
Next generation of life Saving appliances and systems for saFE and swift evacuation operations on high capacity PASSenger ships in extreme scenarios and conditions

MG-2-2-2018 Marine Accident Response No. 815146

# D3.3 Report on Recommendations on Alternative Methods of Training

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[1] **R**=Document, report; **DEM**=Demonstrator, pilot, prototype; **DEC**=website, patent fillings, videos, etc.; **OTHER**=other

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# Acronyms and Abbreviations

| | |
|---|---|
| **LSA** | Life Saving Appliances |
| **VR** | Virtual Reality |
| **AR** | Augmented Reality |
| **PSE** | Personal Survival Equipment |
| **MES** | Marine Evacuation System |
| **SOLAS** | International convention for the Safety of Lives At Sea. |
| **STCW** | Standards of Training, Certification and Watchkeeping |
| **DL** | Davit Launched Liferaft |
| **RCCL** | Royal Caribbean Cruise Lines |
| **VIK** | Viking |

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## Executive Summary

One of SafePASS project's primary focus is to make the next generation of life saving appliances for large passenger vessels safer and more efficient. As part of the product development process, training of crew members is a critical aspect, which must be addressed. Not only to update the crew with regard to new products and the products onboard their particular vessel, but to reduce the potential human errors by having the right tools to deliver effective training such that competent and well-trained personnel can ensure appropriate response to emergencies and safe evacuation.

The implementation of technology has been applied to the training environment in order to provide a safe learning environment, along with improving the learning experience, with skill development and knowledge retention as key indicators to the effectiveness of training. The aim is to make training time more valuable and less risky for all persons involved.

This report reviews the current state of training in the marine industry and also identifies possible alternative methods and technologies that will close the identified gaps, by providing training which is engaging more effectively with the trainee.

# 1. Introduction

## 1.1 Background

SafePASS is concerned with the requirements to identify the methods of the swift, safe and effective methods to evacuate passengers from the future high capacity large passenger ships in extreme scenarios and conditions.

Survitec is a member of the consortium, which includes other LSA and PSE manufacturers, users of LSA (Lifesaving Appliances) and PSE (Personal Survival Equipment), vessel owners, academia and members of Classification Societies and Flag States. In parallel with developing new LSA & PSE prototypes, training of the crew and passengers in the use of the equipment onboard was identified as an area which had the potential to adopt new approaches and methodologies to learning.

The objectives of Work Package 3 within the SafePASS Project include the expansion of the LSA training in order to incorporate procedures regarding evacuation, deployment and use. This includes training for extreme scenarios (fire, flooding, evacuation in damage conditions) and also "training for failure"– allowing for the Crew to deal with failures of equipment during the training exercise without risk to them or the equipment. Simulating these potentially hazardous conditions is difficult, therefore alternative methods need to be adopted, in order to train people safely while giving them a real understanding of the equipment.

Training is more effective when repeated frequently and is as close to the real situation as possible. This causes problems to the LSA training procedures in several different forms, due to:

- The number of people required to deliver a physical abandonment drill.
- The availability of equipment to train frequently.
- The practicality of repeatedly deploying LSA equipment fitted to a vessel.
- The wear and tear on the LSA equipment during training.
- The risk of human error during recommissioning the LSA after the training.

## 1.2 Purpose and scope

The purpose of the review is understanding how to achieve the best training for all those involved in order to carry out safer evacuations as a core workstream of the SafePASS programme. Such training is to include "training for failure" and to consider adverse conditions such as flooding/fire and equipment failure.

The training scenarios will look at the following types of LSA and how the training can be made more effective for each of them.

The LSA types are:

- LSA that can be launched and recovered repeatedly, such as rigid lifeboats.
- LSA equipment such as MES (Marine Evacuation System), which cannot be repeatedly deployed.

This deliverable will also support and guide the work being carried out in WP4 that is developing training tools primarily based around “app” technology.

The main user groups (stakeholders) that need to use the Life Saving Appliances (LSA) in the event of an emergency, that form part of the SafePASS project, are listed as follows:

- Passenger/Guest
- Ship/Vessel Crew – No nominated duties
- Ship/Vessel Crew – Assigned duties for LSA
- Ship/Vessel Crew – Assigned duties for deployment and operation at sea of LSA
- Ship/Vessel Decision Support Group/Command Group – Responsible for issuing the command to deploy LSA and/or abandon ship
- Ship/Vessel LSA Maintainer.

These groups will require different training content, volume and methods. The focus of this report will be on the ship-based crew members and their roles of:

- Maintaining the LSA. This will include training in the maintenance of all types of LSA on the vessel through practical demonstrations. The use of “shadowing” and “hands-on” practical demonstrations are particularly important in this respect.
- Making ready and deploying the LSA in an Emergency. The use of new technologies such as AR, VR and interactive videos will be particularly valuable to trainees to gain an understanding of the equipment in 3D where accessing the equipment is not possible. This will also include “training for failure”.
- Boarding the passengers. Training in the process of passenger accessing and boarding LSA, where new vessels will include MES and inflatable lifeboat systems which cannot be repeatedly deployed, will need to use new training technologies for trainees to gain full understanding of the challenges involved.
- Escaping from the vessel in distress. Training in this aspect of LSA will incorporate “training for failure”.

## 1.3 Approach

This study has been conducted using a combination of methods:

- Desk based research, which involves collecting data from existing resources hence it is often considered a rapid technique as compared to field research, which can become protracted. This approach has been selected because of the ability to gather a wide range of information across different industry sectors.
- Focus groups. The use of focus groups is a research method that is intended to collect data, through interactive and directed discussions by a researcher, which has been used to obtain the in-depth knowledge of the current industry status regarding training methods.

- Also, current training materials have been collected and reviewed to build a rounded picture of what is used to train personnel in areas directly related to LSA deployment.

# 2. Report on Training

## 2.1 Current Training

Training courses for the crew are typically delivered in two different locations – onboard the vessel or at a number of specialised centres, which offer training in the safe, swift and effective use of LSA and PSE.

These centre-based courses cover a range of different equipment types. The equipment typically includes a generic range of LSA and not specifically those on-board the vessels that the crew will be working on including:

- Inflatable Life rafts - Throw over and Davit Launched (DL) types
- Marine Evacuation Systems (MES)
- Lifeboats (twin fall), including davits and launching equipment
- Fast Rescue Boats, including davits and launching equipment
- Personal Safety Equipment, including Lifejackets and Survival/Immersion Suits.

The training that occurs onboard will be specific for the equipment installed onboard that particular vessel.

The majority of current training is conducted with methods that have remained unchanged for some time. The primary delivery method is classroom-based content with some basic demonstrations. Generally, this has limited interaction from the trainees and relies on basic audio and visual equipment to deliver the training.

The classroom learning is often paired with “hands on” practical demonstrations of use and location of the equipment. If conducted on vessel, then the location of the LSA and expected location of personnel can be included. This type of hands-on training can include the deployment of the equipment where possible – launching a lifeboat or a DL life raft, or occasionally the MES.

Some training packages have been put together to allow interaction from the learner. These are typically software-based refresher courses that can be accessed from a PC. The learner will be given the lesson’s content followed by questioning to ensure the information has been retained.

There are some instances of simulator-based training methods being used, however these are limited in number for the LSA applications. To date, these have been generally used for LSA training in the Offshore Sector. Simulator training is used extensively for Bridge and Engine Room training.

Within the SOLAS code, there is the requirement that all personnel on vessels at sea must undertake Standards of Training, Certification and Watchkeeping (STCW) training. STCW training is conducted in a tiered approach, with personnel taking part in the level of training that matches their position on board. Generally, increased responsibility requires an increase in the level of knowledge that the person is expected to have of various different systems, procedures and products, including LSA and PSE. The training is designed to prepare personnel for safe and effective use of LSA starting with basic use of PSE and ranging up to the management of whole vessel LSA systems.

There are currently limited methods to confirm the quality and content of training conducted at land-based institutions. The challenge in this respect is to establish and maintain a high quality and level of training to increase safety in all aspects of LSA deployment and safe evacuation. With a large range of safety products on the market, combined with developments in procedure and product, training can often be outdated if not conducted by the correct training school. Furthermore, it is evident that some STCW courses only carry out limited training in MES systems, which may be largely due to there being poorly defined requirements for this aspect of training.

LSA manufacturers often use service staff to conduct product training whilst on a vessel. Whilst this is an efficient use of personnel, it can result in training that is not always of the highest standard. This can be due to a range of reasons; allocated time (limited time when trainer onboard between other duties), trainer competence, training resources, training environment, training methods and languages spoken.

In other areas of training, crew currently take part in on-line software type training. Onboard a vessel, there is also allotted multi-use training rooms incorporated into the vessel design to allow for small groups of crews to be trained together. This typical could be rest rooms, meaning they will not be best suited to training and learning.

In summary, the majority of training is conducted in a “classroom” environment with limited learner interaction. Some practical “hands on” equipment is possible; however, this is often limited. There are cases of poor awareness of recent developments in training methods, materials and technologies. Trainers are can be under prepared, time bound, and under trained in the most appropriate teaching methods.

## 2.2 Gaps and Shortcomings

### 2.2.1 Identifying gaps and shortcomings in the current methods of training and their causes

During a focus group discussion, there were several key topics that emerged concerning the positives and negatives of the current training situation. These are captured in the following text. Typically, the OEM training courses are led by the service engineering staff, who are technically trained for the service and fitment of the systems. However, they are not normally educated in teaching, therefore the quality of the training can vary. Time restrictions also hamper training sessions, with both trainer and crew members having pressure on their time. Making optimum use of the allotted training time can be challenging and it should be considered that it is incumbent on vessel operators to allow allocated time for training while vessels are in port.

The majority of LSA training programs either have not or are late adopters of technology beyond audio and visual presentations. There are some examples of software-based training programs, however these are limited in number. The main use case for software type training is for the periodic refreshment of an already trained person.

All MES systems currently make use of inflatable structures to allow for vastly reduced stowage space. The consequence of this is that the Systems are not regularly deployed, as they are only required to be deployed once every 5 years. This means that crew members on a vessel fitted with 2 MES are not able to participate in regular training sessions which see the system deployed and fully operational. In this instance with 2 MES onboard, there is only the opportunity to take part in a deployment on average every 2 or 3 years. This results in a skill, knowledge and training gap which has been identified by operators and requires attention. It is also noted that MES deployments cannot be repeated in short time frames, therefore the opportunity for staff to conduct deployment tasks is almost non-existent, other than with the training equipment provided by the OEM.

Current abandonment training does not represent the real-world situation due to the lack of dynamic crowd management. The current state is to receive crowd management training as a separate generalized module. Safety officers have raised the concern that there is a need for improving crew preparedness for the situation that would be expected in a real-world abandonment. This includes a large crowd of passengers to be seated into a lifeboat whilst in an agitated/stressful state, potentially whilst experiencing adverse environmental conditions.

There is an additional space requirement for the training aids on board vessels. This space needs to be considered with the naval architects during the design phase. Attempting to achieve it as an add-on results in poor user interaction and therefore reduction in training effectiveness.

Typically, training for lifeboat and other outdoor activities is conducted in favorable weather conditions whilst alongside a quay. Training in this way can lead to poor performance in a real-world situation. If an abandonment is to happen, it is very unlikely to be in favorable conditions, therefore the ability to prepare crew for such situations should be a requirement of future training.

There is a misconception amongst some vessel training crew, that if a crew member has completed a training session that involves the decent of a MES chute or slide passage, this means that they are ready to operate a full MES system. The action of descending a chute is simply part of the tasks involved in deploying and evacuating through a MES system.

Currently the LSA training requirements defined in SOLAS Chapter III and the STCW code are not uniformly applied across all flag states and it is considered that a more unified approach, including enforcement, is required. The operators in the focus group expressed that the type of assessment process currently used in training is outdated and has plenty of scope for improving its effectiveness in delivering the required knowledge. With a traditional “exit exam” type approach, the ability to address any missed learning is lost because topics are harder to revisit after the completion of the training event, whereas a continuous assessment approach would allow for small adjustments to the training content to ensure that all topics are correctly addressed.

There were also positive points about the current state of training. The physical hands-on type approach to lifeboat preparing and launching are favored by training staff. This not only allows crew members to repeat actions in an identical manner to the calm “real world”, but it also improves knowledge retention through muscle memory.

In addition, complex parts and processes can be clearly explained and demonstrated during a lifeboat launch, as it is normally a sequence of events to be completed by the crew, whereas deploying an MES normally requires one action to trigger the complete deployment. The slower step by step approach also can reduce the “fear factor” of doing tasks for the first time, such as descending an MES chute.

A study conducted by UK MCA and submitted to IMO in 2012 highlighted seven main root causes for lifeboat accidents, four of these can be linked to failures in crew training for the deployment and use of LSA equipment. The key areas which were highlighted were:

- Inadvertent operation of on-load release mechanism
- Communication failures
- Lack of familiarity with lifeboats, davits, equipment and associated controls
- Unsafe practices during lifeboat drills and inspections.

During the SafePASS plenary meeting in Glasgow (January 2020), it became clear that there is the need to ensure the crew regularly have hands-on training with all the equipment types onboard. Ideally suitable and appropriate training equipment should be stored onboard, so that crew is confident in the use of the LSA and PSE. This is to be backed up with the crew confidence that the live equipment is identical to the equipment they are training with and will reliably work when required.

Standards of Training, Certification and Watchkeeping (STCW) courses cover a very broad range of topics. It has been identified that due to this broad but shallow approach to training, there are errors in equipment usage. This highlights a key area of improvement that should be addressed in future training.

### 2.2.2 Interim Summary

In summary, the main causes of the gaps and deficiencies in training are found to be:

- Low frequency of physical deployment of MES.
  Crowd management at the LSA during abandonment needs to be improved.
- Not possible to repeat MES deployments on the vessel.
- Additional physical space required for training aids onboard (MES).
- Environmental conditions for LSA training are not representative of “real world”.
- There are no statutory requirements for training frequency.
- There is the misconception that descending a MES chute is equivalent to full training in the operation of an MES.
- The normally limited space around the controls of the LSA for launching or deployment mean that only a small number of the Crew will actually witness the key activities.

Whilst the positives are found to be physical hands-on practice with equipment, allowing for complex parts to be clearly explained, and davit preparation that can be repeated to ensure learning.

Using MES training chutes, where they are installed onboard, reduces the possible "fear factor" associated with a MES. In addition, there are clear areas for improvement such as:

- Providing the time, equipment, space and funding for training environments that prepare crew for a "real world" situation.
- Establishing a Training Programme that provides a real understanding of the challenges of Evacuation and deployment of LSA in real, adverse vessel and sea conditions. Through the agreement of an international standard for assessing and issuing certification for training, it should be possible to mitigate against training schools that are not conforming.

## 2.3 Potential Technologies and Methods

### 2.3.1 Technologies

The goal of using new technologies in training is to both increase competence of trainees, but also to reduce risk associated with LSA deployment and therefore alternatives must be found. There is a range of different technologies that could be applied to training for LSA, and these are introduced in the following paragraphs.

#### 2.3.1.1 Augmented Reality (AR)

Augmented reality (AR) is an interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, haptic, somatosensory and olfactory (Huffington Post, 2016[3]). An example of the technology in the consumer market is the IKEA Place app[4]. The smart phone app made use of the camera and maps functions to augment products from the IKEA catalog into customers rooms. With the functionality to add multiple products, a customer can design the layout of the room before making any physical purchases.

There are different types of Augmented Reality, which can be utilised in different ways to meet LSA training needs. Overall, AR can turn the ordinary classroom type training experience into an engaging experience, as it increases trainee's knowledge retention and speed of learning and overall increases engagement. AR allows trainees to bring 3D objects into a classroom and can be used as gamification.

**Marker-based AR:** This is one of the most utilised types of AR. It uses a trigger object (for instance: a QR code, product packaging or your logo) to generate an augmented element.

[3] http://images.huffingtonpost.com/2016-05-13-1463155843-8474094-AR_history_timeline.jpg

[4] https://www.digitaltrends.com/home/ikea-place-ar/

**Marker-less AR**: As the name suggests, this type of AR does not rely on a trigger object. Instead, the augmented element activates when other criteria are met (for instance, based on GPS location data associated with your device), like the above-mentioned IKEA app.

**Outlining or Superimposition AR:** As it might be expected, this type of AR uses image recognition to digitally highlight sections of the real world. For instance, it could be used to identify patterns within an image, or to provide digital fold-lines on a piece of paper to aid budding origami practitioners (growtheengineering.co.uk, Feb 2020).

This type of application could be particularly useful for the Maintenance team, which can have information about the components they are checking, displayed automatically or a step-by reassembly procedure displayed.

There are examples of AR being used for training in sectors outside of maritime with positive results. One such case is DAQRI company, which have partnered with companies such as Amazon, IBM and Oracle to create bespoke AR functionality, allowing the workforce to improve efficiency rates and training (DAQRI.com[5]). Their system of smart glasses has been integrated into shop solutions, using marker-based technology to provide additional information in live stream for operators.


Figure 1: AR based machine maintenance, Daqri

The above-mentioned AR methods would be best placed to assist with the training of crew involved in the service and maintenance of LSA systems. It could also be used with certain aspects of deployment training, where the added advantage is that operators have information that is easy to understand, readily available., whilst they can continue to complete the tasks required.

#### 2.3.1.2 Virtual Reality (VR) (Immersive Simulators)

Immersive simulators have been in use for ship bridge training for many years, ranging from desktop to full scale bridge simulators. The simulators allow for a range of

[5] https://www.daqri.com/partners/ , (accessed April 2020)

training topics, including collaborative exercises between linked simulators. One example is Force Technology, that produce full scale bridge simulators. These simulators can be found at training academic institutions, with the functionality to replicate a range of vessels, environments and locations. They are used to train crew members in decision making, vessel control and navigation. There is also the functionality to link simulators and create multiple vessels working in the same scenario.

Figure 2: Full Bridge simulator, Force Technology[6]

For MES style systems, the crew member is required to do a larger amount of movement around the environment. A solution to this for on-vessel training could be to make use of a system such as the KAT walk ODT (omni directional treadmill). This system allows the trainee to move around in any direction whilst immersed in the virtual training environment. Also, it allows various actions/ positions to be adopted. A negative to this system is the lack of co-operation due to the single user interface. However, its relatively small size is of large benefit onboard vessels, due to space being a premium asset.

[6] https://forcetechnology.com/en/services/ship-bridge-simulators, (accessed April 2020)

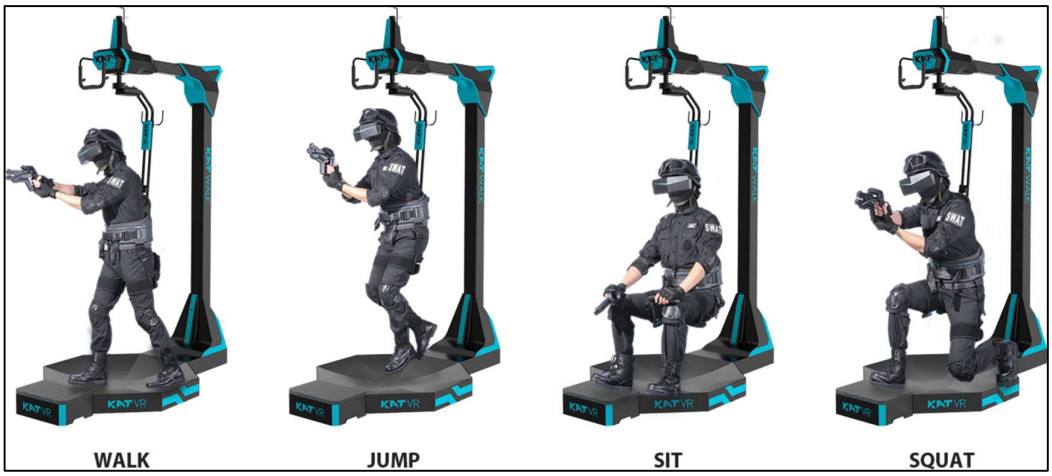


Figure 3 KAT Walk VR equipment[7]

Another example of a simulator that provides recognised levels of training is provided by Virtual Marine. They offer a range of products that make use of VR to train personnel, including mustering, lifeboat preparation, life boat launch and lifeboat coxswain training. Virtual Marine's lifeboat simulators are globally certified by Det Norske Veritas (DNV) and are recognized by the International Maritime Organization's (IMO) STCW and MODU Codes. A 2017 Canadian research study undertaken to evaluate available training alternatives revealed that the likelihood of an error-free launch on the first attempt under average emergency conditions that the skills maintained in simulated emergency conditions was highest for those that practice with a simulator in representative emergency scenario, compared to those who practiced in calm conditions or with classroom based training (Virtualmarine.com[8]).


Figure 4: Virtual lifeboat simulator, Virtual Marine

[7] https://www.kat-vr.com/products/kat-walk-vr-treadmill

[8] https://www.virtualmarine.ca/, (accessed April 2020)

VR (Virtual Reality) technology normally presents images on a screen in a mock-up of the working environment, so that the trainees get a realistic view as practical, while allowing to drill for multiple scenarios. Trainees can be immersed in the equipment and can be trained to engage in more complex tasks. Another example of VR technology is the flight simulators to train pilots. VR technology could be beneficially applied to procedures in evacuation and LSA launching etc., where real-life scenarios, for example fire and smoke and flooding and extreme listing, could allow students to be immersed in a simulated world without the need to expose them to danger (e.g. exposing them by using training facilities of list and fire etc.).

#### 2.3.1.3 Digital Work Instructions

Examples of digital work instructions can be found in the manufacturing and service sector. This often takes the form of an app for the computer or tablet, where the user is guided through a procedure that is not frequently done. The idea is that the pictorial/visual work instructions reduce the likelihood of human error. The digital part of this approach allows for animated actions, video clip attachment and direct entry of sign offs for completed works. The digital approach means that the training or the routines can be monitored by a trainer, as well as the key maintenance steps, either manually with a sign off stage or by uploaded a photograph of the completed action.

Case studies from Dozuki indicate this type of approach to be successful. Other software platforms which can generate Digital Work Instructions, appropriate for SafePASS, are training platforms such as Synap, Eloomi, Absorb LMS.

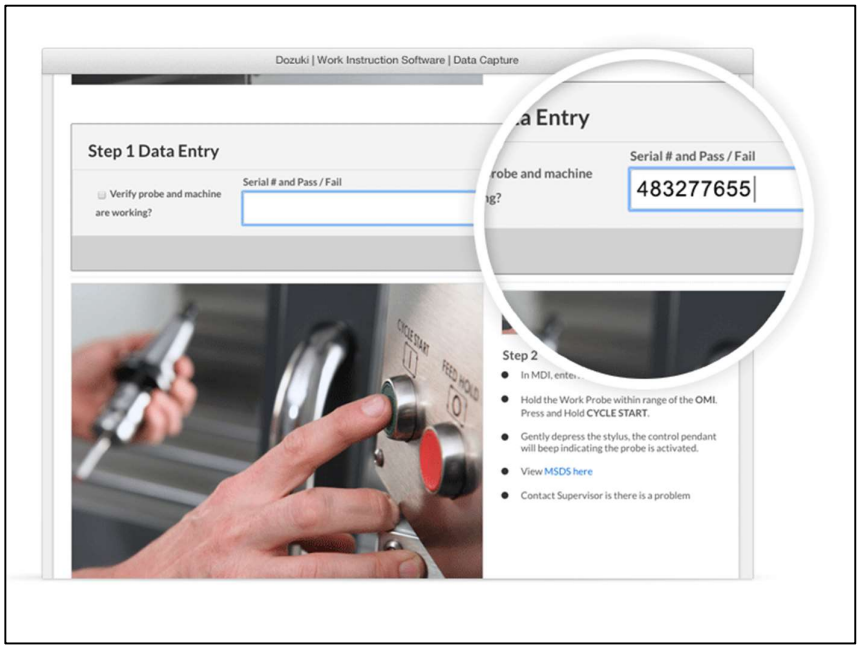


Figure 5: Digital work instructions, Dozuki[9]

[9] www.dozuki.co, (accessed April 2020)

#### 2.3.1.4 Authentic Certification

Issuing of genuine training certification has also been highlighted as a possible issue in connection with STCW training. A robust and proven solution to this is block chain. Blockchain is a reliable, difficult-to-hack record of transactions – and of who owns what. Blockchain is based on distributed ledger technology, which securely records information across a peer-to-peer network. Although it was originally created for trading Bitcoin, blockchain's potential reaches far beyond cryptocurrency. Blockchain ledgers can include land titles, loans, identities, logistics manifests – almost anything of value. The technology is still new, but the potential impact it can have on business is exciting and immense.

A distributed ledger is a database of transactions that is shared and synchronized across multiple computers and locations – without centralized control. Each party owns an identical copy of the record, which is automatically updated as soon as any additions are made. This could be particularly useful for online training materials, maintenance instructions etc., ensuring that they are always current and up to date.

Approved data is entered into the ledger as a collection of "blocks" and stored in a chronological "chain" that cannot be altered (sap.com[10]). This ensures that the data is always secure and that a revision history can be clearly seen.

Through the use of block chain, it is possible to verify any documentation used throughout the training supply chain. Evernym is open example of an enterprise-scale digital verifiable certificate system that uses blockchain to ensure encryption. This can be for entering and storing ID through to issuing of newly generated certification.


Figure 6: Secure Certification, Evernym[11]

[10] https://www.sap.com/insights/what-is-blockchain.html

[11] https://www.evernym.com/products/

### 2.3.2 Methods

This section will gather the potential technologies and methods for the improvement of LSA training and learning. There are several modern approaches to Training Delivery which are detailed in the following section.

#### 2.3.2.1 Shadowing

> *"75% of manufacturers view "on the floor pairing" or shadowing as the most effective way to train workers, followed by a paltry 15% for classroom methods"* (The state of Industrial Augmented Reality 2019, Campbell et al. Ptc.com)

As the majority of current LSA training has a large bias towards classroom-based methods, changing this approach so that the focus is on "shadowing" will improve the training quality and delivery. This style of training lends itself to the servicing and routine checks of an LSA opposed to the deployment of the equipment. Nonetheless, utilizing the methodology would be of benefit to deployment training, if there is sufficient space/visibility or the equipment has a "Training Mode" associated with it.

#### 2.3.2.2 Gamification

Gamification is the use of game mechanics and game dynamics to drive game-like engagements and actions in a non-game setting. As a teaching tool, gamification applies game mechanics, game dynamics and frameworks to promote desired learning behaviors (Tu, Sujo-Montes, & Yen, 2015).

Gamification has proven to be a very effective method to engage and motivate learners, improving delivery due to their extensive interactive involvement with the training aid (Morschheuser et. al, 2017). Leveraging this type of teaching programme would enable crew to be trained in a "learner–led" and "own-pace environment". One example of this is the "Save the children – field managers" development programme. This programmed allowed for rapid training of field managers, for the complex scenarios involved with managing, recruiting and solving problems during humanitarian crisis.

Gamification has been shown to increase learner retention and engagement.

*"Overall, the results indicated significant, small positive effects of gamification on cognitive, motivational and behavioral learning outcomes. These findings provide evidence that gamification benefits learning and they are in line with the theory of gamified learning."*

EI Design is one example of how employee training can be effectively gamified, where employees make their way through a city environment completing "levels" to accomplish the full training programme.


Figure 7: Gamified employee training, EI Design[12]

### 2.3.2.3 Tiered Training

A tiered approach to training is now recognised as being fundamental as a tool in setting up and matching training needs to the trainees, both for those being trained as well as the trainers themselves.

Training for LSA should be based on the Three Tier "Training needs assessment" (McGehee and Thayner, 1961). Within the SafePASS project, the approach to training can be analysed and divided up as follows:

- ***Organisational Analysis.*** - This defines where the training is needed within the "organisation" i.e. within the SafePASS community involved in the safe and efficient use of the LSA. This will identify potential trainee and trainer groups.
- ***Operational Analysis.*** - This defines what the training should consist of, in order for those different groups identified above to be perform to a standard of maximum efficiency and safety.
- ***Man Analysis.*** - This determines who needs to be trained in the groups defined in and the skills and knowledge needed and where their training needs to be added to or improved, which has resulted in the following suggested approach.

An approach to the levels of training required for LSA can use a tiered approach such as shown in the Table 1 below. This table indicates how different methods and technologies can be applied to training and the benefits and challenges associated with them. The six types of training technologies and methods which are described in this section are as follows:

*A = Shadowing and Hands-on experiences*

*B= Gamification*

[12] https://www.eidesign.net/how-personalized-gamification-can-increase-learner-engagement , (accessed April 2020)

*C= Augmented Reality (AR) for Immersive Deployment Training*

*D= AR for Service and immersive maintenance-based requirements*

*E=Virtual Reality (VR) for Immersive Deployment Training*

*F=VR for Service and immersive maintenance-based requirements*

Table 1: Tiered training for LSA

| TIER | Applicable Stakeholders and Trainees | Description of level of Training | Applicable new technology and method to be used | Benefits (B)and/or challenges (C) |
|---|---|---|---|---|
| **T1** | Passenger/Guest with no previous experience | **Entry level.** All must undertake T1 Awareness Training of all LSA as generic | C/B and use of small scale models | (B) Achieves good overall understanding of generic LSA.<br>(C) Space availability and equipment. |
| **T2** | Ship/Vessel Crew without nominated duties | **Beginner Training Level**. Training in LSA applicable to the vessel LSA on which they will serve. | C/B/E/A and practical experience with vessel's LSA | (B) Produces a level of competency in all the ship's LSA.<br>(C) Investment in VR. |
| **T3** | Ship/Vessel Crew with assigned duties for LSA during emergency procedures and launching | **Intermediate Training Level (1)** which will train crew in the LSA currently on the vessel for safe evacuation into LSA. | A/B/C/E and use of E particularly important. Rigid lifeboats and rescue craft launch training | (B) Provides practical understanding of ship's LSA launching.<br>(C) Availability of lifeboat and launching equipment. |
| **T4** | Ship/Vessel Crew with assigned duties of LSA at sea, post launching | **Intermediate Training Level (2)** which will train those with responsibilities for the control of the LSA at sea. | A/B/C /E and use of E particularly important. Rigid rescue craft training at sea | (B) Immersive VR provides "hands-on" experience of LSA control at sea.<br>(C) none |
| **T5** | Ship/Vessel Decision Support Group/Command Group | **High Level Training**. Training in embarkation, crowd control and system limitations. Training for system failure. | B/C/E. Specialised VR training in crowd control and systems failure etc. | (B) Immersive VR training to include system failure etc.<br>(C) None |

| | | | | |
|---|---|---|---|---|
| **M1** | Ship/Vessel LSA Maintainers | Training in maintain/ monitor/ inspect of LSA | A/D/F with specialized, bespoke VR. | |
| **IE** | LSA Installation Engineers | Responsible Engineer for LSA installation to be trained in conjunction with M1 | A/D/F with specialized, bespoke VR. | |

#### 2.3.2.4 Blended Learning

Blended learning (also known as hybrid learning) is a method of teaching that integrates technology and digital media with traditional instructor-led classroom activities, giving students more flexibility to customize their learning experiences.

Although there are 4 basic models of blended learning, the possibilities are endless when it comes to the ways in which instructional technologies can be blended into a teacher's pedagogical approach. The flipped classroom, for example, is one type of blended learning model in which students view lecture material prior to class, then spend class time engaging in exercises under the supervision of the teacher. Other examples include: Station rotation, Enriched virtual, Flex learning, project-based blended learning.

In general, blended learning refers to the following:

- Some learning happens online in a format where the student has control over the path and pace at which they engage with content.
- Some learning happens in an instructor-led classroom.
- Online and in-person learning is complementary, creating a truly integrated learning environment.

The power of blended learning methods lies in their ability to improve the student experience. Studies have shown "blended learning" reduces failure rates, improves learning and boosts engagement. Blended learning combines the best aspects of face-to-face teaching and online instruction in ways that enable students to learn at their own pace. For example, a student in a blended learning course who masters a concept earlier than his peers can move on without having to wait, and conversely, a student who needs more time is not forced to move forward before fully grasping the subject. It is proving to be a scalable learning model that simply works for diverse populations of students (panopto.com[13]).

#### 2.3.2.5 Role Play Training

With proper implementation, role plays can be a powerful tool in the training arsenal. Some of the advantages and disadvantages (pitfalls) are the following.

[13] https://www.panopto.com/blog/what-is-blended-learning/

Advantages:

- Role playing gives the learner a safe, low-stress, no-consequence environment to practice techniques before trying them out in their job.
- It can be used for evaluating potential job candidates or to evaluate progress and understanding of training concepts.
- It can be used by management or team leaders to focus on specific skills to see what areas need improvement in their staff.
- It allows team members to learn from other highly skilled colleagues by watching and copying techniques and receive real-time feedback on their actions.
- It allows learners to learn from both theory and practice, thus getting a more in-depth understanding of the target skill (ventureteambuilding.co.uk[14]).

Disadvantages and pitfalls:

- Many people feel uncomfortable in role play situations and even dread this part of the training.
- Inconsistent feedback from inexpert members can confuse and limit training growth. Effective roleplay facilitators should make use of highly skilled team members (experts in that field) to give constructive feedback to lower skilled members.
- Role play training takes a significant amount of time — preparation, doing the role play, providing feedback, debrief and review — but is often rushed and is not given the time it deserves. You can mitigate this by planning ahead and budgeting enough time.
- Many training sessions fail by having groups that are too large and dilute the amount of learning that could have occurred. The groups should be limited to 10-12 people (or half that) for best results.

### 2.3.3 Interim Summary

In Summary, the available technologies and training methods are wide, varied and are currently not applied to their full potential with the crew for training or maintenance routines. Training for use of LSA, particularly in extreme scenarios and adverse conditions, would greatly benefit from the use of VR to reducing the risk to crew whilst maintaining high levels of learning. Blended Learning would further improve the experience for both trainers and trainees, as it is a suitable mix of interactive activities, to reinforce the taught learning. Using programmes of training that involve “Learner-Led” and in an “own-pace” environment such as Gamification will improve the quality of delivery, due to its high levels of interaction. The issues around certification and verification of documents would benefit from the use of methods such as “Blockchain”, as it makes the activity more secure and controllable[15].

[14] https://www.ventureteambuilding.co.uk/role-play-training/#.XrIVzfZFx9A

[15] https://www.blockchain-council.org/blockchain/document-verification-system-using-blockchain

As there are many different aspects to training for LSA use, along with many different user categories, based on the research, the ideal scenario is a tiered approach to training combined with gamification, which would provide the optimum program in which to use the above-mentioned technologies. The different training groups would make use of the most relevant technologies for them to provide a most effective blended learning experience.

# 3. Conclusion and Recommendations

## 3.1 Conclusion

This report has investigated what is required to achieve a step change in training for LSA use on large passenger vessels. Starting with the current state of training, there were several gaps that were identified. These gaps ranged from underperforming training sessions to low frequency of physical deployment training.

To overcome these gaps, a range of methods and technologies were identified. Methods such as tiered training and role play are simple to implement. However, creating a gamified approach to a training program will require a larger body of work. The technology that has been identified for adding the most valuable to the training program is AR for hard shell LSA deployment and on-board maintenance, whilst MES type LSA systems would see the greatest value from a more immersive experience provided by VR. These technologies will only produce added value when combined with blended learning. This will enable learner-led and individual focus to training, improving skill and knowledge retention, ultimately leading to improved crew performance. However, introducing these new technologies carries a cost and it is vital that the industry as a whole understands the level of cost and the resulting need for investment to ensure that the higher standard of training can be achieved.

In addition to the training content, it was identified that more robust measures are required for the issuing and recording of training. This can be solved through the combination of an internationally agreed training standard, alongside secure certification methods to reduce the possibility of falsified certification.

## 3.2 Recommendations

There are seven primary recommendations for the future training programmes of LSA. These recommendations look to overcome the gaps and deficiencies that occur in current training. The first six recommendations are concerned with the LSA and PSE identified in the SafePASS programme requirements, while recommendation (7) identifies additional life-saving equipment and procedures identified in SOLAS Chapter III, including novel alternative equipment that may be considered in the future or on other programmes.

### 3.2.1 Recommendation 1

LSA Training should make use of AR to assist where it is possible to make use of the physical LSA equipment. This will mean that the learner benefits from training content and physical actions simultaneously.

### 3.2.2 Recommendation 2

VR/ AR should be leveraged to provide scenarios that allow for failure of equipment or incorrect human actions. Through this methodology, it will be possible to keep crew safe, whilst they experience a realistic situation. Such immersive training can provide trainees with an improved understanding of challenges in a real-life scenario without the associated risk, also allowing the crew member to repeat actions which will result in improved embedment of learning.

### 3.2.3 Recommendation 3

By increasing trainee's involvement in gamification and role-play activities, training will achieve higher standards. Through these methods, trainees will become better acquainted with the challenges of safe and fast evacuation of a vessel.

### 3.2.4 Recommendation 4

The future training must be based on internationally accepted and accredited training courses, that will offer training to a high standard and will be utilised to achieve well trained and fully certificated trainees and trainers. These courses will be established using a tiered approach to accommodate the wide range of training requirements needed. In some cases, this will require investment in time, space and funding.

### 3.2.5 Recommendation 5

In order to overcome the current deficiencies in the control of training documentation and certification, a new system using an Auditable and secure Data Storage system is recommended. This will allow the control of all training documentation and certification and will overcome the current deficiencies, whereby there is no control over agreed training course documents and contents and particularly the issue of qualification certificates where bogus certificates can be issued by LSA service stations not qualified to do so.

### 3.2.6 Recommendation 6

As part of the SafePASS project, a work package has been established to create an application to assist in training for LSA. Work Package 4 will make use of the appropriate recommendations from this report as a starting point for the development of the application. It is considered that the key areas of focus will be the incorporation of AR technology, gamification of learning and a tiered approach to training.

### 3.2.7 Recommendation 7

Although training activities focus on the most frequently used LSA and Personal Safety Equipment, SOLAS chapter III Requirements for ships and life-saving appliances cover a much wider scope, including:

- Deployment and use of Embarkation ladders
- Deployment of lifebuoys and EPIRBs
- Survival craft mustering / marshalling of liferafts
- Means of rescue (ro-ro passenger ships)
- Detection (i.e. determination of the location of survivors or survival craft)
- Retrieval / safe recovery of survivors
- Communications (e.g. Radio life-saving appliances, Two-way VHF radiotelephone apparatus, Radar transponders, Distress flares, On-board communications and alarm systems, Public address systems on passenger ships, Information to/on passengers)
- Use and knowledge of all applicable Operating instructions posted on board
- Correct stowage of all kind of LSA.

SOLAS also envisage the use of novel life-saving appliance or arrangement intended as a life-saving appliance or arrangement, which embodies new features not fully covered by the provisions of SOLAS chapter III or the LSA Code, but which provides an equal or higher standard of safety.

SOLAS chapter III, Reg.19 and Reg.20 contain provisions for Emergency training and drills, Familiarity with safety installations and practice musters, Operational readiness, maintenance and inspections.

These aspects are to be systematically addressed by specific training activities to possibly supplement the proficiency in survival craft of the certificated persons under the authority of the Administration.

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