Concrete concepts in a virtual environment – moving VTS training ‘online’

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ABSTRACT

During the past years we have seen significant progress as we embrace tools enabled through the Digital Transformation of the Maritime Environment. While we were unable to meet in the same ‘physical’ environment, we learned to meet, communicate and collaborate using different online tools. This included the need to come up with innovative solutions to providing critical training – such as VTS training – online. The presentation will focus on the concrete benefits of putting VTS training ‘online’ focusing on the successful online delivery of VTS On-The-Job Training (C0103-4, formerly V-103/4), VTS Operator (C0103-1, formerly V-103/1), VTS Supervisor (C0103-2, formerly V-103/2) and VTS Recurrent (C0103-5, formerly V-103/5) training in a virtual environment. The paper will include the move to full online VTS training simulation, replicating the VTS centre, including team training, through a combination of different online technologies.

By looking at what went well and what was revised in the course of multiple course deliveries over the past years the presentation will identify options for further work in this area, including approval process for online training delivery; further development of online training; and next steps as we learn from the Covid Pandemic to move into a post-pandemic era.

**KEYWORDS:** VTS Training, Innovative solutions, VTS Training simulation, approval process

ABSTRACT (French)

Au cours des dernières années, nous avons constaté des progrès significatifs en adoptant des outils rendus possibles par la transformation numérique de l'environnement maritime. Alors que nous ne pouvions pas nous rencontrer dans le même environnement « physique », nous avons appris à nous rencontrer, à communiquer et à collaborer en utilisant différents outils en ligne. Cela comprenait la nécessité de proposer des solutions innovantes pour fournir une formation essentielle - telle que la formation VTS - en ligne. La présentation se concentrera sur les avantages concrets de la mise en ligne de la formation VTS en se concentrant sur la prestation en ligne réussie de la formation en cours d'emploi VTS (C0103-4, anciennement V-103/4), Opérateur VTS (C0103-1, anciennement V-103/1), VTS Supervisor (C0103-2, anciennement V-103/2) et VTS Recurrent (C0103-5, anciennement V-103/5) dans un environnement virtuel. Le document inclura le passage à une simulation de formation VTS en ligne complète, reproduisant le centre VTS, y compris la formation en équipe, grâce à une combinaison de différentes technologies en ligne.

En examinant ce qui s'est bien passé et ce qui a été révisé au cours de la prestation de plusieurs cours au cours des dernières années, la présentation identifiera les options pour des travaux supplémentaires dans ce domaine, y compris le processus d'approbation pour la prestation de formation en ligne ; poursuite du développement de la formation en ligne; et les prochaines étapes à mesure que nous apprenons de la pandémie de Covid pour entrer dans une ère post-pandémique.

**MOTS CLÉS :** Formation VTS, Solutions innovantes, Simulation de formation VTS, processus d'approbation

ABSTRACT (Spanish)

Durante los últimos años, hemos visto un progreso significativo a medida que adoptamos herramientas habilitadas a través de la Transformación Digital del Entorno Marítimo. Si bien no pudimos reunirnos en el mismo entorno "físico", aprendimos a reunirnos, comunicarnos y colaborar utilizando diferentes herramientas en línea. Esto incluía la necesidad de encontrar soluciones innovadoras para brindar capacitación crítica, como la capacitación VTS, en línea. La presentación se centrará en los beneficios concretos de poner la formación VTS 'en línea' centrándose en la entrega en línea exitosa de la formación VTS en el puesto de trabajo (C0103-4, anteriormente V-103/4), Operador VTS (C0103-1, anteriormente V-103/1), VTS Supervisor (C0103-2, antes V-103/2) y VTS Recurrente (C0103-5, antes V-103/5) formación en entorno virtual. El documento incluirá el paso a una simulación de formación VTS en línea completa, replicando el centro VTS, incluida la formación en equipo, a través de una combinación de diferentes tecnologías en línea.

Al observar lo que salió bien y lo que se revisó en el curso de múltiples entregas de cursos en los últimos años, la presentación identificará opciones para seguir trabajando en esta área, incluido el proceso de aprobación para la entrega de capacitación en línea; mayor desarrollo de la formación en línea; y los próximos pasos a medida que aprendemos de la pandemia de Covid para pasar a una era pospandémica.

**PALABRAS CLAVE:** Formación VTS, Soluciones innovadoras, Simulación de Formación VTS, Proceso de homologación

# Introduction

The maritime industry is one of the most critical and complex industries in the world. The Organisation for Economic Co-operation and Development (OECD) notes that around 90% of traded goods are carried by ship [1]. The UNCTAD Review of Maritime Transport 2022 note that ships delivery over 80% of world trade and highlight that disruptions in ports and shipping lanes mean food, energy and medicine shortages [2]. In addition, businesses and production lines that have limited access, or delayed access, to raw materials and supplies results in soaring prices for consumers.

Ports, shipping companies and transport operators need to chart a new course to support resiliency, including ensuring adequate and skilled labour. Vessel traffic services (VTS) are a crucial aspect of the safe, efficient and pollution free operation within ports as well as coastal areas. The traditional approach to VTS training has been in-person training, which has its limitations, including the availability of training facilities, time, and resources. The COVID-19 pandemic further amplified these limitations, driving the need for alternative training methods.

This paper aims to explore the challenges and opportunities of implementing concrete concepts in a virtual environment, specifically in the context of putting maritime education and training (MET) online, including simulation training. The example used will focus on the move by the AMC Search (AMCS), the training and consultancy division of the Australian Maritime College (AMC) at the University of Tasmania, to move the training of Vessel Traffic Services (VTS) personnel from a ‘physical’ synchronous training environment to a ‘virtual’ synchronous training environment. The paper discusses challenges of moving the training online; the solutions implemented to address these challenges and the advantages of creating an interactive virtual training environment, including simulation training.

By examining the concrete concepts in a virtual environment, we hope to shed light on the potential of virtual training simulators and how they can be utilized to enhance the training of seafarers in the maritime industry.

# Challenges facing maritime education and training during covid

When it became apparent that there were going to be severe disruptions due to the global pandemic, the maritime industry, like many other industries, faced a range of challenges. For maritime education and training (MET) these included:

1. **Health and safety concerns**: Training centres had to implement new health and safety measures to ensure that students and trainers were protected from the virus.
2. **Distancing Requirements**: To address the health and safety concerns, training centres that did remain open had to deal with the requirement for social distancing or implementation of measures to separate trainees with physical barriers. (Figure 1)
3. **Reduced capacity:** Those training centres that were able to remain open had to reduce their capacity to comply with social distancing requirements. This led to longer wait times for students to attend training.
4. **Travel restrictions:** The pandemic led to widespread travel restrictions, which made it difficult for students and trainers to travel to training centres. This was particularly challenging for students and instructors who needed to travel internationally to attend training. Within some countries significant travel restrictions were in place within the country, in some cases cities or areas within a city faced focused lockdowns.
5. **Reduced availability of trainers:** Many trainers were unable to work due to illness, quarantine, or other pandemic-related reasons. This led to a shortage of available trainers and made it difficult for training centres to operate at full capacity.
6. **Closure of training centres:** Many maritime training centres were forced to close due to lockdown measures and travelling restrictions. This made it difficult for students to complete their training and for new students to begin their training.
7. **Difficulties for audit and accreditation:** Maritime education and training is provided to meet the requirements of international, regional, and national standards. This means the training institutes, and the training programs themselves, must be audited for accreditation. Onsite visits for audits became impossible during the lockdown periods.



Figure 1: VTS OJT Zeebrugge, February 2021, with physical barriers (photo courtesy of Stefaan Priem)

Overall, these challenges made it difficult for maritime training to continue as usual during the pandemic. However, developments in technology and the rise in use of the existing online platforms, such as MSTeams, GoToMeeting and Zoom meant that many training centres were able to adapt and offer online or remote training to students.

# Developments in Technology

While COVID-19 pandemic created numerous challenges for the maritime industry, including disruptions to traditional training and education methods, it also provided an opportunity to ‘pivot’ work processes to make best use of technology. Technology developments helped to mitigate the many challenges facing maritime training organisations using virtual environments and online platforms. In some cases, the technology was already being used while in others the technology was developed rapidly to meet the demand.

Some of the key developments in technology that helped mitigate the challenges of MET during the pandemic include:

* Learning management systems
* Virtual and online learning platforms
* Online / cloud-based simulation
* Augmented and virtual reality
* Remote assessment

## Learning management systems

A Learning Management System (LMS) is a software application that facilitates the delivery of educational courses, training programs, or learning and development programs. The LMS provides an online platform for instructors and learners to communicate, collaborate, and manage course materials and assignments. The system can be used by educational institutions, corporations, and government agencies for the delivery of training and education programs.

LMS based on software were initially introduced in the 1990’s where files and data could be accessed by teachers and students, with private email and public forums [3]. Over the decades the capability of LMS has grown, with the first LMS hosted in an online ‘cloud’ environment from 2012.

LMSs typically offer a wide range of features, such as course creation and management, assessment and evaluation tools, reporting and analytics, and communication and collaboration tools. These features enable instructors and learners to work together in a flexible and efficient manner. Instructors can upload course materials, create and grade assignments, and provide feedback to learners. Learners can access course materials, complete assignments, and collaborate with peers and instructors. LMSs can be used in a variety of settings, from traditional classroom-based education to online and hybrid learning environments.

Prior to the pandemic, the AMCS VTS training was already using the University of Tasmania LMS ‘MyLo’ as the repository for reference material, access to the classroom activities, including power points as presented, and managing student marks for assessments and tests. During the pivot to online training, the role of MyLo remained, continuing to act as a focal point for the sharing of classroom activities access to course material, including assignments and assessments, was possible through the ongoing use of LMS.

## Virtual and Online Learning Platforms

The use of virtual and online learning platforms has been essential in supporting learning during the pandemic, providing a way for instructors and learners to continue with their courses and training despite physical distancing requirements and travel restrictions. They provide an opportunity to facilitate interactive and engaging synchronous training sessions, using communication tools that allowed trainees to participate in collaborative learning experiences remotely.

Some features to support effective learning interventions include: [4] [5]

* Flexibility and Support – access to course materials and activities such as course notes, presentations, videos, sound files
* Collaboration – ability to interact with instructors and other course participants with visual, audio and text based interactions
* Usability – supporting an interactive learning environment including breakout rooms, shared whiteboards, annotated screens
* Bandwidth – recognising limitations in internet speed, and minimizing the platform requirements to maximise the learning experience
* Security – ensuring a secure link, but also ensuring secure and safe learning environments.

Another important benefit of virtual and online learning platforms is their ability to support a range of learning styles. These platforms can offer a range of resources, including videos, podcasts, interactive simulations, and quizzes. This variety of resources helps to engage learners and accommodate different learning preferences.

## Cloud-based Simulation

Cloud-based simulation refers to a simulation process that is performed on remote servers over the internet, instead of being run on local hardware. Prior to the pandemic work was already underway to move maritime simulation technology to a cloud-based environment; the pandemic accelerated adoption of the ‘cloud’ concept, as part of the pandemic ‘pivot’ of digital transformation and digitalization. Cloud based simulators use cloud computing technology to process complex computations and simulations by distributing the workload across multiple servers. Within a few months of the pandemic, Microsoft CEO Satya Nadella noted that the company had seen two years of digital transformation in two months, with more customers adopting cloud solutions [6]

Using simulators in a cloud environment provides the opportunity for trainees to gain practical experience in a virtual environment, joining from different locations in different timezones. By using cloud-based simulation, organizations can avoid the need to invest in expensive hardware and software infrastructure for simulations. Instead, they can rent cloud computing resources on a pay-per-use basis, allowing them to scale their simulation capacity up or down as needed. This can lead to significant cost savings, increased flexibility, and faster simulation times.

The AMCS VTS Training was already using the Wartsila NaviHarbour VTS simulation tool. When the training was put online, the same tool, with the existing simulation exercise stack, was used with access to physical machines at a remote location, accessed through TeamViewer. More recently, the simulation tool is via RDP (remote desktop protocol) to cloud based instances of the same simulation tool. An example of online simulation is provided in Figure 2.

Map

Description automatically generated

Figure 2: Online VTS Simulation Training Activity, AMCS VTS Supervisor Course, March 2022

## Augmented Reality and Virtual Reality

Augmented reality (AR) and Virtual Reality (VR) technology have also helped with maritime training during the pandemic. By overlaying digital information onto the real world, AR allows trainees to engage with training materials and simulations in a more immersive and interactive way. VR technology can provide an immersive environment where trainees address specific emergency situations.

VR based simulations take simulation training to the next step, providing a highly engaging learning environment with a psychological presence of ‘being there’. Through connectivity, students at different locations can participate collaboratively in hands-on learning activities.

## Remote Assessment

The use of remote assessment tools has also been critical in enabling maritime training during the pandemic. These tools allow trainers to evaluate trainees' knowledge and skills from a distance, using virtual simulations and real-time feedback mechanisms. This technology has helped to ensure that trainees receive accurate and timely feedback on their performance, even when in-person assessments are not possible.

Within an LMS, the use of online testing and assignments are common. These tests tend to focus on the types of questions that can be automatically assessed – true/false; multiple choice; multi choice (chose all that apply); listing or ordering questions; matching questions and some key word short answer questions.

Key concerns with remote assessment include how to invigilate (monitor) an assessment and how to assess performance.

**Invigilation:** Invigilation can be done using software that monitors the learner's computer and internet activity, with remote proctor software or the use of synchronous tools, such as confirmation of workspace and then physically monitoring students during tests visually (webcam).

**Performance assessments:** Performance assessments involve evaluating the learner's practical skills through remote means. For an online assessment this can be done through video recordings of the learner performing tasks or simulations that evaluate the learner's ability to apply knowledge to real-world scenarios.

# Putting VTS training ‘online’

The maritime industry has always relied heavily on in-person training, and it is not hard to see why. When it comes to training Vessel Traffic Services (VTS) operators, the importance of hands-on experience cannot be overstated. However, the COVID-19 pandemic challenged the traditional approach to VTS training.

## Challenges of online VTS training

One of the most significant challenges of online VTS training is the (perceived) lack of hands-on experience or student/student, instructor/student interaction. More traditional approaches to distance or e-learning has been predominantly asynchronous (not in ‘real’ time) with little interaction between instructor and student, and between students themselves.

This leads to the challenge of addressing the practical aspects of VTS when provided through online tools using cloud-based simulation training. VTS operations require constant communication between operators, vessels, and other stakeholders using VHF radios, telephones and digital communications such as email. In an online environment, the challenge is to replicate this level of communication and interaction.

With training available ‘anywhere’ the global nature led to challenges of participation from different time zones and circadian rhythms with some students commencing their training ‘day’ at 0500, while others may be starting at 1900. Other concerns include eye strain and ‘zoom-fatigue’ as well as technical issues from personal digital intelligence to internet connectivity. Figure 3 presents some of the comments commonly shared at the beginning of the course, using the interaction tool ‘Mentimeter’.

Graphical user interface, text

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Figure 3: Word cloud from the beginning of the training on ‘challenges’

## VTS Training online – the reality

To provide an effective learning environment, putting training ‘online’ needs to consider the core focus, goals of the ‘in person’ training. The focus is always on quality training to meet stated objectives and adult learning theory, or andragogy, with a structured approach to experiential learning. [7]

In essence, there is a need to consider how to make online learning, including online simulation training **STICK:**

* addressing the **Sequencing** of the learning making use of both synchronous (in real time) and asynchronous learning opportunities;
* providing the **Technology** to support the learning environment;
* focusing on **Interaction** to enrich the learning process;
* ensuring the objectives are addressed through relevant **Content**; and
* providing opportunities to implement, and measure, the **Knowledge** transfer. [8]

Through an ongoing focus on the objectives of the training, the presentation of the material can be provided in an interactive and engaging manner. The discovery learning approach, with a focus on experiential learning theory, provides the students with the opportunity to achieve the higher order thinking skills identified within the IALA VTS Training model course. Table 1 provides an overview of the physical training space requirements and opportunities to address these in the online environment and the approach used in the AMCS VTS Online Training.

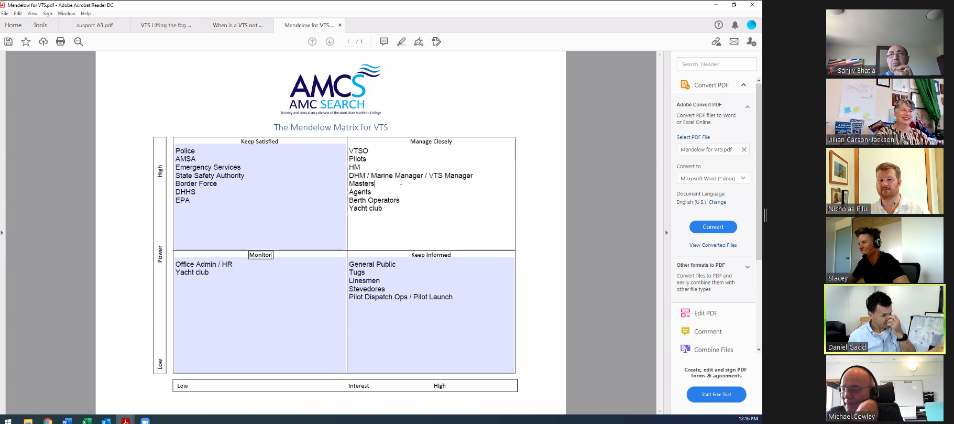


Figure 4: Online interaction – building a Mendelow Matrix for stakeholder engagement, AMCS VTS Supervisor Training, December 2020

Table 1 Physical training requirements with Online Training equivalent

| Physical Training | Online Equivalent | Tool used in online VTS Course |
| --- | --- | --- |
| For theory presentations / classroom activities | | |
| Learning Management System | Learning Management System | LMS ‘MyLo’ |
| Training space with reference materials | Virtual learning space with reference materials | LMS ‘MyLo’ with reference section updated for each course |
| Full classroom interaction | Virtual classroom with video and audio feeds | Zoom, including video, audio and chat box  Mentimeter polls, rating statements |
| Small group discussion / activities | Breakout room option within the virtual classroom tool | Zoom break out, students use tools available for share screen, annotate, chatbox |
| Brainstorming activities using white boards or flip charts | Whiteboard feature in virtual classroom too, Use of mindmap software shared online | mindjet mindmanager (results put into MSWord and then uploaded to MyLo) |
| Demonstration of information / sharing of ideas using white boards or Flip chart activities | Collaboration tools in virtual classroom tool - annotate feature / white board | Zoom annotate feature and white board feature (captured and included in ppts, which are then uploaded to MyLo) |
| Guest lecture / expert presenters | Guest lecture / expert presenters | Zoom (provides increased opportunity to access expertise) |
| Ongoing review of content presented and preparation for tests | Verbal and breakout room review activities, online ‘quizzes’ | Zoom, break out rooms  Kahoot quizzes prior to each test |
| Interaction / sense of being part of a cohort (incidental learning during breaks, after hours) | Opportunities for interaction, sharing of knowledge and experience | Zoom, including breakout rooms; group activities; building in ‘fun’ to course  What’s App group for out-of-hours interaction (also used to support technical issues when they arise) |
| For simulation training | | |
| Simulated VTS Decision Support Tool | Simulated VTS Decision Support Tool | Wartsila cloud based VTS simulator |
| Simulated VHF radio | Simulated VHF radio | Zello (free app for smart devices) |
| Simulated telephone lines | Simulated telephone line | Skype (free app for smart devices or computer) |
| Time of day activities – adjustable clock in simulator | Time of day activities | Microsoft XNote Stopwatch / related ‘time’ app that can set custom time (free app for smart device or computer) |
| Training spaces for:   * VTS Centre * Simulation control room * Outside world / Port Team | Breakout rooms for:   * VTS Centre * Simulation control room * Outside world / Port Team | Zoom (set up of breakout rooms for each simulation activity) |
| Peer Monitor (Student as Peer Monitor sits in the VTS Centre and monitors the activity, making notes as per Peer Monitor Form ) | Peer Monitor (Student as Peer Monitor monitors the activity in the VTS Centre, making notes as per Peer Monitor Form ) | Zoom (peer monitor placed in the VTS Centre, student being monitored shares their screen, peer monitor listens to VHF communications on the identified channel using Zello, making notes on the Peer Monitor form) |

## Benefits of online training

There are many benefits to online training, including: accessibility, flexibility, time and cost benefits, and support for diversity, equity and inclusion. These benefits have been seen in the online VTS training:

**Accessibility**: One of the most significant benefits of online VTS training is accessibility. Online training allows trainees to access training materials from anywhere in the world, as long as they have an internet connection. This is particularly beneficial for trainees who may not have access to training facilities or who are unable to travel due to restrictions. As VTS is a shift-work environment, the impact of time zones was minimized by the concept of doing training on ‘night shift’ or ‘morning shift’. During the courses students share their own tips and tricks to manage their fatigue.

**Flexibility**: The flexible access to VTS training provides an opportunity for global participation. With the online training provided through the AMC Search, for example, students cohorts for VTS training have included all areas of Australia working with students from Brazil, Papua New Guinea and Saudi Arabia. The sharing of experiences from across the globe supports consistent provision of VTS based on the international standards and best practices.

**Time and Cost benefits**: Online VTS training can offer overall cost savings. Without the need for travel, accommodation, and other associated expenses, online training can be significantly cheaper than in-person training. Time is saved through travel to/from the training centre. For instructors, the increased use of automated marking tools can assist in managing the time to ensure focused online interactions.

**Support for DEI:** The accessible nature of online training can support diversity, equity and inclusion for students who may be limited in travel due to carer duties or health issues. The use of multiple engagement tools can be less confronting to some learners, who may have language difficulties. Through peer-to-peer interaction, students can develop networks that remain after the training has been completed.

While technical challenges do arise and are recognised, the VTSO already deals with a significant amount of technology – including the DST with fused data from radar and AIS, radio and recording tools, logkeeping applications and more. One of the ‘incidental’ learning outcomes of the training online is increased digital intelligence and confidence. Comments from both learners and organisations for the online training continue to be positive (Figure 4)

The benefits of online training continue to be realized in the post-pandemic environment. Learning from the challenges of the covid ‘pivot’ we are able to make use of technology to respond to the demand for maritime education and training.

*“Very comprehensive and kept interesting for the entire workshop. [I] Struggled with the technology at first, but got into the swing.” (VTS Training participant)*

*“It allowed our staff to interact with and learn from students and instructors from around the country. We found the simulation component just as engaging as in person training and were very impressed with the standard of the overall product.” (VTS Provider)*

Figure 4: Comments from students VTS Provider regarding the online VTS training

# Accreditation and approval for online training

The accreditation of training is a fundamental component in MET. Specifically, for VTS, accreditation and approval are critical components of Vessel Traffic Services (VTS) training, as outlined in IALA Guideline 1014. The accreditation for the training organisation, with approval for each of the specific training programs, has been developed to ensure that trainees receive a high-quality education and that training programs meet international best practice and industry standards.

*“Accreditation is the formal endorsement by a competent authority that a training organization operates under a quality management system to deliver effective training”* [9]

Accreditation and approval of online training should continue to reflect the same process as for ‘physical’ training, with audits including:

* Leadership and commitment
* Policies
* Risk management, including actions to identify and address risks and opportunities
* Educational organisation objectives
* Resources, competence and awareness
* Planning and monitoring
* Training material development, documentation
* Delivery
* Continuous improvement

The accreditation and approval process for online training is therefore consistent with the accreditation and approval process for ‘physical’ training programs. The revision of IALA G1014 includes reference to the use of online simulation technology. Noting the increased implementation of online training technologies, it is proposed that the IALA VTS Committee prepare guidance on remote training in VTS during the 2023-2027 work programme.

# Conclusions

In conclusion, technological developments have played a vital role in facilitating maritime training during the pandemic. By enabling remote and virtual learning environments, cloud-based simulation, augmented reality, and remote assessment tools, technology has helped to ensure that maritime training continues to meet the highest standards of safety and efficiency. As the maritime industry continues to evolve, ongoing investment in technology development will be critical to ensuring that training programs continue to reflect clearly identified objectives, are delivered in a manner that meets the needs of the students and the industry, and are accessible to all.

Online training, like any training program, requires careful consideration of the objectives and approaches taken. Within the online environment, the concept of STICK – sequence, technology, interaction, content and knowledge transfer – is critical. Through effective integration of different tools to address specific learning outcomes there is opportunity to develop training programs that are engaging and appropriate to meet the required competence levels.

Looking ahead, the maritime industry is facing an ongoing challenge to provide training in a world that has changed due to the global pandemic. While online training offers many benefits, such as accessibility, flexibility, and cost-effectiveness, it also poses challenges that need to be addressed, including technology access, bandwidth requirements and instructor skill sets. However, with the right tools and interactive facilitation, online training can provide a viable alternative to traditional ‘in the physical’ training. As the industry continues to embrace digitalisation, it is likely that online training will become an increasingly important part of maritime education and training.

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