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Instructor Autonomy and Training Structures in Simulator-Based Education: A Study of Maritime and Aviation Training Approaches

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ABSTRACT: Simulator-based training is an essential component of both maritime and aviation education, yet the regulatory frameworks and pedagogical approaches governing these fields differ significantly. Aviation training operates under highly standardized and prescriptive regulations, ensuring structured progression through predefined exercises, while maritime training is more flexible, guided by the International Maritime Organization's (IMO) Standards of Training, Certification, and Watchkeeping for Seafarers (STCW) convention. This study explores how these differences impact simulator training design, instructor autonomy, and student learning experiences. Using a qualitative research approach, data was collected through instructor interviews and observations of simulator training sessions in both maritime and aviation institutions. Findings reveal that maritime instructors have significant freedom to design and adapt training exercises, leading to high levels of customization but also inconsistencies across institutions. In contrast, aviation instructors follow strict, externally approved training manuals, ensuring coherence but limiting adaptability. Another key difference is in assessment structures—aviation training includes mandatory level confirmation checks throughout the program, whereas maritime training relies on final exams, with simulator exercises seen as learning opportunities rather than evaluative assessments. This study highlights the advantages and challenges of both approaches. While the flexibility in maritime training fosters innovation and adaptability, it risks a lack of coherence between courses. Conversely, aviation's structured training ensures standardization and regulatory compliance but may hinder responsiveness to technological advancements or evolving industry needs. The study suggests that a balanced approach—incorporating aviation's structured assessments into maritime training while preserving instructor-driven adaptability—could optimize learning outcomes in the maritime sector, and that a balanced approach also could be considered for the aviation sector. This research contributes to the ongoing discourse on simulator-based education by identifying areas for cross-sector learning and improvement. Recommendations include enhancing coordination between maritime training programs, implementing structured assessment milestones, and exploring adaptive simulation techniques to enhance both standardization and flexibility in training methodologies.

1 INTRODUCTION

The use of simulators has significantly changed training methodologies in industries where precision, safety, and high-stakes decision-making are key factors (Jentsch & Curtis, 2017; Sellberg, 2017). Two industries that have really embraced this technology are maritime and aviation, where simulation plays a key role in preparing professionals for real-life situations. In both domains, simulators are used to replicate complex operational environments, enabling trainees to develop critical skills, enhance decision-making capabilities, and build confidence in handling routine and emergency scenarios (Hjelmervik et al., 2018). As tasks and systems in these industries become more complex, simulation training has become more important than ever.

Even though both sectors rely heavily on simulators, their training goals and how they use the technology can differ quite a bit. These differences come from the unique operational demands, risks, and regulatory frameworks that define each sector (Allerton, 2009; Vederhus et al., 2018). In the maritime field, simulator training often focuses on navigation, vessel operation, and teamwork on the bridge, with scenarios designed to address challenges such as adverse weather, port entry, and collision avoidance. On the other hand, aviation simulators focus on flight operations, aircraft systems management, and the mitigation of critical in-flight emergencies, reflecting the sector's focus on speed, precision, and passenger safety.

A big part of what shapes how simulators are used is the regulatory framework behind them. Organizations such as the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO) set standards to ensure that simulation-based training aligns with industry-specific requirements for competency, safety, and operational efficiency (EASA, 2020; ICAO, 2018; IMO, 2011). These frameworks influence not only the technical specifications of simulators but also the pedagogical approaches employed by training institutions.

This paper seeks to explore two critical aspects of simulator training in the maritime and aviation sectors. First, it investigates the primary objectives of simulator training in each domain and examines how these objectives shape the methodologies used. Second, it analyses the influence of regulatory frameworks on the design and application of simulators, highlighting points of convergence and divergence between the two industries. By addressing these questions, the study aims to provide a deeper understanding of the role of simulator training in enhancing safety and operational performance, while identifying opportunities for cross-industry learning and innovation (Aronsson et al., 2021).

2 BACKGROUND AND LITERATURE REVIEW

Simulation-based training has become an essential component of professional development in safety-critical industries such as maritime and aviation. The adoption of simulators in these fields dates back several decades, driven by the need to replicate real-world scenarios in controlled environments. This section reviews the historical development, technological advancements, and pedagogical theories underpinning simulator training, as well as the current regulatory frameworks that govern its application.

2.1 *Historical Development of Simulator Training*

The origins of simulator training can be traced to the early 20th century, with the development of flight simulators for pilot training during World War I. The iconic Link Trainer, introduced in the 1930s, marked a significant leap forward, offering pilots an opportunity to practice instrument flying in a safe and controlled setting (Jeon, 2015). In the maritime sector, the adoption of simulators gained traction in the late 20th century, as advances in computing power enabled the creation of sophisticated models for bridge operations and ship handling (Gudmestad et al., 1995; Hanzu-Pazara et al., 2008).

Both sectors have seen a steady evolution in simulation technologies, moving from simple mechanical devices to high-fidelity systems that incorporate virtual reality (VR), augmented reality (AR), and artificial intelligence (AI). These advancements have enhanced the realism of training scenarios, enabling professionals to practice complex operations and decision-making under near-real-world conditions (Myers III et al., 2018).

2.2 *Pedagogical Foundations of Simulator Training*

Simulator training is grounded in experiential learning theories, particularly Kolb's experiential learning model, which emphasizes learning through active engagement with experiences (Morris, 2020). The model's four stages—concrete experience, reflective observation, abstract conceptualization, and active experimentation—are inherently aligned with simulation-based education. In both maritime and aviation contexts, simulators facilitate hands-on learning, allowing trainees to apply theoretical knowledge to practical situations.

Another key pedagogical principle is the concept of deliberate practice, which focuses on repetitive, goal-oriented training with continuous feedback. In aviation, for instance, pilots use simulators to master specific manoeuvres and emergency protocols, while maritime trainees focus on more general tasks such as navigation, collision avoidance, and crisis management. The structured nature of simulator training ensures that learners can refine their skills incrementally, minimizing the risks associated with real-world errors.

2.3 *Regulatory Frameworks Governing Simulator Training*

International regulations play a crucial role in standardizing the use of simulators for training and certification purposes. In maritime education, the International Maritime Organization (IMO) prescribes guidelines under the Standards of Training, Certification, and Watchkeeping for Seafarers (STCW) (IMO, 2011). These standards mandate the use of simulators for training in navigation, engine room operations, and crisis management, ensuring that seafarers are adequately prepared for operational challenges.

Similarly, in the aviation sector, the International Civil Aviation Organization (ICAO) and regional authorities such as the Federal Aviation Administration (FAA) and the European Union Aviation Safety Agency (EASA) establish requirements for simulator training (EASA, 2020; ICAO, 2018). These frameworks specify the design, fidelity, and operational capabilities of flight simulators used for pilot certification and recurrent training.

2.4 *Research Gap and Study Focus*

While extensive research has been conducted on simulator training in individual sectors, (Nazir et al., 2019; Tusher et al., 2024), comparative analyses remain relatively limited. A literature search in the database Web of Science was performed using the following Boolean search string: ("Maritime" AND "Aviation" AND "Simulator"). The search returned a total of 29 documents after including only peer-reviewed articles. After the initial screening of abstracts, a total of 11 articles were selected for review. 5 of the articles were related to maritime simulators, and 5 were related to aviation simulators, but none were found to compare the simulator training in each domain. One study looked into factors related to negative transfer of training in safety-critical professions (Pennings et al., 2025). This study is based on interviews with instructors from both the aviation and the maritime sectors. But most of the instructors interviewed in the study come from the aviation sector, and only one came from the maritime sector. There is a need for studies that explore how the objectives and regulatory frameworks of simulator training shape methodologies in maritime and aviation contexts. This paper aims to address this gap, contributing to a better understanding of the role of simulator training in enhancing safety and operational efficiency across industries.

3 REGULATORY FRAMEWORKS

Simulator training in the maritime and aviation sectors is underpinned by regulatory frameworks designed to ensure safety, competency, and adherence to industry standards. These frameworks establish guidelines for the design, application, and evaluation of simulators, promoting consistency and reliability in training programs. This section examines the key regulatory bodies and standards that shape simulator training in both industries.

3.1 *Regulatory Frameworks in Maritime Training*

In the maritime industry, simulator training is governed by the International Maritime Organization (IMO), which sets global standards for seafarer training under the International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers (STCW). The STCW convention specifies the competencies required for various maritime roles and mandates the use of simulators for specific training tasks (IMO, 2011).

Key provisions include:

– Navigation and Bridge Operations: Simulators are used to train officers in collision avoidance, route planning, and response to navigational hazards.
– Engine Room Operations: Engine room simulators allow engineers to practice operating and troubleshooting propulsion systems and auxiliary machinery.
– Crisis Management: Scenario-based training focuses on emergency response, including fire-fighting, abandoning ship, and oil spill containment.

The IMO's Model Courses provide detailed guidance on the design and implementation of simulator training, emphasizing realism, relevance, and assessment methodologies. An example is IMO Model Course 1.22, Ship Simulator and Bridge Teamwork. The IMO Model Courses also set requirements regarding the instructors' competence through IMO Model Course 6.09 and 6.10, Training Course for Instructors and Train the Simulator Trainer and Assessor.

3.2 *Regulatory Frameworks in Aviation Training*

The aviation sector's regulatory environment is equally robust, with international and regional bodies overseeing simulator training. The International Civil Aviation Organization (ICAO) sets global standards through its Standards and Recommended Practices (SARPs), which are detailed in Annex 1 (Personnel Licensing) and Annex 6 (Operation of Aircraft) (ICAO, 2018).

Regional authorities, such as the Federal Aviation Administration (FAA) in the United States and the European Union Aviation Safety Agency (EASA) in Europe, enforce these standards and provide additional regulations. Key aspects include:

– Simulator Standards: Simulators must meet strict standards for fidelity and functionality, as outlined in documents such as EASA's CS-FSTD(A) (EASA, 2020).
– Pilot Certification and Recurrent Training: Simulators are integral to the initial certification of pilots, as well as ongoing proficiency checks and scenario-based training.
– Crew Resource Management (CRM): Regulatory requirements emphasize the use of simulators for training in teamwork, communication, and decision-making under high-stress conditions.

Simulator instructors' competence is regulated through EASA regulations (EASA, 2020).

3.3 *Commonalities in Regulatory Approaches*

Both maritime and aviation regulators share key principles in their approach to simulator training:

– Focus on Safety: Regulations prioritize training that minimizes risks and prepares professionals to handle emergencies effectively.
– Competency-Based Standards: Training programs are designed to ensure that trainees meet clearly defined performance criteria.
– Emphasis on Realism: High-fidelity simulators are mandated to replicate real-world operational environments accurately.
– Continuous Evaluation: Regular audits and updates to training programs ensure compliance with evolving standards and technologies.

3.4 *Challenges in Regulatory Compliance*

While regulatory frameworks provide a strong foundation, their implementation presents challenges:

– Cost and Accessibility: High-quality simulators and compliance with stringent standards require significant investments, which can be excessive for smaller organizations.
– Standardization Across Regions: Variability in regional regulations can complicate the development of standardized training programs.
– Technological Advances: Regulators must continuously adapt to new technologies, such as autonomous systems and artificial intelligence, ensuring that training remains relevant.

3.5 *Opportunities for Harmonization and Innovation*

Efforts are underway to harmonize regulations across regions, facilitating cross-industry learning and resource sharing, for example, in the case of port security training (Urciuoli, 2016). Also, joint initiatives between the IMO and ICAO explore synergies in simulator training methodologies, leveraging best practices from both sectors.

Innovation in simulator design, driven by advancements in virtual reality (VR) and artificial intelligence (AI), offers opportunities to enhance training quality. Regulatory frameworks will probably in the future evolve to incorporate these technologies, ensuring that they meet safety and performance standards.

In conclusion, regulatory frameworks in maritime and aviation training play a pivotal role in maintaining safety and competency. By addressing challenges and embracing innovation, these frameworks can continue to support the development of highly skilled professionals capable of meeting the demands of their industries.

4 METHODOLOGY

This study employs a combined methods approach to examine the similarities and differences in simulator training between the maritime and aviation sectors. The methodology combines document analysis, interviews, and observational techniques to provide a thorough understanding of training practices and their regulatory and operational contexts.

4.1 *Research Design*

The research design is structured to explore the multifaceted nature of simulator training through the triangulation of qualitative data sources. By integrating document analysis, interviews, and observation, the study ensures a robust and nuanced analysis of the research questions.

4.2 *Document Analysis*

Document analysis can serve as the foundation for understanding the regulatory frameworks and historical development of simulator training in both sectors (Clark et al., 2021). Key documents include:
– Regulatory Texts: International Maritime Organization (IMO) guidelines, such as the STCW convention (IMO, 2011), and aviation standards from the International Civil Aviation Organization (ICAO) and EASA (EASA, 2020; ICAO, 2018).
– Training Manuals: Operational and procedural guides used in maritime and aviation training centres.

These documents were reviewed to identify commonalities and differences in training objectives, methodologies, and compliance requirements (Clark et al., 2021). Table 1 below gives an overview of the documents reviewed as part of the study.

Table 1. Regulatory texts and training documents

Regulatory Texts	
Name	Type
STCW-code	Maritime international legislative framework for education and training
ICAO and EASA framework	Aviation international legislative framework for education and training
Training Documents	
Name	Type
Exercise descriptions	In total, 10 exercise descriptions from 4 different providers of higher maritime navigational education and training
Training manual	Training manual describing all simulator training from 1 provider of higher aviation navigational education and training

4.3 *Semi-Structured Interviews*

Interviews were conducted with subject matter experts, including:
– Maritime Professionals: Captains, training officers, and simulator instructors.
– Aviation Professionals: Pilots, flight instructors, and regulatory compliance officers.

The semi-structured format allowed for flexibility, enabling participants to elaborate on their experiences and perspectives (Kvale & Brinkmann, 2009). The interviews covered topics such as:
– The role of simulators in skill development.
– Perceptions of regulatory requirements and their impact on training design.
– Challenges and opportunities in integrating new technologies.

Table 2 below gives an overview of the interviews performed as part of the study. A total of 8 interviews were performed with 5 maritime instructors from 2 different providers of higher maritime navigational education and training, and 3 aviation instructors from 1 provider of higher aviation navigational education and training.

Table 2. Interview candidates

Candidate	Position	Method
1	Maritime Instructor	Virtual
2	Maritime Instructor	Virtual
3	Maritime Instructor	Face to face
4	Maritime Instructor	Face to face
5	Maritime Instructor/PhD-student	Face to face
6	Aviation Instructor	Face to face
7	Aviation Instructor	Face to face
8	Aviation Instructor/ Flight Operations Officer	Face to face

4.4 *Observational Studies*

Observations were conducted at simulator training centres in both industries to capture real-time insights into training practices. Key aspects included:

- Session Dynamics: The structure and flow of simulation sessions, including pre-briefings and debriefings.
- Instructor-Trainee Interactions: Communication patterns, feedback mechanisms, and decision-making processes.
- Technology Utilization: The integration of high-fidelity systems, virtual reality, and other advanced tools.

Field notes were taken to document observations systematically, and these were later analysed to identify patterns and themes (Emerson et al., 2011).

Table 3 below gives an overview of the observations of simulator training as a part of the study. A total of 98 hours of simulator training were observed as a part of the study, where 93 hours were observation of maritime simulator training at the 4 maritime training providers, and 5 hours of aviation simulator training were observed at the aviation training centre.

Table 3. Observation of simulator training

Type of provider	Number of exercises	Duration
Maritime	3	25.5 hours
Maritime	2	21.5 hours
Maritime	3	18 hours
Maritime	3	28.5 hours
Aviation	2	5 hours

4.5 *Data Analysis*

The collected data were analysed using thematic analysis, which involved the following steps:

1. Coding: Initial codes were generated from the data, focusing on recurring themes such as safety, teamwork, and regulatory compliance.
2. Categorization: Codes were grouped into categories, reflecting the research objectives.
3. Integration: Insights from document analysis, interviews, and observations were synthesized to develop a well-integrated narrative.

4.6 *Ethical Considerations*

The study adhered to ethical guidelines to ensure the integrity and confidentiality of the research process:

- Informed Consent: Participants were informed about the study's objectives, methods, and potential outcomes, and their consent was obtained before data collection.
- Confidentiality: Data were anonymized to protect participants' identities and sensitive information.
- Voluntary Participation: Participants were free to withdraw from the study at any time without penalty.

4.7 *Limitations*

While the combined-methods approach provides a useful perspective, certain limitations must be acknowledged:

- Access to Participants: Challenges in securing interviews with regulatory officials may have limited insights into policy-making processes.
- Generalizability: Findings may not fully represent all training centres or regulatory contexts, given the variability across regions and organizations.

In summary, the methodology integrates document analysis, interviews, and observations to ensure a holistic exploration of simulator training in maritime and aviation contexts. This approach not only addresses the research questions but also provides actionable insights for stakeholders in both industries.

5 ANALYSIS AND DISCUSSION

Simulator training in the maritime sector operates within a regulatory framework primarily governed by the International Maritime Organization (IMO) through the Standards of Training, Certification, and Watchkeeping for Seafarers (STCW) convention. While the STCW convention provides a global baseline of standards and competencies for maritime professionals, it leaves significant room for interpretation and implementation at the national and institutional levels. This flexibility has a profound impact on how simulator training is designed and delivered. Interviews with instructors and observation of simulator training at different institutions show variations in how the simulator training is organized and executed

Unlike aviation, where training requirements are often codified in detailed and prescriptive regulations issued by bodies such as the FAA or EASA, maritime regulations emphasize outcomes rather than specific methodologies. For instance, the STCW convention mandates the use of simulators for tasks, such as bridge resource management or engine room operations, but does not dictate the exact scenarios or instructional techniques to be used. This approach gives simulator instructors considerable freedom to design exercises tailored to the specific needs of their trainees and the operational contexts of their vessels.

Regarding the training manuals, a significant difference observed between the maritime training centres and the aviation training centre is the layout and structure of the training manual. For the aviation training centre, the training manual is an implemented part of the total training system that is certified and approved by external accreditation authorities. This means that all simulator exercises a student is to execute during a training program are available from the start of the training program. This kind of organization of the training program will probably also lead to a stronger coherence between the exercises, and thereby a predetermined progress through the exercises. A negative effect can be that it can be difficult to implement changes to the training program, for example because of new technology or new instructors with new ideas and thoughts regarding the training program. It is possible to argue that this strict handling of the training manual can have a negative impact on innovation in the field of simulator training in aviation.

For the training manuals at the maritime training centres, the situation is very different. It can be argued whether the maritime training centres have training manuals or if they have a training program consisting of independent training exercises. Interviews and observations indicate that the freedom for the instructor is high when it comes to which exercises to run and when it comes to implementing changes to the simulator exercises. Often, an instructor is assigned as the course responsible for a single course. As a result of this, usually the consistency between exercises inside a specific course is high, but the coordination between different courses can be weak. An instructor stated in the interview that it is normal to inherit a training program when you start as a new instructor or take over responsibility for a new course, and then to adjust the program over time based on your own experience. The same instructor stated that if he finds it necessary to, for instance, make a new simulator exercise and implement it into the training program, he will make the exercise himself. There would be no requirements for control from other instructors responsible for other courses or from the study program management. However, it was normal to discuss new exercises with colleagues, especially since there were always two instructors in the specific course he was responsible for.

Another instructor informed that he preferred to have a dynamic approach to simulator exercises. He usually uses baseline scenarios with a preset traffic scenario, but he always makes alterations to the exercise based on the decisions the students take. To deliberately put students in situations where they must learn how to handle different circumstances. As an example, he elaborated on a situation where a student was consequently positioning the ship in the wrong part of the fairway. He would then insert extra traffic to force the student to act regarding the positioning of the ship. Regarding the planning of the training program, he informed that he always makes a rough plan together with the assistant instructor before the start of the semester. They set up a list of exercises with goals and aim for each exercise, and descriptions of desired learning outcomes. But the plan is changed every semester based on the progression of the students. Some years they change the sequence of the exercises, and some years they replace exercises with other exercises with other learning outcomes. They have a library of extra exercises that can be used as replacement exercises when necessary. After each exercise, they have a debrief session and discuss the outcome of the exercise, and if it is necessary to adjust the sequence of exercises or adjustments for the next exercise.

Another factor specific to maritime simulator training is that the instructors have a high threshold for non-approval of exercises for students based on their performance. One instructor informed that he had never failed a student in his career as an instructor, as he considered the goal of the exercise to be learning, and that making mistakes can be an effective way to learn. A quote that sums up this instructor's feelings regarding this matter is "Exam is for passing and failing, exercises are for learning". This is also supported by another instructor who states that students failing exercises are very rare and are considered extreme cases.

Another instructor from another institution points out the advantages of having dynamic exercises that evolve based on trainees' actions. He claims that the most fantastic characteristic of humans is the ability to adapt and to change direction during the exercises. The same instructor states that the timing and sequence of exercises are very important, and that these are key factors in the planning of the courses he is responsible for. The exercises used in these courses are well-tested exercises that have been used for several years and adjusted when needed. But he also states that if the instructor responsible for the other courses at his institution wants to make 5 new exercises and replace the old ones, he would have no problem with that.

The last point to discuss related to maritime simulator training is that nearly all training is carried out with more than one student in the simulator at the same time. This means that the instructor must focus on several students at the same time. In the simulator exercises observed as a part of this study, the number of bridges used in the exercises varied between 3 and 7, and the number of students on each bridge varied between 2 and 4. At the same time, the number of instructors handling the exercise varied between 1 and 2. As a result of this, the worst-case scenario can be that one instructor is available for the monitoring and assessment of 28 students at the same time.

For simulator training in aviation, the execution of the training is quite different. Almost all training in a simulator is individual, with one student and one instructor present in the simulator. The exception is specified training courses in crew resource management. This is a significant difference from the maritime simulator training, as explained above. Another difference is that for aviation training, students must pass mandatory level confirmation exercises before progressing to the next level of the training program. As described above, this is not the case for maritime simulator training, as the exam normally is the only level confirmation check for the students.

A good case for illustrating the differences between the two fields of simulator training is to consider training regarding the loss of important instruments during operations. This is highly relevant for both maritime and aviation, and something the students need to be able to detect and handle. In maritime simulator training, an example of this can be found in the training manual from one of the simulator training centres. One of the learning objectives in a specific exercise is to train on handling loss of GPS signals, which is a highly relevant and possible situation that can occur. In this specific exercise, loss of GPS signals is 1 out of a total of 12 learning objectives, which vary from route planning, equipment familiarization, bridge resource management and communication to leadership and situational awareness. The exercise description does not instruct the students in any way regarding how to handle the situation, it only states the goal, to ensure the position of the ship using other means than the GPS. The exercise description includes some recommendations and hints for the students on how to reach this goal. How and when the failure is implemented is up to the instructor to decide.

A similar exercise can be found in the training manual for the aviation training centre. The goal with this exercise is to handle the loss of important equipment during the flight. A major difference is that both the student and the instructor have access to the same description and procedures regarding how the situation should be solved. The instructor follows a predefined list that describes when and in what sequence the failures should be implemented. The student follows procedures and checklists that describe how the situation should be handled. The role of the instructor is to run the exercise and implement failures, and to assess if the student handles the situation following the procedure. If the student is making mistakes, the instructor will interfere and guide the student.

Although the aviation exercise seems to be stricter and more formal than the maritime exercise, observations show that exercises in this segment can include dynamic elements. In one specific exercise, the student was allowed to practice landing skills at the end of the exercise, although this was not relevant for this part of the training manual. The instructor emphasized that this was a reward for the student performing well on the objectives in the exercise, and that the time would have been used for more training on the objectives if this had not been the case. Interviews with instructors from aviation shows that they share the maritime instructors' view that these kinds of exercises are mainly for learning, and not for testing of performance or progression. The level confirmation checks will serve this function. One instructor stated that he wants the students to make mistakes in the simulator instead of in the aircraft, so the mistakes can be handled and discussed in a safe environment without safety concerns or time restrictions. However, the instructor said that he knows that not all instructors share this view, and that some instructors handle every exercise as a test. Students rarely fail basic exercises like this one, but it occurs that students are denied access to the exercise due to a lack of preparation. It can also be that the student and instructor together decide that the students need to train more to reach the desired level, and because of this repeats the exercise or parts of the exercise.

6 CONCLUSION AND RECOMMENDATIONS

Simulator training in the maritime sector differs significantly from aviation due to the flexibility allowed by the IMO's STCW convention. While maritime instructors have greater autonomy in designing exercises, this results in varied training approaches across institutions. In contrast, aviation training follows strict regulatory frameworks, ensuring consistency but limiting adaptability. Maritime training emphasizes learning over assessment, while aviation incorporates mandatory level confirmation checks. These differences impact training coherence, assessment rigor, and innovation. Based on this, the following recommendations are given:

- Maritime training centres should consider adopting structured guidelines while preserving instructor autonomy to enhance consistency.
- Maritime training should consider implementing level confirmation checks in addition to exams while maintaining learning-oriented exercises.
- Aviation training centres should consider leveraging dynamic training scenarios to better prepare trainees for real-world challenges.

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