. It allows for analyzing how different leadership paradigms influence innovation outcomes, providing a comprehensive understanding of best practices for integrating structured methodologies into innovation management strategies.

One of the most significant contributions of this study is its potential to reshape innovation education and leadership training programs. If maritime institutions incorporate structured scientific methodologies into product and service innovation curricula, future leaders will be better prepared to develop, test, and validate new innovations using systematic, evidence-based approaches. Additionally, this research provides practical recommendations for maritime businesses seeking to enhance innovation success through structured methodologies, reducing financial risks and improving the long-term sustainability of product and service development.

This study seeks to redefine innovation management in maritime leadership by advocating for a structured, scientifically grounded approach to product and service development. The maritime industry, despite being a cornerstone of global trade, continues to rely heavily on traditional innovation models that prioritize intuition over structured validation. By integrating scientific paradigms into innovation methodologies, this research contributes to the development of a systematic framework that enhances decision-making effectiveness, minimizes risk, and fosters a culture of evidence-based innovation. As the industry continues to navigate challenges such as environmental regulations, digital transformation, and technological advancements, the adoption of structured methodologies in product and service innovation will become essential for maintaining a competitive edge, ensuring long-term sustainability, and delivering high-value solutions to industry stakeholders. This research provides a foundation for future studies, policy recommendations, and practical implementation strategies aimed at integrating structured scientific reasoning into maritime innovation management.

2. Literature Review

1. Innovation Management in Maritime Leadership

Recent scholarship emphasizes that **structured scientific methodologies are increasingly critical in maritime innovation management**, particularly as the industry faces digital transformation, sustainability pressures, and regulatory complexity. Studies highlight that while intuition-based decision-making remains prevalent, reliance on unstructured approaches often leads to inefficiencies and higher failure rates (Halomoan et al., 2025). Evidence suggests that epistemological reasoning and structured frameworks improve

leadership decision-making in maritime technological innovation, offering resilience against market volatility.

2. Scientific Paradigms and Decision-Making Frameworks

The integration of **positivist and constructivist paradigms** into maritime innovation has been explored in recent research, showing that hybrid models combining empirical validation with contextual adaptability yield stronger outcomes. Spyrou and Themelis (2025) argue that structured methodologies in ship operations, autonomy, and logistics enhance safety and sustainability, aligning innovation with long-term industry goals. This supports the conceptual framework in your study, where scientific methods act as independent variables influencing leadership decision-making and innovation success.

3. Risk Reduction and Sustainability in Innovation

Risk management remains a critical challenge. Contemporary findings indicate that structured scientific approaches significantly reduce risks in product and service development, though adoption is hindered by organizational conservatism (Halomoan et al., 2025). Sustainability-focused innovation frameworks, particularly those tied to environmental regulations and smart shipping technologies, demonstrate that evidence-based decision-making enhances resilience and adaptability in maritime organizations (Spyrou & Themelis, 2025).

4. Competency Development and Academic-Industry Collaboration

Competency development in evidence-based innovation methodologies is essential for bridging the gap between academic training and industry practice. Recent methodological guides emphasize the importance of mixed-methods research in maritime studies, integrating qualitative insights with quantitative validation to strengthen innovation outcomes (Charting a New Course, 2024). This aligns with your study's findings that postgraduate students recognize the theoretical value of structured methodologies but remain frustrated by their limited industry application.

5. Comparative Perspectives Across Stakeholders

Experts, lecturers, and postgraduate students differ in their perceptions of structured innovation. Experts highlight practical constraints such as regulatory compliance and financial feasibility, lecturers emphasize theoretical benefits and advocate for curriculum integration, while students stress the disconnect between academic training and industry adoption. This triangulation of perspectives is consistent with recent scholarship that calls for **stronger academic-industry collaboration** to institutionalize structured innovation frameworks (Halomoan et al., 2025; Spyrou & Themelis, 2025).

A Comparative Table contrasting intuition-based vs. structured scientific innovation

Table1. Comparative approaches in Maritime Leadership Intuition-Based vs. Structured Innovation in Maritime Leadership

Dimension	Intuition-Based Innovation	Structured Scientific Innovation	Recent Literature
Decision-Making Basis	Relies on personal experience, tacit knowledge, and trial-and-error methods.	Grounded in empirical evidence, hypothesis testing, and systematic validation.	Halomoan et al. (2025); Spyrou & Themelis (2025)
Risk Management	Higher risk exposure due to lack of systematic evaluation; prone to resource misallocation.	Reduced risk through structured risk assessment, regulatory compliance, and data-driven evaluation.	Halomoan et al. (2025)
Efficiency & Success Rate	Often unpredictable outcomes; innovation cycles may be faster but less reliable.	Higher success rates, improved efficiency, and better resource allocation due to structured frameworks.	Spyrou & Themelis (2025)
Leadership Attitudes	Favored by conservative leaders who value tradition and speed over validation.	Requires leadership commitment to evidence-based reasoning and long-term sustainability.	Charting a New Course (2024)
Competency Development	Skills passed informally through mentorship and experience; limited analytical training.	Competency built through structured education, industry-academic collaboration, and analytical skill development.	Charting a New Course (2024)
Sustainability	Short-term focus; innovations may fail to adapt to regulatory and environmental changes.	Long-term resilience; structured models align with sustainability and digital transformation goals.	Spyrou & Themelis (2025)
Industry Adoption	Widely practiced but increasingly criticized for inefficiencies.	Recognized as essential but adoption remains slow due to conservatism and training gaps.	Halomoan et al. (2025)

The comparative analysis highlights a clear divergence between intuition-based and structured scientific approaches to maritime innovation. Intuition-driven models, while historically dominant, often prioritize speed and experiential judgment at the expense of systematic validation, leading to higher risks and inconsistent outcomes. In contrast, structured scientific methodologies provide a disciplined framework for decision-making, ensuring innovations are empirically tested, strategically aligned, and sustainable in the long term. Recent scholarship underscores that the adoption of evidence-based frameworks enhances efficiency, reduces risk, and fosters resilience in maritime organizations navigating digital transformation and environmental regulation (Halomoan et al., 2025; Spyrou & Themelis, 2025). However, industry conservatism and limited competency development remain barriers to widespread implementation, suggesting that stronger academic-industry collaboration is essential to bridge the gap between theoretical training and practical application (Charting a New Course, 2024). Ultimately, the synthesis indicates that while intuition remains valuable as a source of experiential insight, its integration with structured scientific reasoning is critical for advancing innovation success and sustainability in maritime leadership.

3. Research Methods

This research employs a qualitative approach with a descriptive analysis framework to explore the role of philosophical scientific methods in product and service innovation in maritime leadership. The study focuses on how systematic, evidence-based methodologies contribute to innovation success and the challenges faced by industry professionals in implementing structured decision-making in product and service development. Given the complex and evolving nature of maritime innovation, the research methodology is designed to capture insights from key stakeholders involved in innovation management, leadership, and decision-making within maritime organizations and academia.

The study population consists of experts, lecturers, and postgraduate students specializing in applied management, marketing, innovation, and leadership, with a sample of five to six respondents selected to provide diverse yet complementary perspectives on the application of scientific methodologies in product and service innovation. The inclusion of maritime industry experts ensures that practical, real-world insights on structured innovation methodologies are obtained, while lecturers contribute academic viewpoints on the theoretical foundations of evidence-based decision-making. Postgraduate students, as emerging professionals, provide perspectives on how innovation is conceptualized in modern academic training and how prepared they feel to apply structured methodologies in professional environments. This selection allows for a multi-dimensional analysis of how scientific methodologies are integrated into innovation processes, the barriers to their adoption, and the potential improvements that can be made through structured education and industry practice.

The research instrument primarily consists of semi-structured interviews, which allow respondents to reflect on their experiences, decision-making strategies, and perspectives on structured innovation methodologies. The dependent variable in this study is the success and sustainability of product and service innovation in maritime business, which is influenced by independent variables such as the application of structured scientific methods, leadership decision-making approaches, and the extent to which epistemological reasoning is embedded in innovation frameworks. Several key indicators are used to evaluate these variables. One indicator assesses the extent to which maritime organizations employ structured innovation methodologies, including hypothesis-driven testing, structured experimentation, and empirical validation of new products and services. Another indicator examines the role of leadership in promoting or hindering evidence-based decision-making in innovation management, particularly the influence of intuition-based decision-making versus structured reasoning models. Additional indicators include the perceived effectiveness of structured methodologies in reducing innovation failure rates, improving risk assessment, and enhancing long-term business sustainability.

To complement the qualitative interviews, the study also incorporates document analysis as a supporting research instrument, reviewing industry reports, case studies on successful and failed product innovations, and strategic frameworks used by maritime companies to guide innovation. The inclusion of secondary data allows for triangulation of findings, ensuring that insights from expert interviews are contextualized within broader industry trends. This multi-method approach strengthens the validity and reliability of the study, providing a holistic understanding of how structured methodologies influence product and service innovation (Cascetta, 2013; Creswell & Clark, 2011; Saldana, 2014).

The data collection process follows a structured yet flexible approach, ensuring that critical themes emerge organically from respondent discussions while maintaining methodological rigor. Each interview is designed to elicit detailed reflections on the role of scientific methodologies in innovation management, with questions focusing on how

decision-makers validate new product ideas, how leadership attitudes influence the adoption of structured innovation frameworks, and what challenges organizations face in integrating evidence-based decision-making. Experts provide insights into how structured methodologies affect product development cycles, investment decisions, and risk management in innovation. Lecturers contribute by discussing how innovation science is taught in academic settings and whether current educational models prepare students for evidence-based decision-making in professional environments. Postgraduate students share their perspectives on how innovation is framed in academic coursework and whether they feel adequately prepared to apply structured methodologies in industry settings.

Following data collection, a comprehensive thematic analysis is conducted to categorize insights into competency development, sustainability of structured innovation frameworks, and leadership influence on decision-making (Manning & Curtis, 2019; Rosenbach et al., 2018; Theotokas et al., 2014). The first stage of analysis involves identifying recurring themes related to the integration of scientific reasoning in product and service innovation, particularly in reducing reliance on trial-and-error approaches and improving systematic validation of new ideas. The second stage focuses on cross-group comparisons, analyzing how perspectives differ among experts, lecturers, and students regarding the feasibility, benefits, and challenges of structured decision-making in innovation management. This comparative approach enables the study to identify disconnects between academic training and industry practice, generational shifts in attitudes toward scientific innovation methodologies, and barriers that must be overcome to integrate structured reasoning into maritime leadership strategies (Cicek et al., 2019; de la Peña Zarzuelo et al., 2020).

The final stage of analysis involves narrative synthesis, where findings are structured into a cohesive interpretation of how philosophical scientific methods influence product and service innovation in maritime leadership. This synthesis incorporates both theoretical and practical insights, ensuring that the study provides actionable recommendations for industry leaders, educators, and policymakers seeking to enhance structured innovation methodologies in maritime business. The research ultimately contributes to the development of a conceptual framework for evidence-based innovation, demonstrating how scientific methodologies can improve decision-making effectiveness, enhance product development outcomes, and ensure long-term sustainability in maritime leadership.

By engaging key stakeholders from industry and academia, the research generates nuanced insights into the interplay between structured methodologies, leadership strategies, and innovation success. The methodological rigor applied in respondent selection, data collection, and thematic analysis ensures that findings are not only academically sound but also practically relevant. This study offers a valuable contribution to both innovation science and maritime business management, reinforcing the importance of integrating structured scientific reasoning into product and service innovation to achieve higher efficiency, sustainability, and strategic clarity in maritime leadership.

4. Results and Discussion

The findings of this research demonstrate the high effectiveness and efficiency of structured scientific methodologies in product and service innovation within maritime leadership. The study indicates that integrating evidence-based decision-making frameworks significantly enhances innovation success rates, reduces risks, and ensures long-term sustainability. However, challenges such as industry reluctance, over-reliance on intuition-based leadership, and limited competency development in scientific reasoning hinder full adoption. By analyzing perspectives from experts, lecturers, and postgraduate students, this research provides a data-driven understanding of how structured methodologies contribute to innovation management in maritime business.

A key indicator of innovation success in maritime leadership is the application of scientific methodologies in product and service development, which received an overall score of 8.0. Experts emphasize that maritime organizations that integrate structured scientific methodologies into innovation demonstrate higher success rates and improved efficiency. Unlike intuition-based development models, which often rely on trial and error, structured methodologies provide a systematic approach to hypothesis testing, validation, and data-driven innovation strategies. Lecturers advocate for a stronger emphasis on structured methodologies in maritime management education, ensuring that future leaders are equipped with the skills necessary to apply scientific reasoning to innovation decision-making. However, postgraduate students express concern that while structured methodologies are emphasized in academic training, they are not widely implemented in real-world maritime innovation processes. This disconnects between theory and industry application suggests the need for stronger industry-academic collaboration to bridge the gap between scientific innovation frameworks and their real-world adoption in maritime product and service development.

Another significant finding is the effectiveness of structured innovation frameworks in improving decision-making, which received the highest overall score of 8.3. Lecturers highlight those structured frameworks in innovation management lead to a more systematic approach to decision-making, ensuring that product and service development is guided by empirical evidence rather than subjective intuition. Experts also recognize the benefits of structured frameworks in reducing uncertainty, aligning innovation strategies with long-term business goals, and improving overall operational efficiency. Postgraduate students acknowledge the advantages of structured innovation but argue that many maritime organizations continue to prioritize rapid, intuition-based decision-making over evidence-based approaches. This suggests that while structured methodologies are recognized as beneficial, industry-wide implementation remains slow, requiring a shift in leadership attitudes toward adopting structured frameworks for innovation success.

A major concern identified in this research is the reduction of risk in product and service development, which received an overall score of 6.7, the lowest among the evaluated indicators. Findings indicate that applying scientific paradigms significantly reduces risks associated with product and service development, yet adoption is hindered by industry reluctance. Experts emphasize that structured methodologies minimize financial losses, reduce product failures, and improve regulatory compliance. Lecturers argue that a lack of structured training in risk management contributes to continued reliance on intuition-driven innovation models. Postgraduate students express frustration that despite being exposed to risk management methodologies in their academic training, industry leaders often disregard structured decision-making frameworks in favor of experience-based judgments. This discrepancy suggests that greater efforts must be made to institutionalize structured risk assessment methodologies in maritime leadership training programs, ensuring that decision-makers apply scientific reasoning when evaluating innovation risks.

Competency development in evidence-based innovation methodologies is another key factor that influences the adoption of structured decision-making in maritime product and service innovation, receiving an overall score of 7.3. Lecturers emphasize that structured competency development programs are essential for ensuring that innovation leaders possess the necessary analytical skills to evaluate and implement scientific methodologies in product development. Experts agree that without structured competency development, maritime innovation will continue to rely on fragmented, unstructured approaches, reducing the overall success rate of new product and service initiatives. Postgraduate students acknowledge the importance of competency development but highlight the need for accessible training programs that provide real-world exposure to structured innovation methodologies. These

findings suggest that enhancing competency development through industry-academic collaboration is essential for improving the application of scientific reasoning in maritime product and service innovation.

The sustainability of scientific innovation models in maritime leadership received an overall score of 8.3, reflecting strong agreement that structured decision-making frameworks contribute to long-term strategic success. Experts emphasize that maritime organizations that implement evidence-based decision-making in innovation are more resilient, adaptable, and capable of navigating global market challenges. Lecturers highlight that sustainability in structured innovation depends on continuous professional development, ongoing research, and commitment from industry leadership to integrate scientific reasoning into long-term business strategies. Postgraduate students express optimism about the future of structured innovation methodologies but stress that their long-term sustainability depends on widespread industry adoption and leadership commitment. These findings indicate that for structured innovation methodologies to remain viable in maritime business, leaders must actively support scientific reasoning in their strategic planning processes.

Table 2. Research Results Based on Indicators, Analysis, and Scoring

Indicator	Expert Score (1-10)	Lecturer Score (1-10)	Postgraduate Student Score (1-10)	Overall Score (1-10)	Analysis
Application of Scientific Methodologies in Innovation	9	8	7	8.0	Experts emphasize that maritime organizations that integrate structured scientific methodologies in innovation demonstrate higher success rates and improved efficiency.
Effectiveness of Structured Innovation Frameworks	8	9	8	8.3	Lecturers highlight those structured frameworks in innovation management lead to a more systematic approach to decision-making, ensuring data-driven development strategies.
Reduction of Risk in Product and Service Development	7	7	6	6.7	Findings indicate that applying scientific paradigms significantly reduces risks associated with product and service development, yet adoption is hindered by industry reluctance.
Competency Development in Evidence-Based Innovation	8	7	7	7.3	Competency development remains a critical factor, with lecturers advocating for stronger integration of evidence-based innovation models in maritime education.
Sustainability of Scientific Innovation Models in Maritime Leadership	9	8	8	8.3	Sustainability of scientific innovation frameworks depends on long-term commitment from leadership, continuous professional development, and academic-industry collaboration.

A comparative analysis of responses across experts, lecturers, and postgraduate students highlights notable differences in perspectives on structured innovation methodologies. Experts, who operate within maritime industry settings, emphasize practical constraints, such as regulatory limitations, financial feasibility, and leadership attitudes, that affect the implementation of structured decision-making in innovation. Lecturers focus on the theoretical advantages of structured innovation, advocating for academic programs that train

leaders in applying scientific reasoning in innovation management. Postgraduate students, while supportive of structured innovation, express frustration over the slow adoption of scientific methodologies in real-world maritime settings. These findings suggest that stronger collaboration is needed between academic institutions and industry leaders to align innovation training programs with real-world business challenges.

The research data concludes that structured scientific methodologies significantly enhance product and service innovation success rates in maritime business, yet widespread adoption remains hindered by industry conservatism and lack of competency development programs. Moving forward, greater efforts are needed to integrate structured innovation methodologies into maritime education and leadership training programs, ensuring that decision-makers apply evidence-based reasoning in strategic innovation management. The findings of this study emphasize that without structured methodologies, maritime leadership risks inefficiencies, increased innovation failure rates, and reduced long-term sustainability. By adopting a scientific approach to product and service innovation, maritime organizations can enhance strategic clarity, improve innovation success rates, and foster a culture of evidence-based leadership in an increasingly competitive global market.

Discussion

The findings of this research reveal the significant impact of structured scientific methodologies on product and service innovation in maritime leadership. The results indicate that evidence-based innovation frameworks contribute to higher success rates, reduced risk, and greater sustainability in maritime businesses. However, despite the clear benefits of structured decision-making in innovation, industry-wide adoption remains limited due to barriers such as organizational conservatism, reliance on intuition-based leadership, and a lack of structured competency development programs. This discussion interprets the findings by examining how structured methodologies influence innovation success, the challenges hindering their adoption, and the implications for leadership training and maritime business sustainability.

One of the most critical findings is the strong correlation between structured scientific methodologies and innovation success, reflected in the overall score of 8.0. This suggests that organizations that apply systematic, evidence-based approaches to innovation tend to experience higher efficiency, better resource allocation, and reduced failure rates. Experts highlight that structured methodologies provide a logical framework for evaluating new ideas, ensuring that innovation decisions are backed by empirical data rather than intuition alone. In contrast, organizations that rely on unstructured, intuition-based approaches often encounter unpredictable outcomes, increased development costs, and a higher likelihood of product or service failure. Lecturers argue that structured innovation methodologies should be integrated into maritime management education, providing future leaders with the tools necessary to make data-driven innovation decisions. However, postgraduate students express concerns that while structured methodologies are emphasized in academic settings, they are not widely applied in real-world maritime business environments. This discrepancy between academic training and industry practice suggests that stronger collaboration is needed between educational institutions and industry stakeholders to bridge the gap between scientific innovation frameworks and their real-world application.

The effectiveness of structured innovation frameworks in improving decision-making emerged as a key finding, receiving the highest overall score of 8.3. This indicates broad consensus that structured frameworks provide a clear, systematic approach to innovation management, reducing uncertainty and improving strategic alignment. Lecturers highlight that structured innovation models ensure consistency, helping businesses align new products and services with long-term business objectives. Experts emphasize that structured frameworks

also facilitate better resource allocation, ensuring that innovation efforts are strategically planned rather than executed on a trial-and-error basis. Postgraduate students acknowledge the benefits of structured innovation but argue that many maritime businesses continue to prioritize intuition-based decision-making, often underestimating the importance of scientific validation in innovation development. This finding suggests that while structured frameworks are recognized as beneficial, widespread industry adoption remains slow, requiring a shift in leadership perspectives on innovation management.

A critical challenge identified in this research is the difficulty in reducing risk in product and service development, which received an overall score of 6.7, the lowest among the evaluated indicators. The findings indicate that applying scientific paradigms significantly reduces risks associated with product and service development, yet adoption is hindered by industry reluctance. Experts emphasize that structured methodologies allow for rigorous risk assessment, ensuring that new products and services undergo systematic evaluation before full-scale implementation. However, many maritime businesses remain hesitant to adopt structured methodologies, fearing that extensive testing and validation processes may slow down innovation cycles. Lecturers argue that this resistance stems from a lack of structured training in risk management, which leads to continued reliance on intuitive decision-making rather than structured analytical approaches. Postgraduate students express frustration that despite being trained in risk assessment methodologies, many maritime organizations fail to apply these principles in real-world innovation processes. These findings suggest that stronger efforts must be made to institutionalize structured risk assessment methodologies in maritime leadership training, ensuring that decision-makers apply scientific reasoning when evaluating innovation risks.

Competency development in evidence-based innovation methodologies is another crucial factor that influences the adoption of structured decision-making in maritime product and service innovation, receiving an overall score of 7.3. The results indicate that while competency development is recognized as essential, structured training programs remain limited within the maritime industry. Lecturers emphasize that competency development programs must be expanded to include structured methodologies for product and service innovation, ensuring that future maritime leaders are equipped with the necessary analytical skills to evaluate and implement scientific approaches to innovation. Experts agree that without structured competency development, maritime businesses will continue to rely on fragmented, unstructured approaches, reducing the overall success rate of new product and service initiatives. Postgraduate students acknowledge the importance of competency development but highlight the need for accessible, industry-focused training programs that provide real-world exposure to structured innovation methodologies. These findings suggest that enhancing competency development through academic-industry collaboration is essential for improving the application of scientific reasoning in maritime product and service innovation.

The sustainability of scientific innovation models in maritime leadership received an overall score of 8.3, reflecting strong agreement that structured decision-making frameworks contribute to long-term strategic success. Experts emphasize that maritime businesses that implement structured, evidence-based decision-making models are more resilient, adaptable, and capable of navigating complex global challenges. Lecturers highlight that sustainability in structured innovation depends on long-term commitment, continuous professional development, and active engagement between academic institutions and industry stakeholders. Postgraduate students express optimism about the future of structured innovation methodologies but stress that their long-term sustainability depends on widespread industry adoption and commitment from business leaders. These findings indicate that for structured innovation methodologies to remain viable in maritime business,

leadership teams must actively support scientific reasoning in their strategic planning and innovation management processes.

A comparative analysis of responses across expert, lecturer, and student groups highlights notable differences in perceptions of structured innovation methodologies. Experts emphasize practical constraints, such as regulatory compliance, financial feasibility, and leadership resistance, that affect the implementation of structured innovation methodologies in maritime business. Lecturers focus on the theoretical benefits of structured methodologies, advocating for stronger integration of evidence-based decision-making into maritime education programs (Dyagileva et al., 2020; Toriia et al., 2023). Postgraduate students, while largely supportive of structured innovation, express frustration over the slow pace of industry adoption, highlighting that many maritime organizations still prioritize experience-based decision-making over structured scientific reasoning. These findings suggest that greater collaboration between academia and industry stakeholders is necessary to ensure that structured methodologies are both theoretically sound and practically relevant.

The findings of this research suggest that a paradigm shift is necessary in maritime leadership and innovation management, ensuring that decision-making processes are guided by structured scientific reasoning rather than intuition alone. The study emphasizes that scientific paradigms should not replace experience-based decision-making but should serve as a validation tool, ensuring that intuition-driven decisions are supported by empirical evidence and structured analysis. By combining experiential knowledge with structured reasoning, maritime leaders can develop more robust, resilient innovation strategies, improving overall efficiency, risk management, and long-term sustainability.

One of the most significant implications of this study is its potential to reshape maritime education and leadership training programs. If maritime institutions incorporate structured innovation methodologies into their curricula, future business leaders will be better prepared to develop, test, and validate new innovations using systematic, evidence-based approaches (Baş et al., 2002; Demirel, 2020). Furthermore, industry-wide efforts must be made to integrate structured innovation frameworks into professional training programs, ensuring that maritime leaders at all levels have access to competency development programs that reinforce scientific reasoning in decision-making.

This study provides a comprehensive evaluation of the role of structured scientific methodologies in maritime product and service innovation, highlighting both the strengths and challenges of integrating evidence-based decision-making into leadership strategies. The findings suggest that structured decision-making frameworks significantly improve innovation success rates, reduce financial risks, and enhance strategic clarity. However, barriers such as industry conservatism, lack of structured training, and reliance on intuition-based leadership continue to hinder widespread adoption. Moving forward, greater efforts are needed to develop competency-based training programs, align academic curricula with industry needs, and foster a culture of evidence-based leadership within maritime business. By adopting a structured scientific approach to innovation management, maritime organizations can enhance operational efficiency, mitigate risks, and build a sustainable framework for long-term innovation success.

5. Conclusion

The study and supporting literature converge on the importance of **structured scientific methodologies** in maritime product and service innovation. Evidence shows that organizations relying solely on intuition-based decision-making face higher risks, inefficiencies, and inconsistent outcomes, while those adopting structured frameworks achieve greater success rates, improved efficiency, and long-term sustainability.

The comparative analysis demonstrates that intuition remains valuable as a source of experiential insight, but it must be complemented by **empirical validation and systematic reasoning** to ensure innovations align with regulatory requirements, sustainability goals, and strategic industry needs. Leadership attitudes play a mediating role: conservative reliance on intuition slows adoption, whereas evidence-based leadership fosters resilience and adaptability in the face of global market volatility.

Competency development emerges as a critical enabler. Without structured training programs and stronger academic-industry collaboration, maritime leaders risk perpetuating fragmented, unstructured innovation practices. Bridging this gap requires embedding epistemological literacy and scientific reasoning into both education curricula and professional training programs.

Ultimately, the conclusion is clear: structured scientific innovation frameworks significantly enhance maritime leadership by reducing risk, improving decision-making accuracy, and ensuring sustainability**. However, widespread adoption remains hindered by industry conservatism and limited competency development. This study contributes by identifying these barriers and offering pathways for integration, positioning structured methodologies not as replacements for intuition, but as essential validation tools that strengthen innovation outcomes.

Practical Recommendations

To strengthen innovation management in maritime leadership, organizations and educators should prioritize the integration of structured scientific methodologies into both practice and training. Leaders are encouraged to adopt evidence-based frameworks that validate intuition-driven ideas through hypothesis testing and empirical data, thereby balancing experiential knowledge with systematic reasoning. Risk management must be institutionalized through structured assessment tools and analytical training, ensuring that financial losses, regulatory non-compliance, and product failures are minimized.

Competency development plays a central role in this transition, requiring maritime education curricula to embed epistemological literacy and structured innovation frameworks, while industry-focused training programs provide real-world exposure to evidence-based practices. Academic-industry collaboration is essential, with joint innovation labs and collaborative research projects serving as platforms to test and refine structured methodologies in practical contexts.

Leadership commitment is equally critical, as fostering a culture of scientific reasoning and incentivizing evidence-based innovation ensures that organizations remain resilient and strategically aligned with long-term goals. Finally, sustainability must be embedded into innovation strategies, aligning structured methodologies with environmental regulations, digital transformation, and smart shipping technologies to prepare maritime businesses for future disruptions. Collectively, these recommendations highlight the need for a paradigm shift in maritime leadership, where intuition is not discarded but validated and strengthened through structured scientific reasoning, ultimately enhancing innovation success, reducing risk, and ensuring long-term competitiveness

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