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Case study design for facilitating the green transition of the maritime industry

Tim van Erp[1], Adela McMurray[2], Rajesh Johnsam[2], Bartłomiej Gładysz[3], Niels Gorm Malý Rytter[4]

[1]College of Science and Engineering, Flinders University, Australia, [2]College of Business, Government and Law, Flinders University, Australia, [3]Faculty of Mechanical and Industrial Engineering, Warsaw University of Technology, Poland, [4]Department of Technology and Innovation, University of Southern Denmark, Denmark.

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Abstract

The future green transition of the maritime industry is largely driven by electrification and a shift towards using more sustainable fuels such as green methanol or ammonia. Higher education must facilitate this transition and is under pressure to bridge the growing green skills gap across the industry. For this purpose, a new case study designed to convey key project management competencies of a green transition in the maritime industry is presented. The study contributes to case-based learning research and practice by demonstrating and discussing how the green transition can be facilitated in teaching and learning based on a real-world example.

Keywords: *Case-based learning (CBL); Project management; Sustainability and SDG in higher education.*

1. Introduction

The green transition, i.e., the decarbonization of global industry sectors, is paramount to mitigating the ongoing climate crises and meeting the so-called "1.5°C target" outlined in the Paris Agreement (UNFCCC, 2018). The International Maritime Organization (IMO) identified that the share of shipping emissions in global anthropogenic emissions has increased by 13% over 6 years from 2.76% in 2012 to 2.89% in 2018 (IMO, 2020). Hence, as a relevant contributor to climate change, the member states of the IMO adopted in 2023 the IMO Greenhouse Gas Strategy to reduce greenhouse gas (GHG) emissions from international shipping, including a commitment to reach net-zero GHG emissions close to 2050 (IMO, 2023). This future green transition of the maritime industry is largely driven by electrification and a shift towards using more sustainable fuels such as hydrogen or methanol.

The green transition has brought with it the introduction of new skills and knowledge to address sustainable design, environmental management, and green technologies (Thake, 2025). Both, industry and higher education, must facilitate the green transition in the maritime industry and are under pressure to bridge the growing green skills gap. Currently, the growth in demand for green skills is outpacing its supply with seven in eight workers lacking even a single green skill (LinkedIn, 2023).

With this approach to case-based learning, we intend to contribute towards closing the skills gap in teaching and learning in higher education within the context of engineering management. We are proposing a new case study design to convey key project management competencies of a green transition in the maritime industry to undergraduate and postgraduate students. This includes the investigation of the following main research question (RQ):

RQ: How can a case study be designed to convey relevant project management competencies of a green transition in the maritime industry?

2. State-of-the-art

2.1. Case-based learning

Cased-based learning (CBL) as an active teaching method (Cen et al., 2021) introduces the complexity of the real world in teaching and learning by using scenarios, challenges, and problems (Pinto, 2022). While being quite similar to problem-based learning (PBL), its main difference is that CBL can include all details of the underlying problem, including the solution, and often requires learners to develop solutions with the guidance of the teacher, which often makes CBL less complex and easier to implement for achieving the learning outcomes (Pinto, 2022). CBL can provide an open-ended exploration of solutions, encourage discussion and explore ambiguity while offering more structure and targeted assistance to the learner during the solution-finding process (Srinivasan et al., 2007). Some recent studies confirm the general effectiveness and efficacy of CBL for different educational areas such as the medical and pharmaceutical (Tsekhmister, 2023; Cen et al., 2021), psychology (Wu et al., 2023), anatomy (Sangam et al., 2021), or leadership education (Asyifa et al., 2024). Maslen and Hayes applied CBL in engineering practice and demonstrated that it is useful to implement Kolb's four-stage model of experimental learning (Kolb, 2014) in teaching activities (Maslen and Hayes, 2020). To facilitate deeper learning, some studies discuss combining additional teaching approaches with CBL. For example, Tayce et al. discuss the combination of CBL with peer-assisted and just-in-time teaching and learning (Tayce et al., 2021), while van Erp highlights an approach for combining CBL with project, and research-based learning (van Erp, 2022).

2.2. Green transition in the maritime industry

The maritime industry is composed of maritime shipping, ports, management, and ancillary services as its main elements (Notteboom et al., 2022). Wang et al. (2023) elaborate that green shipping management can reduce carbon emissions by using new green fuels, and green port construction can increase profits implementing electrification and automation solutions. Other authors highlight clean technology adoption and environmental policies such as emissions trading schemes as important drivers (Buchmann, 2022) and emphasise the relevance of a digital transformation to support a green transition (Oloruntobi et al. 2023). The adoption of this so-called twin (green and digital) transition can assist the maritime industry improve efficiency while reducing its environmental impact (Laybourne, 2023).

2.3. Project management

Project management is oriented on the integrated project management practices or life cycle phases of a project, spanning from pre-project activities, initiating a project, overseeing, directing, and controlling a project, to managing delivery, closing a project, and post-project activities (ISO, 2020). It covers management practices related to planning, benefits, scope, resources, cost, quality, and risks among many others (ISO, 2020). In addition, modern project management addresses agile, hybrid, data-driven or lean approaches.

3. Case-based learning design

3.1. Method

The research method for designing the case study as a central element of case-based learning follows a qualitative, action-research approach comprised of critical reflection. The design process hereby is understood as a dialogue between a problem and a solution through an iterative process of analysis, synthesis, and evaluation (Nijhuis and Vries, 2019). The morphology presented in Table 1 highlights the fundamental criteria and constraints for performing this iterative design process.

Table 1. Morphology of design criteria and constraints.

Learning activities	Should reflect the relevant activities of the project life cycle (ISO, 2020).
Case Study Subject	Should reflect key aspects of the twin (green and digital) transition of the maritime industry.
Case Study Structure	Should reflect the key elements of a business model according to Osterwalder and Pigneur (2010).
Constraints	Should support 3 assessment types: Creation of project management artifacts, results presentation, and quiz; should be suitable for 4 days (4 x 8h) learning activities, where 4-6h per day are used for student work on the case study.

3.2. Results

3.2.1. Student tasks, rationale, and constraints, results

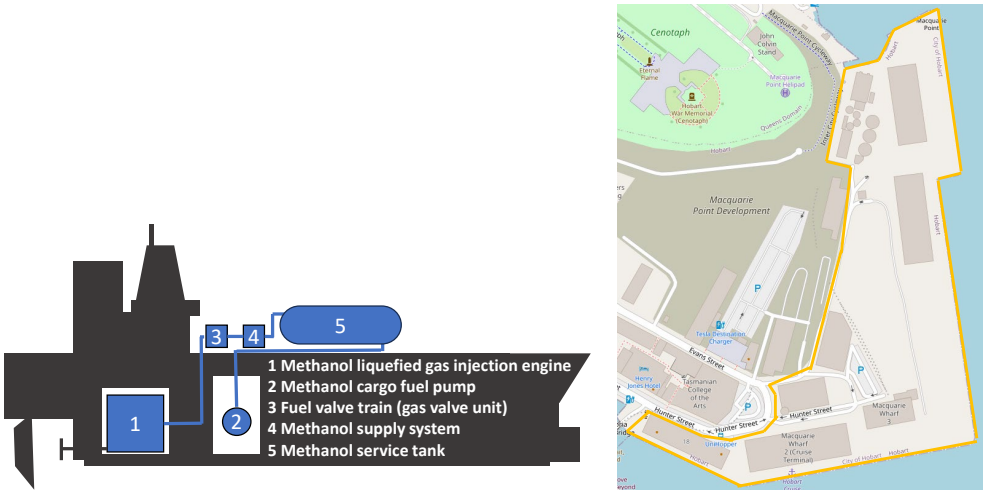
The results of the design process are introduced in the following sections. Table 2 presents the task, rationale, deliverables, and constraints for the case study.

Table 2. Task, rationale, deliverables, and constraints.

Task (for student groups of 4 to 6 team members)	• You as a student group are acting as a project planning team from a civil shipbuilding and construction company located in Australia. • The company aims to establish a new business unit for building, maintaining, and retrofitting climate-neutral vessels, and just bought the port in Hobart, Australia, for this purpose. • The sustainable vessels will be using methanol as a fuel for the engine. As a project team you are responsible for re-imagining the current port in Hobart, so that it can be used for building, maintaining, and retrofitting, climate-neutral vessels. • Retrofitting means installing a new methanol drive system by replacing the conventional drive system of a vessel.
Rationale (to motivate the case study for the students)	• "Green ambitions are high, with shipowners and operators dedicating manpower to green initiatives and developing roadmaps"; 73% view net zero as a high priority and 77% have set net-zero targets (Loo et al., 2023). • For example, the shipping giant Maersk plans to achieve net zero emissions across its business and offer 100% green solutions to customers by 2040 with green methanol as a cornerstone of this transition towards more sustainable e-fuels (Maersk, 2022).
Deliverables (to be presented to the fictive board of directors)	• Business case of the new facility and project plan. • Re-imagined conceptual layout for the port including an overview of shipbuilding and retrofitting processes, an indication of the material flow and a selection of key manufacturing, and material handling equipment. • Technology radar for prescriptive and predictive maintenance of the vessel.
Constraints (to be considered while developing project solution for the case study)	• Cutting-edge technology: Industry 4.0-ready. • High Changeability: Layout should be easy to change for new products. • Sustainable: Re-use as much as possible from the already existing infrastructure and utilise local contractors and suppliers if possible. • Cost-efficient: Budget should be in the range of $50Mio. to $80Mio. • Time-efficient: The facilities should be ready to use by 01.06.2026

3.3.2. Product and site

The case study product which will be manufactured by the shipyard is a 65m coastal roll-on, roll-off (RORO) vessel operated on green methanol, while the shipyard site is the port area in Hobart, Tasmania (Figure 1).



(a) (b)

Figure 1. (a) Product. Source: Methanol Institute (2020). (b) Site. Source: OpenStreetMap (2024).

3.3.3. Customers and stakeholders

Table 3 lists the customers and other relevant stakeholders of the project.

Table 3. Customers and stakeholders.

Tasmanian Government	• Will buy 3 vessels per year for the next 5 years including a 20-year maintenance contract for the vessels. • Aims to promote tourism from and to the islands around Tasmania as well as the local industry by upgrading the shipping capacities.
Government of Indonesia	• Will buy 7 vessels per year for the next 20 years including a 20-year maintenance contract for the vessels. • Aims to promote tourism from and to the islands around Indonesia as well as the local industry by upgrading the shipping capacities.
Australian coastguard	• Will have 5 vessels per year retrofitted.
City of Hobart	• Requires the creation of at least 50 new jobs and subsidises the shipyard with $20 Mio.
Local port community	• Aims for safe and quiet operation of the new ports, lobbies for a stop of operations between 8.00 p.m. and 7.00 a.m. and no weekend shifts.

3.3.4. Additional context

To support the case study, additional context is made available to the students. This context includes: (1) Additional stakeholders and their expectations and values; (2) an organizational chart of the company and affiliation of the project planning team; (3) the project scope, including a proposal for a work package structure; (4) the shipbuilding process chain, including relevant

layout zones, key fabrication and assembly technologies, and material handling equipment; (5) the maintenance process chain for vessel maintenance, i.e., prescriptive, predictive, preventive, reactive/ corrective maintenance, including layout zones, and key technologies; (6) the retrofitting process chain, including layout zones, technologies, and material handling equipment; (7) an example of a port layout including a depiction of a generic material flow and relevant manufacturing, assembly, and material handling zones; and (8) the relevant phases of facility planning from target specification to ramp-up support.

3.3. Proof-of-concept

The first implementation of the case study design was tested at Flinders University in 2024. The sample size for validation was comprised of more than 20 diploma students but did not include the gathering of primary data for an in-depth validation and evaluation of the case. Thus, a future replication aims at implementing the case in a controlled teaching environment in combination with an accompanying ethics approval to evaluate the efficacy and effectiveness of the case design by gathering student feedback about the learning process and outcomes by using Kolb's four-stage model of experimental learning (Kolb, 2014) as a theoretical foundation for the evaluation. We aim to gather student feedback on how the case study impacts the competency and skill building for the green transition as well as for project management. This data will allow us to derive further improvements for the next iteration of the case study design.

4. Discussion

The case study demonstrates one possible design pathway for applying case-based learning for teaching the green transition of the maritime industry while simultaneously emphasizing the development of relevant project management competencies. The case study design contributes to CBL research and practice by providing a specific example that enables the creation of novel approaches for efficaciously applying case-study design learning in project management. The case study is expected to enable the competency development of future maritime professionals, allowing them to make a meaningful contribution to the IMO GHS reduction strategy (IMO, 2023) and the Paris Agreement (UNFCCC, 2018). Furthermore, it is expected to provide teachers in higher education with a relevant teaching concept for supporting the United Nations (UN) Sustainable Development Goals (SDGs), specifically SDG 7 and SDG 9 (UN, 2015). However, an in-depth evaluation of the case study design to efficaciously and effectively teach aspects of the green transition and project management competencies still needs to be performed. Thus, future study activities aim at confirming the importance of implementing a case-based learning design in higher education which ultimately can equip the next generation of workforce employees to understand the costs and benefits of the green transition (Thake, 2025) in workplaces and particularly the maritime industry. These costs and benefits can be shared between employees, organizations, and communities (Thake, 2025).

5. Conclusion

The study creates new insights into how case-study-designed learning can be utilized during the different life cycle phases of project management to improve the problem-solving and solution-finding process. To support the success of the green transition, higher education in conjunction with training policies plays a significant role in ensuring that today's workforce has the relevant knowledge and skills to adapt to the changing requirements of the green economy. This study contributes to the growing body of literature on educational impact by exploring how case-study learning can be designed with the broader goals of higher education, including fostering critical thinking, creativity, and career readiness. The study findings offer valuable insights for educators and institutions seeking to leverage case-study learning to enhance the effectiveness of group work and prepare students for the green transition workplaces of the future. This study is timely given the rapid advancement of the green transition and the increasing emphasis on collaborative skills in the modern workforce.

References

Asyifa, M., Tarjiah, I., & Utomo, E. (2024). Evaluating the effectiveness of case-based learning in designing basic leadership training: a systematic literature review. Jurnal EDUCATIO: Jurnal Pendidikan Indonesia, 10(2), 266-273.

Buchmann, F. M. (2022). Driving the Green Transition of the Maritime Industry through Clean Technology Adoption and Environmental Policies. Copenhagen Business School [Phd]. PhD Series No. 10.2022.

Cen, X. Y., Hua, Y., Niu, S., & Yu, T. (2021). Application of case-based learning in medical student education: a meta-analysis. European Review for Medical & Pharmacological Sciences, 25(8).

IMO (2020). Fourth Greenhouse Gas Study 2020. International Maritime Organisation.

IMO (2023). Revised GHG reduction strategy for global shipping adopted. International Maritime Organisation. News. 7th July 2023.

ISO (2020). ISO 21502:2020 - Project, programme and portfolio management — Guidance on project management. International Organization for Standardization.

Kolb, D. A. (2014). Experiential learning: Experience as the source of learning and development. FT Press.

LinkedIn (2023). Global Green Skills Report 2023.

Loo, L., Kuttan, S. C., Tan, M. Mohottala, S., Goh, S. C. (2023). Voyaging Toward a Greener Maritime Future. Boston Consulting Group. Available online at: https://www.bcg.com/publications/2023/voyaging-toward-a-greener-maritime-future

Maersk (2022). A.P. Moller-Maersk accelerates Net Zero emission targets to 2040 and sets milestone 2030 targets. Press release. 12th January 2022.

Maslen, S., & Hayes, J. (2020). Case based learning among practicing engineers: design, facilitation and lessons learned. Cognition, Technology & Work, 22(2), 307-319.

Methanol Institute (2020). Methanol as a Marine Fuel. Presentation. Available online at: https://www.methanol.org/wp-content/uploads/2020/01/Methanol-as-a-marine-fuel-january-2020.pdf

Nijhuis, S., & de Vries, J. (2019). Design as research in landscape architecture. Landscape Journal, 38(1-2), 87-103.

Notteboom, T., Pallis, A.& Rodrigue J.-P. (2022). Port Economics, Management and Policy, New York: Routledge.

OpenStreetMap (2024). https://www.openstreetmap.org/#map=17/-42.879616/147.342796. OpenStreetMap data is licensed under ODbL.

Oloruntobi, O., Mokhtar, K., Gohari, A., Asif, S., & Chuah, L. F. (2023). Sustainable transition towards greener and cleaner seaborne shipping industry: Challenges and opportunities. Cleaner Engineering and Technology, 13, 100628.

Osterwalder, A., & Pigneur, Y. (2010). Business model generation: a handbook for visionaries, game changers, and challengers (Vol. 1). John Wiley & Sons.

Pinto, B. L. (2022). Distinguishing between Case Based and Problem Based Learning. International Journal of Kinesiology in Higher Education, 7(3), 246–256.

Sangam, M. R., Praveen, K., Vinay, G., Bokan, R. R., Deka, R., & Kaur, A. (2021). Efficacy of case-based learning in anatomy. Cureus, 13(12).

Srinivasan, M., Wilkes, M., Stevenson, F., Nguyen, T., & Slavin, S. (2007). Comparing problem-based learning with case-based learning: effects of a major curricular shift at two institutions. Academic Medicine, 82(1), 74-82.

Tayce, J. D., Saunders, A. B., Keefe, L., & Korich, J. (2021). The creation of a collaborative, case-based learning experience in a large-enrollment classroom. Journal of Veterinary Medical Education, 48(1), 14-20.

Thake, A. M. (2025). Transitioning to a green economy-the impact on the labor market and workforce skills. In: Greening Our Economy for a Sustainable Future (pp. 163-175). Elsevier.

Tsekhmister, Y. (2023). Effectiveness of case-based learning in medical and pharmacy education: A meta-analysis. Electronic Journal of General Medicine, 20(5).

UN (2015). The 2030 Agenda for Sustainable Development. United Nations.

UNFCCC (2018). The Paris Agreement. United Nations Framework Convention on Climate Change. Paris Climate Change Conference - November 2015.

van Erp, T. (2022). Combining Research-, Project-, and Case-Based Learning in Higher Manufacturing Engineering Education. In Global Conference on Sustainable Manufacturing (pp. 1016-1024). Cham: Springer International Publishing.

Wang, T., Cheng, P., & Zhen, L. (2023). Green development of the maritime industry: Overview, perspectives, and future research opportunities. Transportation Research Part E: Logistics and Transportation Review, 179, 103322.

Laybourne, G. (2023). Sailing towards the twin transition: How shipping can use digital to decarbonize. World Economic Forum Annual Meeting. 16th January 2023

Wu, F., Wang, T., Yin, D., Xu, X., Jin, C., Mu, N., & Tan, Q. (2023). Application of case-based learning in psychology teaching: a meta-analysis. BMC Medical Education, 23(1), 609.