

STRENGTHENING THE UNIVERSITY-MARITIME INDUSTRY COLLABORATIONS (UMICS): TECHNOLOGY ISSUES

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ABSTRACT

In management practise and research, the university-maritime industry collaborations (UMICs) have grown in significance. This trend is reinforced by the necessity for innovation in the current industry environment and the desire of policymakers to commercialise knowledge from academia. Much less is known about these collaborations, although significant research efforts have been made to identify the success factors for these collaborations. Therefore, the aim of this study is to identify and explore the key factors that strengthen UMICs and propose a framework to enhance collaboration, so that a research agenda for the future will be developed based on an assessment of the existing literature. This study adopted a method of systematic literature review using published and unpublished theoretical literature to conduct analysis using five research databases in order to propose a framework aimed at identifying the key factors to strengthen UMICs. The findings of this study concluded that effective communication, trust, and adequate fund resources are essential for UMICs to succeed. Open communication channels, mutual trust, and shared vision can help build strong partnerships, while adequate funding can support research and development of new technologies, practices, and solutions. Based on previous research, none of them treated combined fund resources, effective communication, and trust as an independent variables towards UMICs relationship specifically. Hence, this study fills the gap by proposing a framework to test the relationship between fund resources, effective communication, and trust towards UMICs. Thus, the proposed framework can be used as a benchmark to strengthen UMICs in the future. This study also will encourage the managers in the maritime industry to drive innovation, establish strategic collaborations, actively involve stakeholders, and foster innovation and economic growth in the maritime industry to strengthen UMICs. The existing limited body of knowledge and literature will also benefit from this study.

Keywords: University; Maritime Industry; Collaborations; Framework

1. Introduction

Universities are crucial to attaining economic growth in knowledge-based societies, and collaboration between academics and industry has drawn significant attention in a number of nations around the world (Ankrah and Al-Tabbaa, 2015). Collaboration between these two dissimilar organisations has several advantages. Myoken (2013) first pointed out that highly skilled human resources like researchers or students might be advantageous to organisations. They also have access to information and technology (Barnes et al., 2002). They can also make utilize of high-cost research infrastructures (Ankrah and Al-Tabbaa, 2015).

Up to 10% of new resources, according to the OECD (2015), are based on the work of academic researchers. Universities receive more financing, access to business facilities, or money from licensing in exchange. In fact, funds provided by international organisations and commercial firms for research and development (R&D) are a "critical source" in many countries, and engagement with industry has become an essential component of university funding (OECD 2015).

Meanwhile, the maritime industry is a crucial sector in Malaysia, and it is essential to strengthen the collaboration between universities and the maritime industry to address the challenges faced by the industry (Daniel, 2019). However, poor collaboration between

universities and industries remains an issue of talent development, which leads to a talent shortage (Azman et al., 2018). The lack of resources and the challenge of geography are some of the key issues currently impacting Malaysia's maritime policies and postures (Daniel, 2019). To ensure the future competitiveness of the maritime industry in post-pandemic times, enhanced collaboration and innovation are crucial (Lind et al., 2021). While the Malaysian government has introduced various administrative policies and initiatives emphasizing collaboration between universities and the private sector, there are still issues regarding academics' ability to engage in research on critical topics that are useful to the nation (Azman and Sirat, 2021).

However, there hasn't been a thorough analysis of the crucial aspects of university-industry collaborations, notably university-maritime industry collaborations (UMICs). Therefore, it is essential to set the stage for this study to gain a deeper understanding of UMICs in the maritime industry context. This can be done by identifying the essential elements that could boost UMICs, putting forth a framework, and offering helpful advice and ideas for further research, this study seeks to close this gap. In addition, to summarising the findings as well as proposing a framework based on a rigorous methodology that considers the most recent research from 2017–2022, the study offers a clearer understanding of the essential components. Hence, the aims of this study are to identify and explore the key factors that strengthen UMICs in Malaysia's maritime industry and propose a framework to enhance collaboration.

Apart from that, the significance of this study is to inform policymakers on the necessary changes and investments required to facilitate the key factors in the maritime industry. Besides, clear and supportive policies or frameworks can create a conducive environment, attracting investments as well as contributing to Malaysia's economic growth and competitiveness in the maritime industry.

Based on the previous literature review, the key factors of fund resources, effective communication, and trust are considered to be the driving forces behind UMICs. Therefore, the following section examines the key factors that strengthen UMICs. Then, the framework proposed in this study is explained in the third section. The methodology is presented in the fourth section. The concluding section offers a summary and a look ahead to forthcoming studies.

2. Technology Issues and Challenges

One of the main issues is the lack of collaboration between universities and maritime industries, which has resulted in a talent shortage in the maritime industry. To ensure the future competitiveness of the maritime industry in post-pandemic times, the collaboration between the university and the maritime industry is crucial (Lind et al., 2021). However, despite the Malaysian government's efforts to promote these collaborations, there are still issues regarding academics' ability to engage in research on critical topics that are useful to the nation (United Nations, 2022). Therefore, it is necessary to identify the issues and challenges of UMICs and develop strategies to strengthen these collaborations. Hence, this study will focus on the technology issues that can hinder the collaboration between the university and the maritime industry.

One of the technology issues involved is maritime hackathons which promote technology innovation within the maritime industry. Ultimately, the goal is to make the maritime industry in Malaysia more efficient, predictable, sustainable, and resilient, which will require a change in mindset and a new recipe for capital creation (Lind et al., 2021).

Furthermore, reports from the 12th Malaysia Plan (2020–2025) have shown that the influence of industry and community outcomes, as well as research and technology innovation outcomes, is still quite low, and the UIC agenda is still in its infancy. Universities and industry have divergent expectations for the outcomes of their partnerships, which frustrates both parties and demotivates them to carry out their research project. Industry partners frequently want quantifiable objectives and timelines that allow for a more focused approach.

Furthermore, industry partners view academic partners' lack of urgency in meeting deadlines or addressing potential delays in research as a failure of sound project management techniques. Academics, on the other hand, blamed the obstacles on a lack of time caused by their busy schedules and a lack of technological and laboratory resources for R&D work. Even after policies were put in place, according to Azman and Sirat (2021), the university strategy did not address practical concerns like placing academics in industry and vice versa, or how the approach

would benefit both parties. There are also problems with academics' capacity to conduct vital technology innovation research that benefits the whole country. The industry has yet again claimed that investing in Malaysian universities carries a significant risk and that academics' technological and scientific expertise is not growing at a rate that meets the expectations of the global industry (Azman and Sirat, 2021).

Based on other previous studies, as stated by Aung (2009), the maritime industry in Malaysia faces challenges in communication, such as language barriers and ineffective communication channels. Therefore, in order to cater to these issues, the communication channels need to be improved by utilizing technology tools and platforms such as video conferencing, project management software, and collaborative document-sharing platforms. Hence, this can facilitate knowledge exchange, coordination of projects, and problem-solving. Koto and Nakisa (2014) stated that the maritime industry in Malaysia faces challenges in human resources, such as talent attraction and retention, skills development, and diversity and inclusion.

Other than that, Koga (2015) stated that sound competitive conditions are essential to promote innovation, knowledge transfer, and economic growth in the sector. He further stated that the maritime industry in Malaysia faces challenges in security and technology, such as piracy, terrorism, and cyber threats. Hence, ensuring maritime security is essential to promote safety, stability, and sustainability in the sector. Further, Branker et al. (2017) stated that multinational crewing poses challenges such as individual attitudes and expectations, collaboration, cohabitation, and language issues as well as some of the challenges of the collaborations between universities and industry. Besides, technology adoption, digitalization, and automation are also the challenges that the maritime industry frequently faces. Thus, they need to adopt new technologies to improve efficiency, productivity, and competitiveness (Rauf et al., 2023; Brenker et al., 2017).

Apart from that, the impact of these technology-related challenges on UMICs is insufficient collaboration between universities and the maritime industry in research can hinder the development of innovative solutions to technological challenges. For example, without collaborative efforts, research initiatives may lack real-world applicability, slowing down the pace of technological advancement in the maritime industry (Chadwick and Cashen, 2020). Besides, Farah et al. (2022) stated that the failure to address cybersecurity concerns and integrate advanced safety technologies can pose risks to vessel and port security. For example, instances of cyber-attacks on maritime systems can result in disruptions, compromising the safety of vessels and the security of sensitive data which will have a bad impact on the maritime industry. Furthermore, the impact of technological challenges on the broader economy will reduce the overall competitiveness of a nation in the global marketplace. For example, countries with advanced and efficient maritime infrastructure may attract more international trade, leaving those with outdated systems at a disadvantage (Lane and Pretes, 2020).

Meanwhile, the challenges faced by universities in Malaysia that can hinder effective collaboration with the industry are related to fund resources, effective communication, and trust. Adequate funding resources are essential to support and strengthen the UMICs. However, allocating funding resources can be challenging due to budget constraints and competing priorities. Research grants, infrastructure development, and scholarships/internships can incentivize participation and promote innovation (He et al., 2019).

Therefore, Malaysian government has provide incentives for maritime companies to adopt and implement advanced technologies. This could include tax breaks, grants, or subsidies for companies investing in modernizing their technological infrastructure. The effectiveness of this policy is that it was able to monitor the rate of technology adoption in the maritime industry, comparing it before and after the introduction of incentives, and assess the impact on operational efficiency and competitiveness (Plaza et al., 2020).

Furthermore, effective communication is also vital for successful university-maritime industry collaborations. However, communication challenges such as language barriers, time zones, and ineffective communication channels can hinder effective communication. It has been highlighted that there is a lack of communication and coordination concerning research projects, potential partners, and the strategic direction of the institution itself (Aung, 2019; Suresh, 2022).

Clear and efficient communication channels can facilitate knowledge exchange, coordination of projects, and problem-solving.

Last but not least, building trust between universities and industry stakeholders can be challenging due to various factors such as cultural differences, language barriers, and individual attitudes and expectations. A lack of trust among partners has been identified as a key issue affecting the success of research and innovation. Trust takes considerable time to develop among partners, particularly among industries that are keen to protect their technological advantage in a highly competitive sector. Establishing transparency, demonstrating mutual benefits, and establishing long-term commitments can foster trust and enhance collaborations (Abuarqoub, 2019).

Therefore, addressing these issues and challenges is crucial to strengthening UMICs in Malaysia. By establishing trust, allocating adequate funding resources, and improving communication channels, universities and industry stakeholders can foster effective collaborations, drive innovation, and promote economic growth in the maritime industry. Collaborations with the private sector and international cooperation also can be conducted to address these challenges.

According to Lee (2000), the reasons universities seek collaboration with industry and industry seek collaboration with universities are many and complex. Table 1 shows incorporates items that appear frequently in the literature on university-industry collaboration.

Table 1 - Reasons for university-industry collaboration

Reasons for Universities Collaborating with Industry	Reasons for Industry Collaborating with Universities
1. To supplement funds for one's own academic research.	1. To solve specific technical or design problems.
2. To test the practical application of one's own research and theory.	2. To develop new products and processes.
3. To gain insights in the area of one's own research.	3. To conduct research leading to new patents.
4. To further the university's outreach mission.	4. To improve product quality.
5. To look for business opportunity.	5. To reorient R&D agenda.
6. To gain knowledge about practical problems useful for teaching.	6. To have access to new research via seminars and workshops.
7. To create student internships and job placement opportunities.	7. To maintain an ongoing relationship and network with the university.
8. To secure funding for research assistants and lab equipment.	8. To conduct "blue sky" research in search of new technology.
9. To look for business opportunities.	9. To conduct fundamental research with no specific applications in mind.
	10. To recruit university graduates.

3. Literature Review

University-Maritime Industry Collaborations (UMICs)

The collaboration between universities and the maritime industry in Malaysia is crucial for the country's economic growth and development. Malaysia's maritime industry plays a vital role in improving the local economy, contributing to 40% of the country's gross domestic product (Menhat et al., 2021; Azman et al., 2018). These collaborations provide a platform for academia and industry to work together to address the challenges and opportunities in the maritime industry. These collaborations also have the potential to drive innovation, foster knowledge transfer, and prepare students for careers in the maritime industry.

One of the key reasons for promoting university-maritime industry collaborations in Malaysia is the need to make the maritime industry more efficient, resilient, and environmentally friendly. The maritime industry players must invest in new expansions and technologies to strengthen their resilience to upcoming crises. Additionally, Malaysia's ambition to emerge as a maritime nation should be supported by a robust and far-reaching collaboration between academia and industry (Zaideen & Ramli, 2023).

Stakeholders in Malaysia have recognized the importance of university-industry collaboration (UIC) for transforming the country into a knowledge-based economy (Azman et al., 2018). UIC has been identified as an essential item on Malaysia's agenda, emphasizing the need for academia, industry, and community collaboration (Gill, 2009). This collaboration can lead to the development of innovative solutions, knowledge transfer, and the creation of a skilled workforce that meets the needs of the maritime industry.

Apart from that, the development and implementation of a maritime management program serve as a model of successful industry-university collaboration in Malaysia (Chadwick and Cashen, 2020). These collaborations create value by bringing together the expertise and resources of both academia and industry, leading to the development of new technologies, practices, and solutions as well as helping to prepare students for careers in the maritime industry.

Furthermore, these collaborations are crucial to making the maritime industry in Malaysia more efficient, predictable, sustainable, and resilient (Lind et al., 2021). This is to ensure the future competitiveness of the maritime industry in post-pandemic times. Therefore, Malaysia needs enough skilled professionals to ensure that all business activities in the maritime industry are up and running efficiently (Bakar, 2022).

Fund Resources and UMICs

Malaysia has historically implemented various initiatives to support research, development, and collaboration between universities and industries. Programs such as the Malaysia Education Blueprint have aimed to allocate funds for enhancing research infrastructure and fostering industry-academic partnerships. The extent of industry funding and its impact on maritime education would depend on the specific initiatives and partnerships established (Malaysia Education Blueprint, 2015).

In the context of the maritime industry, funding can be used to support the development of new technologies and practices that improve efficiency, sustainability, and resilience. Nevertheless, the government does not allocate sufficient funds for maritime education in poor provinces. Due to a lack of funding, maritime training institutions (MET) sometimes operate on a for-profit basis, and there is a significant shortage of trained instructors as well as training resources. As a result, the caliber of their graduates diminishes (Bao et al., 2021).

Therefore, additional investment from educational institutions is required to raise the caliber of marine graduates. In addition, higher education institutions derive much of their revenue from private sources, such as tuition, endowments, grants, and research contracts. Universities, faculty, and staff are driven by their demand in numerous activities. Universities must provide world-class education and research, support organizational and pedagogical innovation, and be competitive to attract significant funding (Liefner, 2003). This will help strengthen UMICs as both parties work together to achieve equal benefits.

Inadequate funding can result in outdated infrastructure, laboratories, teaching resources and may limit research opportunities in maritime education institutions. This will lead to a stagnant academic environment, impeding the development of innovative solutions to emerging challenges in the maritime industry (Šamanić, Jardas, and Hadzic, 2022).

Adequate fund resources are necessary for university-maritime industry collaborations to be successful as they can support research and development (R&D) activities, which can lead to the development of innovative solutions, implementation of new technologies, and the creation of a skilled workforce that meets the needs of the industry. In order to gain adequate funds for R&D activities, universities can leverage corporate partnerships to gain additional funding and resources to undertake research and diversify their research areas (Rusli, 2023). Thus, this will contribute to the economic growth in the countries (Muthiah et al., 2023), particularly in Malaysia.

Other than that, fund resources are also significant in order to overcome the challenges of innovation development, such as the high cost of research and development, the complexity of the maritime industry, and the lack of collaboration among stakeholders (Šekularac-Ivošević & Milošević, 2019). This is supported by the Maritime Administration (2023), which stated that fund resources can be used to support such collaborative efforts such as cost-sharing efforts in partnership with government agencies. In summary, based on the justification from the previous study, fund resources are an essential factor in strengthening UMICs. Hence, it is posited that:

H1: There is a significant association between fund resources and UMICs

Effective Communication and UMICs

In recent years, efforts have been made to improve communication channels between academia and the maritime industry. Dialogues, conferences, and workshops serve as platforms for knowledge exchange and mutual understanding of industry needs. Besides, the use of digital

platforms and technology tools can facilitate real-time communication and collaboration between academia and industry stakeholders. These tools enhance information sharing and coordination (Benites et al., 2021)..

In the maritime industry specifically, information sharing requires good communication across the organizations (Mallam, 2019). Information sharing allows for better coordination between ships, which is necessary regardless of the purpose for which the ship is underway. Due to the importance of coordination in the maritime industry, more and more efforts are being made to develop an information exchange system that enables better coordination. Technological advancements will drastically alter maritime industry employment patterns and increase the demand for highly skilled human resources (Suresh, 2022). Because of this, pinpointing the future competencies of human resources in the marine sector offers a fresh viewpoint, particularly for maritime education and training institutions that need to evolve their educational and training initiatives.

The specified competencies give maritime education and training institutions additional information about how to improve their educational and training programs. Additionally, the identified competencies serve as prospective areas for advancement in their careers. This study can be used as a foundation for future research and studies to examine sustainable capabilities in the marine industry, even if it is mostly based on a literature review (Cicek, 2019). Therefore, it is crucial for any organisation to have good communication to ensure effective information sharing in the maritime industry and develop good relationships with the university (Basak, 2017). Even with the help of modern information technology, their ability to connect socially is still limited (Zoe et al., 2020). Therefore, the work environment makes it less likely for these employees to be members of networks.

Effective communication is essential to identify and solve the issues and challenges related to the UMICs. collaboration problems. According to Johler (2022), effective communication can be achieved through regular meetings, open communication channels, and clear expectations and goals. The communication should be open, timely, and transparent such as sharing meeting agendas, minutes, and relevant documents in advance of meetings to avoid misunderstandings and delays. Furthermore, effective communication is a two-way process that involves active listening and providing feedback. Allowing participants to express their ideas, concerns, and suggestions, will foster a collaborative environment where everyone feels heard and valued (Johler, 2022).

This can be supported by Noviana et. al (2019), which stated that effective communication is not just about transmitting information but also about fostering a collaborative culture. Encouraging open and respectful communication, promoting knowledge sharing, and creating opportunities for interaction and collaboration, can strengthen the overall collaboration, particularly the UMICs. This can be done by utilizing technology tools and platforms such as video conferencing, project management software, and collaborative document-sharing platforms (Benites et al., 2021). Brady (2022) further stated that communication also needs to be clear to make sure the involved collaborative parties have a shared understanding of goals, expectations, and responsibilities. This clarity helps to align efforts and avoid misunderstandings.

Ineffective communication practices can result in a lack of information flow between academia and the maritime industry. Universities may miss out on industry insights and evolving technological needs, leading to a mismatch between educational offerings and industry requirements (Caloghirou et al., 2021).

In summary, effective communication is a vital factor in strengthening UMICs. timely and transparent information sharing, promoting a collaborative culture, technology-enabled communication, and clear understanding are some of the ways in which effective communication can be improved. Accordingly, this hypothesis adheres:

H2: There is a significant association between communication and UMICs

Trust and UMICs

The Malaysian maritime industry has seen the development of partnership frameworks that aim to establish trust and collaboration. Frameworks that clearly define roles, responsibilities, and expectations contribute to building trust between universities and industry partners. Positive

outcomes and success stories from previous university-industry collaborations can contribute to increasing trust levels. Demonstrable impacts on workforce development, research outcomes, and industry advancements help build confidence in collaborative efforts (Yang et al., 2022).

As pointed out by many authors (Attia, 2015; Canhoto et al., 2016), trust is a crucial relationship aspect in developing university-industry collaboration. As a result, both organisations must devote enough effort to developing this trust (Gawel 2014). In addition, trust can be developed based on prior collaboration and cooperation experiences. According to Bstieler et al.'s (2017) research, trust can be preserved by adhering to a similar decision-making style based on prior experiences. This was also discovered in the Canhoto et al. (2016) study.

While some respondents said that physical interaction is still necessary to establish trust, nevertheless, some of them said that it is unnecessary. A very positive reputation, interpersonal connections, and strong contractual agreements between organisations are enough to foster trust, as stated by Hemmert et al. (2014). However, if organisations already have strong links with one another, extensive usage of contractual agreements may actually erode trust between them (Hemmert et al., 2014). Therefore, it is very important to consider trust as one of the supporting factors and act as a "glue" to strengthen collaboration between academia and industry (Rajalo and Vadi, 2017), especially in the maritime industry.

According to Azman, Noraini, and Sirat (2021), partnerships need to have mutual trust to ensure that all parties are working towards the same goals and that the collaboration is beneficial for everyone involved. A lack of trust can hinder effective collaboration. Muthiah et. al (2023) further stated that trust has to be built through open communication, transparency, honesty, and mutual respect between academia and industry. Thus, it can lead to a more productive and successful collaboration between them.

Meanwhile, UNESCO (2021) stated that, in the context of the maritime industry, trust can be built through partnerships that have equitable access to education as a common good. This can be supported by Yang et. al (2022), which stated that partnership can build trust and interdependence. As the partnership is willing to work jointly, the collaboration will lead to more stability. Besides, trust is an implicit condition for collaboration, and it is an essential prerequisite and management mechanism for building relationship capital with suppliers, enabling supply chain partners to focus on the long-term benefits of the relationship specifically for collaboration in research, thereby increasing competitiveness (Yang et al., 2022; Green & Johnson, 2015).

Last but not least, trust can facilitate knowledge exchange, which is increasingly recognized as a key factor in facilitating collaboration (Cvitanovic et al., 2015). According to Oliver, Montgomery, and Barda (2020), lack of trust may hinder collaborative research efforts between academia and the maritime industry. Research outcomes may not effectively address industry challenges, limiting the impact of research on technological advancements in the maritime industry. In summary, trust is a critical factor in UMICs. Building trust can help to strengthen relationships and facilitate knowledge exchange. Based on the argument that has been discussed earlier, it is hypothesized that:

H3: There is a significant association between trust and UMICs

Research landscape of University-Industry collaborations

This paper extends the literature review in the area of university-industry collaborations. To strengthen the quality of the review, the top 10 citations were selected to further emphasize the topic. Table 2 and Figure 1 outline the top 10 citations from 2017 to 2023 and top contributing authors from 2000 to 2023 to this field respectively. Based on Table 2, there is an author who has three articles in the list of the ten most cited articles: Caleb Burns from Iowa State University, United States. In one of these articles, the author writes alone, in the other two articles she co-writes with Shweta Chopra (Iowa State University, United States) and with Shweta Chopra and Mack Shelley (Iowa State University, United States) respectively.

The author with the most citations and research influence is Caleb Burns and Shweta Chopra from Iowa State University, United States. The article published by Burns and Chopra (2017) is the most popular article with the highest citation count (37). The paper describes the effect of industry engagement on student learning in undergraduate programs by using a meta-analysis. It also highlights various engagement activities in which these activities were useful not

only for students but also for the industry and the educational institution. From this study, it was identified that each industry engagement provides a valuable learning experience to researchers. Other authors who also stood out are Amanpreet Kapoor and Christina Gardner-McCune, Gail Carmichael, Christine Jordan, Andrea Ross, Alison Evans Adnani, Tullio Vardanega and Monica Fedeli, Caleb Burns with more than five citations in the area to their credit.

Another important research by Kapoor and Gardner-McCune (2020) discussed the findings of a study aimed at understanding why less than 60% of computer science students pursue an internship before graduation. The study surveyed 302 computer science undergraduate students who did not intern across two universities in the United States and used thematic analysis on the open-ended survey responses.

The article by Carmichael et al. (2018), describes a new approach to work-integrated learning that aligns workplace experience with the academic curriculum. The program is designed for students to earn a Bachelor of Computer Science from the university while being paid employees of the industry partner throughout their degree. Some core computer science classes and practicum courses are delivered with the industry partner so as to integrate them with placements on-site. Likewise, Vardanega and Fedeli (2018) reported in their study that the capstone project was organized as a two-staged progression, with the first leg being a preparatory, learning-for-work collaborative laboratory aimed at the acquisition of soft skills, and exposure to technology innovation challenges, and the second leg promoting a learning-through-work individual internship. Furthermore, Burns (2017), focuses on higher education and examines the impact of industry engagement activities on student learning in the undergraduate technology program. This paper also highlights the importance of industry engagement activities in providing students with a better learning experience before graduation and the benefits for educational institutions and industries involved in such activities.

There are also recent articles from Pandey and Azeem (2023) and Chadwick and Cashen (2020) that have not received any citations yet. Therefore, this shows that the study on university-industry collaborations was limited. Hence, this study is crucial in order to contribute to this field.

Table 2 - Top 10 Citations For University-Industry Collaborations

Authors	Year	Title	Journal	Citations
Burns, C. and Chopra, S.	2017	A Meta-analysis of the Effect of Industry Engagement on Student Learning in Undergraduate Programs	The Journal of Technology, Management, and Applied Engineering	34
Kapoor, A. and Gardner-McCune, C.	2020	Barriers to Securing Industry Internships in Computing	Proceedings of the Twenty-Second Australasian Computing Education Conference	8
Carmichael, G., Jordan, C., Ross, A. and Evans Adnani, A.	2018	Curriculum-Aligned Work-Integrated Learning: A New Kind of Industry-Academic Degree Partnership	Proceedings of the 49th ACM Technical Symposium on Computer Science Education	8
Vardanega, T. and Fedeli, M.	2018	A two-staged capstone project to foster university-business dialogue	Proceedings of the 23rd annual ACM conference on innovation and technology in computer science education	8
Burns, C. I.	2017	Systematic analysis of industry engagement activities on student learning in the undergraduate technology program	New Directions for Teaching and Learning	6
PEKSATİCİ, O. and Ergun, H. S.	2019	The barriers against effective university industry collaboration - A study in Turkish aviation industry	Journal of Management Marketing and Logistics	2
Burns, C., Chopra, S. and Shelley, M.	2018	Utilizing Multivariate Analysis for Assessing Student Learning Through Effective College-Industry Partnerships	Journal of STEM Education	2
Pantzos, P., Gumaelius, L.,	2023	Engineering students' perceptions of the role of work industry-	European Journal of Engineering Education	1

Buckley, J. and Pears, A.		related activities on their motivation for studying and learning in higher education		
Pandey, J. and Azeem, M. A.	2023	Novel Industry Engagement approaches for academic projects leading to internships, placements, and entrepreneurship	SHS Web of Conferences	0
Chadwick, K. and Cashen, L.	2020	The 'berth' of a maritime management program: A case study on value creation through industry-university collaboration	Industry and Higher Education	0

Note: *The table was generated using the web link: <https://www.connectedpapers.com/>

4. Forming of Proposed Framework

Experts prioritise investing in human resources because the maritime industry's growth is heavily dependent on people. The utilisation of human capital theory posits that universities are anticipated to play a significant role in fostering the generation of national human capital and facilitating overall growth (Sebola et al., 2023). According to Lau et al. (2021), the human capital theory shows that higher levels of education correlate with higher levels of production. This means that in order to have a skilled workforce for the maritime economy, education system investment is essential. University students are anticipated to form a sizable pool of creative human capital in the future, as stated by He et al. (2019). The industry is anticipated to transition from low value-added export to high-value-added export by investing in higher education. Higher education consequently has both a qualitative and a quantitative effect, such as boosting economic growth.

University-maritime industry collaborations (UMICs) are outlined in a framework. The association between exogenous and endogenous variables is depicted in the proposed framework in Figure 2. The proposed framework was formed as suggestions for future research to adopt and extend the statistical study and provide empirical evidence to strengthen the field of research in the university-maritime industry collaborations (UMICs).

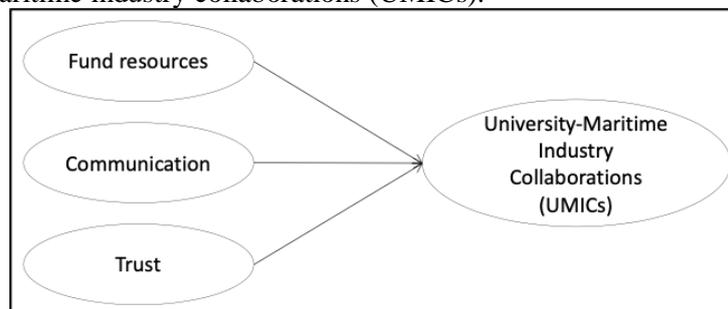


Fig. 1. Proposed Framework

5. Methodology

A thorough literature study was carried out to better understand the critical elements that might strengthen university-maritime industry collaborations (UMICs). Figure 3 summarises the methodology process of this study.

This study adopted a systematic literature review using published and unpublished theoretical literature to conduct analysis using five research databases. The analysis was done using keywords presented in Figure 3. There are also some requirements being set for the article inclusions. The methodology was adapted from Dreyer et al (2019).

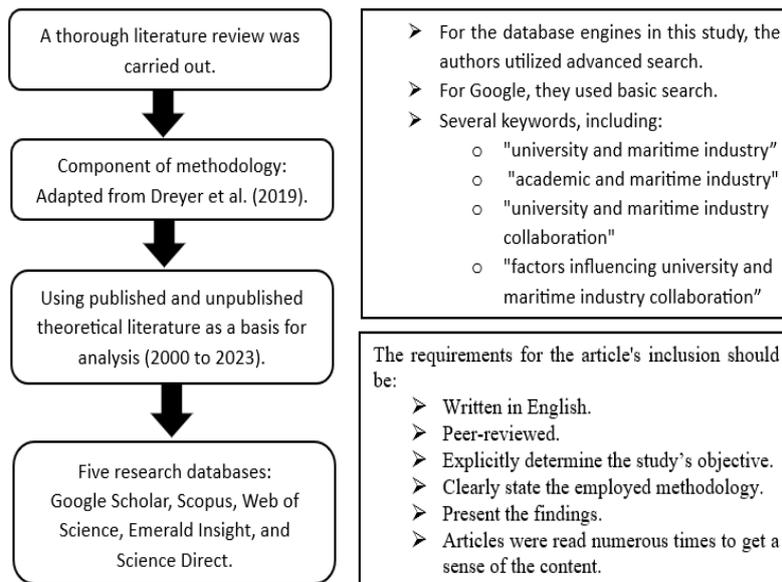


Fig. 2. Summary of Methodology Process

6. Discussion and Implications

The study highlights the importance of stakeholder engagement underpinned by a strategic rationale that involves stakeholders from universities, industry, government, and communities in decision-making processes and collaborative efforts. This can ensure that diverse perspectives are considered, leading to more effective and sustainable outcomes.

Strengthening university-maritime industry collaborations, can foster innovation and drive the economic growth in the maritime industry. Collaborative research projects, knowledge exchange, and talent development can lead to the development of new technologies, processes, and business opportunities, contributing to the industry's competitiveness and sustainability. Besides, collaborations can result in the creation of eco-friendly technologies and practices, aligning the industry with sustainability goals (Trujillo-Gallego et al., 2021). Effective communication in UMICs facilitates the exchange of knowledge, research findings, and industry insights between academic institutions and maritime companies, enhancing the understanding of technological challenges and solutions. Clear communication is essential for identifying and addressing complex technological issues that require joint efforts from academia and the industry through collaborative problem-solving (Sharma et al., 2022). Open and effective communication between university and industry practitioners can expedite the development and implementation of innovative technologies, ensuring that maritime practices remain at the forefront of technological advancements.

In order to strengthen the UMICs, managers in the maritime industry can use the insights and recommendations provided in this study to establish effective collaborations with universities. By doing so, they can drive innovation and economic growth in the sector. Collaborations with the private sector and international cooperation can also be conducted to address the challenges faced by the university and maritime industry. In terms of reducing ineffective communication, managers in the maritime industry can establish clear and efficient communication channels to facilitate knowledge exchange, coordination of projects, and problem-solving. Stakeholder engagement underpinned by a strategic rationale can also be conducted to ensure effective communication.

Additionally, trust is a fundamental element in University-Maritime Industry Collaborations (UMICS) as it forms the basis for successful and productive partnerships. Trust between universities and the maritime industry fosters an environment where both parties are willing to share valuable knowledge, data, and insights openly (Kontovas et al., 2022). Trust encourages both academia and industry to take risks in exploring innovative solutions and technologies, knowing that failures will not result in blame but rather opportunities for learning and improvement. When trust exists, any conflicts or disagreements that arise can be addressed

constructively, without damaging the overall relationship. Trust facilitates effective conflict resolution mechanisms (O'Dwyer et al., 2023). Moreover, successful UMICs partnerships built on trust can enhance the reputation of both universities and maritime companies, making them more attractive to prospective students, researchers, and employees.

Next, adequate funding is essential for conducting in-depth research, developing new technologies, and addressing complex challenges in the maritime industry. This funding allows universities and industry partners to invest in cutting-edge projects. According to Polese et al. (2021), partnerships between universities and industry with sufficient investments enabled them to access cutting-edge scientific knowledge and a wider knowledge base. These resources are used for the establishment and maintenance of state-of-the-art laboratories, equipment, and facilities, which are crucial for conducting experiments, tests, and research in maritime technology. Adequate funds can support educational programs, scholarships, and training initiatives, ensuring that students and professionals receive relevant and up-to-date education in maritime technology. It can be used to attract and retain top talent, including researchers, faculty members, and students, who can contribute to collaborative projects and advance technological solutions (Borah et al., 2019). The challenges of inadequate funding resources can be addressed by allocating funding resources through research grants, infrastructure development, and scholarships/internships to incentivize participation and promote innovation.

By considering these implications, managers in the maritime industry can strengthen UMICs, drive innovation, establish strategic collaborations, actively involve stakeholders, and foster innovation and economic growth in the maritime industry. Technological improvements, actions to reach legislative targets, and increasing the transition to circular models can also be explored. Stakeholders' engagements in the maritime industry also can take concrete actions to strengthen collaborations, promote sustainability, and drive positive change in the sector.

7. Conclusion

In conclusion, this study contributed to the lack of literature and expertise that is readily accessible on UMICs. The findings concluded that effective communication, trust, and adequate fund resources are essential for UMICs to succeed. Open communication channels, mutual trust, and shared vision can help build strong partnerships, while adequate funding can support research and development of new technologies, practices, and solutions. These aspects are crucial for driving innovation, fostering knowledge transfer, and preparing students for careers in the maritime industry. Strengthening UMICs in Malaysia requires a focus on trust, fund resources, and communication. By fostering trust through transparency, mutual benefits, and long-term commitments, collaborations can thrive. Adequate funding resources, such as research grants and infrastructure development, are essential to support collaborative projects. Effective communication channels facilitate knowledge exchange, coordination of projects, and problem-solving. By addressing these key factors, Malaysia can enhance university-maritime industry collaborations and drive innovation and economic growth in the maritime industry.

UMICs are also becoming increasingly significant in today's world. Governments, researchers, and practitioners have a stake in the successful growth of these collaborations. In the context of Malaysia, UMICs' technology issues can have specific implications and examples that are relevant to the country's maritime industry. For instance, Malaysia has a significant maritime industry, including ports, shipping, and offshore activities. Collaborations between Malaysian universities and maritime companies can result in the development of innovative technologies, making the country's ports more efficient and its shipping industry more competitive globally. These collaborations can lead to the adoption of green propulsion systems and emissions reduction technologies, aligning with Malaysia's goals towards net zero carbon emission. Besides, UMICs can play a role in enhancing Malaysia's connectivity within the ASEAN region. As an illustration, in August 2019, Inmarsat, Cargotec, Shell, HHLA, and Wärtsilä initiated the second round of the Trade & Transport Impact Program, with the objective of identifying ten well-established startups. This innovation initiative was established to foster business collaborations between startups and leading transport companies. Similarly, Eastern Pacific Shipping (EPS), Singapore's largest shipping company, joined forces with the investor and accelerator Techstars

to establish an environment that accelerates innovation. These collaborations cannot be successful without effective communication, trust, and sufficient resources among those parties involved.

8. Future Research

Firstly, this study is preparing future research to adopt the suggested hypotheses and proposed framework of University-maritime industry collaborations (UMICs) to conduct empirical research on that area and to evaluate the framework proposed in this study, as it is likely to be more effective and successful in strengthening UMICs. Furthermore, future research needs to explore the other potential key factors that could strengthen UMICs. Other than that, future research can explore the potential for collaborative innovation within the maritime industry to enhance university-industry collaborations in Malaysia. This can involve investigating the potential for enhanced collaboration, overcoming legacy systems and silo-thinking, and leveraging digital technologies to drive efficiency, predictability, sustainability, and resilience in the industry.

Moreover, future research can investigate the development of the Malaysian maritime cluster, comprising shipping, ship industry, ports, and terminals. This can involve analyzing the strengths, weaknesses, opportunities, and threats of the cluster and identifying potential areas for collaboration between universities and industry stakeholders. Last but not least, future research can focus on the development of marine education and research in Malaysia. This can involve studying the challenges and opportunities of the shipbuilding and offshore industries in Malaysia and identifying potential areas for collaboration between universities and industry stakeholders. Hence, by conducting research in these areas, scholars and industry experts can gain a deeper understanding of the potential future developments, challenges, and opportunities in the maritime industry in Malaysia. This can encourage the decision-makers, policymakers, and strategic business units to drive sustainable growth and innovation in the industry in order to strengthen the UMICs.

Hence, by conducting research in these areas, scholars and industry experts can gain a deeper understanding of the potential future developments, challenges, and opportunities in the maritime industry in Malaysia. This can encourage the decision-makers, policymakers, and strategic business units to drive sustainable growth and innovation in the industry in order to strengthen the UMICs.

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