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1. INTRODUCTION

A major factor in the effective delivery of VTS is the competence of its personnel. VTS personnel should only be considered competent when appropriately trained and qualified. IALA Recommendation R0103 states that competent authorities and VTS providers implement and establish VTS training and certification in a standardized and harmonized manner in accordance with the guidelines and model courses developed by IALA.

Simulation training provides a structured and effective method for developing and maintaining competencies by replicating real-world scenarios in a controlled setting. Specifically:

- it allows VTS personnel to practice technical skills, refine their decision-making, and enhance operational competence without the risks associated with real VTS operations;
- it emphasizes teamwork, communication, and adaptability; and
- it allows VTS personnel to build confidence in undertaking both routine day-to-day tasks as well responding to developing situations or emergencies.

2. DOCUMENT PURPOSE

This document provides guidance for training organizations and VTS providers on developing and conducting simulation in their VTS training. It aims at describing the various types of simulation, the harmonization of the practices of simulation training, instructional techniques and the use and benefits of simulation training.

This Guideline is associated with *IALA Recommendation R0103 (V-103) Training and Certification of VTS Personnel*, a normative provision of *IALA Standard 1050 Training and Certification*. To demonstrate compliance with the recommendation the practices described in this guideline should be taken into account.

2.1. RELATIONSHIP TO OTHER DOCUMENTS

This Guideline should be read in conjunction with all IALA documents related to VTS training, and in particular:

- IALA Recommendation R0103 Training and Certification of VTS Personnel [1]
- IALA Guideline G1156 Recruitment, Training and Certification of VTS Personnel [2]
- IALA Model Course C0103-1 VTS Operator Training [3]
- IALA Model Course C0103-2 VTS Supervisor Training [4]
- IALA Model Course C0103-3 VTS On-the-Job Training[5]
- IALA Model Course C0103-4 On-the-Job Training Instructor [6]
- IALA Model Course C0103-5 Revalidation Training for VTS Personnel [7]

3. DESCRIPTION OF SIMULATION TRAINING

Simulation training is a form of experiential learning that uses a realistic, safe and controlled environment to:

- develop and improve skills in the provision of VTS;
- assess the levels of competencies of new and existing VTS personnel; and
- maintain the levels of competencies of existing VTS personnel.

Simulation training enables the creation of simple and complex, high-risk situations within a VTS environment. These situations replicate the interaction between VTS, ships, ports, allied services, and other organizations as appropriate, to manage and monitor ship traffic and respond to developing unsafe situations.

The safe environment refers to an environment where participants are allowed to make mistakes without an impact on the actual VTS operations.

A controlled environment means that all parameters influencing the training are defined to ensure specified training objectives are met.

4. USE AND BENEFIT OF SIMULATION

Simulation training is a widely adopted tool for training and assessing VTS personnel, making training more effective, realistic and consistent.

4.1. WHEN TO USE SIMULATION IN TRAINING

Training organizations as well as VTS providers should use simulation to assist in VTS training. Simulation should be included in VTS training as part of the C0103 model courses and in the process of maintaining qualifications to:

- verify to what extent the competence levels of VTS model courses have been met; and
- assess performance as part of the process of maintaining qualification (skills and development training and revalidation training).

Additionally, simulation may also be included for other purposes, such as:

- assessing a candidate's suitability to operate in a VTS during the recruitment process;
- testing, analyzing and improving procedures or equipment;
- introducing new procedures or equipment;
- performing risk analysis and routeing design;
- carrying out incident/near miss debriefings; or
- conducting joint operation exercises.

4.2. BENEFITS OF SIMULATION TRAINING

Simulation offers a range of benefits to develop skills, improve performance and prepare VTS personnel with real-world challenges such as equipment operation, procedural knowledge, reactive capabilities and responses in emergency situations.

The benefits of simulation training include:

- **Realistic experience:** simulations provide a realistic environment where participants can practice skills and scenarios that closely mirror real-world situations, enhancing their preparedness for actual tasks.
- **Safe learning environment:** in simulations participants can learn from their mistakes without the risks associated with real-life errors. This method allows trial and error and learning in a risk-free environment.
- **Immediate feedback:** simulations often include mechanisms for immediate feedback, allowing participants to quickly understand and correct mistakes, which accelerates the learning process.



- Enhanced engagement: interactive and immersive simulations can increase engagement and make the learning experience more effective. It also promotes the participant's situational awareness, critical thinking and decision making.
- Complex scenario practice: participants can train complex, rare, or high-risk scenarios that might be difficult or impractical to replicate in real life.
- Scalable: simulations can be used for both individual and team training, and they can be tailored to various levels of expertise, from beginners to experienced personnel.

Simulation helps stakeholders gain a broader understanding of situations from multiple perspectives by switching roles (role play). This facilitates mutual understanding and enables the analysis of problem scenarios from various viewpoints.

5. APPROACHES TO SIMULATION TRAINING

Simulation may be conducted in many different ways and using many different techniques. The type of simulation technique depends on the training objectives or the expected outcomes. Simple training objectives may not require complex and technical simulation techniques. Where as, other simulations may involve a full-mission simulator offering a training environment almost identical to the VTS centre itself.

Any training that reflects a work environment or a part of it could be used to develop a simulation. It is up to the training organization or the VTS provider to determine what simulation type is suitable to meet the training objectives.

5.1. OPTIONS FOR SIMULATION TRAINING

Different options of simulation training may include:

- Tabletop exercises – using group discussions, drawings, models, traffic charts, etc.
- Role play exercises – using scenario's where every participant will take part in a specific role.
- Communications simulator – such as verbal, face-to-face, telephone, VHF and/or electronic communications, etc.
- Computer programs aimed at specific tasks or exercises.
- VTS equipment operated in simulation mode, to simulate the operational environment of the VTS under different operational circumstances.
- Mobile simulators which are portable allowing training to take place in various locations.
- Part task VTS simulator to replicate an element of the working environment.
- Full-mission VTS simulator designed to replicate the work environment.
- Cloud-based or virtual simulation allowing online and remote training.
- Joint operational training environment where multiple parties on different simulators (VTS simulator, bridge simulator, etc.) are participating, such as VTS, tugs, pilots, response agencies.

5.2. EXTRA DEVICES IN SIMULATION TRAINING

Simulation may be complemented with equipment or techniques that provide deeper insight in the participant's performance or facilitate the simulator training, such as:

- Eye tracking

- Automatic broadcasting
- Rate of speech monitoring
- Heart rate monitoring
- Speech to text technology
- Camera monitoring
- Self-assessment tools
- Virtual and augmented reality technology

5.3. USE OF ARTIFICIAL INTELLIGENCE

An Artificial Intelligence (AI) system is a machine-based system that can, for a given set of defined objectives, make predictions, recommendations or decisions, influencing real or virtual environments. AI systems are designed to operate with varying levels of autonomy.

AI provides an opportunity to create or enhance simulation exercises fast by making them more interactive, realistic, and adaptive to the individual. It allows scenarios to dynamically adjust in real-time based on the individuals' actions, skill levels or decisions, which creates a more responsive and engaging learning environment. Furthermore, AI can assess operator performance, provide real-time feedback, and adapt scenarios to match the learner's level, ensuring continuous improvement and preparedness for real-world operations.

Future simulations may use AI to enhance realism and interactions through the use of predictive modelling to simulate potential outcomes or risks to help individuals understand the consequences of their actions.

When using AI in simulation training care should be given to realism, biases, accuracy and transparency.

IALA G1178 An introduction to Artificial Intelligence (AI) from an IALA perspective [8] discusses the advantages and risks of AI within the IALA domain.

5.4. REALISM IN VTS SIMULATION

VTS simulation should provide sufficient behavioural realism to allow personnel to acquire skills appropriate to the training objectives. VTS simulation should have the amount of realism for the participant to believe it is real.

VTS simulation could be augmented with equipment to enhance realism and provide experience of the operating capabilities of the VTS equipment concerned. The level of physical realism should be appropriate to training objectives and include the capabilities, limitations and possible errors of such equipment.

To achieve realism in simulation, the following should be considered:

- Simulation training should be developed by training staff with adequate experience in the provision of VTS.
- Simulation exercises or scenarios could be fictive but should provide sufficient realism. If possible, simulation exercises or scenarios could be based on events that actually occurred or derived from imported (digital) data (e.g. snapshots, recordings, etc.).
- Training in a fictive area may be appropriate if, e.g. the real VTS area is too complex. Although not similar the fictive area should provide sufficient realism.
- Simulation training should include all necessary equipment to meet the training objectives.

6. INSTRUCTORS

Simulation training should be developed, delivered, reviewed and updated by instructors who meet the requirements as identified in *IALA G1156 Recruitment, Training and Certification of VTS Personnel*. The training organization or VTS provider should determine the additional qualifications and experience required for instructors delivering simulation training.

An instructor conducting VTS simulation training should have:

- a detailed understanding of the training programme and its objectives;
- knowledge of, or experience in the provision of VTS;
- ability to translate training objectives into a simulation exercise;
- practical instructional experience;
- ability to create realistic and challenging training scenarios;
- knowledge of the technical capabilities and limitations of the simulator to be comfortable with the tool or technique;
- skills in identifying and resolving technical issues within the simulation environment;
- capacity to adapt to changing circumstances and unexpected situations;
- skills to carry out briefings and debriefings;
- skills to analyse performance and coach participants to enhance performance; and
- skills to collaborate within the instructor team to ensure the simulation meets the learning outcomes.

7. DEVELOPMENT OF SIMULATION EXERCISES

To ensure that simulation training meets its training objectives, a structured approach to developing exercises is essential. This structured process allows for:

- the planning and design of realistic, relevant scenarios ensuring that the training is effective;
- consistency across training programs and facilitates evaluation processes to measure the effectiveness of training;
- scalable scenarios to reflect different training needs and experience levels;
- continuous improvement through systematic feedback and updates; and
- relevant and up-to-date training.

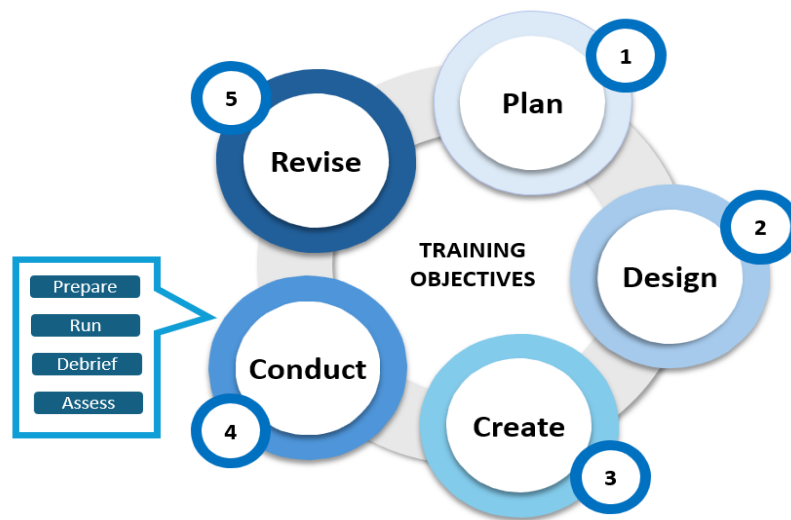


Figure 1 Phases of the development of a simulation exercise

7.1. PLANNING

The planning phase is essential for laying the groundwork of the simulation exercise. It involves a thorough needs analysis based on the training objectives to identify the skills or knowledge gaps. This phase also defines the specific content of the exercise and outlines the required time, budget, technology and support tools, ensuring that all elements are in place for successful implementation.

The planning phase provides instructors with:

- a clear focus to align the content, activities and assessments with the desired outcomes;
- guidance in deciding what type of simulation training is most appropriate and what equipment will be required;
- an indication of the duration of the training;
- number of participants in the training;
- approval of the deployment of the resources required;
- the time required to develop the simulation training, especially for computer-based simulation training; and
- an indication of the staff and other resources required to carry out the training.

7.2. DESIGN OF SIMULATION EXERCISES

The design of simulation exercises refers to the creation of the structure and the content of the exercise, based on the planning previously defined. The design should indicate how the training objectives will be met and what will be necessary to carry out the training.

Design of simulation exercises should include:

- determining the type of simulation that is appropriate;
- deciding on the method to how the exercise will be delivered;
- identifying the equipment, the staff and the time required;
- assessing if there are any individual needs and skill gaps that need to be addressed;



- identifying scenarios suitable for the exercise by outlining key situations or challenges that need to be simulated;
- outlining how the exercise will flow; and
- deciding how exercises will be debriefed and, if included, how assessment will be conducted.

A simulation exercise should be designed with the intention of delivering specific outcomes. The exercise environment may be real or fictitious, with consideration given to the following:

- defining the sea area or part of a VTS area including local features and navigational aids;
- typical traffic patterns appropriate to allow an individual to organise, monitor and manage ships;
- vessel types to be used. Where practical, this may include a database of ship names that actually participate in the VTS;
- the effects of meteorology and hydrographic factors on vessels;
- integration of allied services (e.g. search and rescue, pilotage, tugs, agents, customs);
- operational procedures used to maintain a safe and efficient VTS area including responding to developing situations; and
- relevant international, national and local regulations.

7.3. CREATION OF SIMULATION EXERCISES

During this phase simulation exercises are created and upon completion of this phase the simulation exercise should be ready to be conducted.

The creation of the simulation exercise involves:

- scenario story boarding to create a detailed and realistic plot that aligns with the training objectives. The scenario should include a timeline, key events and challenges;
- configuring the simulation tools to replicate the relevant VTS environment;
- preparing training materials such as instructor guides, scripts and scenarios, presentations, briefing and debriefing material;
- preparing participant information and hand-outs;
- developing debriefing and assessment tools such as rating scales, checklists, evaluation forms; and
- prior to conducting the training to participants, a test run should be carried out to verify its effectiveness and if further adjustments are required.

7.4. CONDUCT OF SIMULATION EXERCISES

The conduct of simulation training is when the exercise will be carried out with the participants. Sufficient time should be taken into account prior to, and after the exercise to enable thorough preparation and effective debriefing.

7.4.1. PREPARATION

Prior to running the simulation exercise all necessary arrangements should be made to assure a flawless start. This includes a detailed briefing to inform the participants of the primary goals of the simulation exercise and how these training objectives align with the overall training program/course. A thorough pre-exercise briefing ensures that all

participants are well-prepared and understand their roles, the scenario, and the objectives of the exercise. This will contribute to a more effective and valuable training experience.

Other elements to be included during the preparation/set-up of a simulation exercise should include:

- Consider the participant's outcomes/results from previous training, including previously identified areas of improvement.
- Consider allowing participants to become familiar with new skills or learning objectives prior to the simulation exercise.
- Explain the functionality of the simulator and any relevant tools, interface, controls and communication systems.
- Assign specific roles and responsibilities to each participant, especially if different from previous exercises.
- Develop procedures to be followed and possible constraints or limitations.
- Identify exercise rules (respectful communication, active participation and constructive feedback) and expectations.
- Explain the debriefing process and how the participant will be assessed.
- Provide an overview of the exercise scenario. This may include details of:
 - the time period and weather conditions;
 - the traffic situation; and
 - the potential challenges and hazards that may arise.
- Ensure all equipment is operational and functioning. and
- Ensure all members in the instructor team (if any) are aware of their roles and responsibilities.

7.4.2. RUNNING OF THE EXERCISE

The running of the exercise happens from the moment where the scenario starts. All involved in the exercise will take on the role(s) that has/have been identified and discussed for the length of the exercise.

Key elements of the running of the exercise for the instructor should include:

- Begin the simulation exercise with clear communication when it starts.
- Actively monitor the participant's actions throughout the simulation.
- Consider if the participant's performance during the simulation differs from their usual operational performance.
- Observe participants' behaviour (tone and speed of speech, body language, etc.).
- Consider informal communication to improve realism. However, this should not influence the participant's use of communication procedures.
- Take into consideration the participant's stress, fatigue, pressure, etc.
- Make notes of key teaching points for debriefing and, if possible, the exercise should be recorded to facilitate key points playback.
- Make notes for participant assessment.
- Avoid interrupting the exercise.
- Decrease/increase exercise difficulty if required (scalability).

- Observe and note any deviations from the scenario or expected outcomes.
- Adjust the simulation environment if required (e.g. introduce new conditions, change vessel movements).
- Ensure each participant understands the evolving nature of the scenario and adapts accordingly.
- Finish the simulation exercise with clear communication when it ends.

7.4.3. DEBRIEFING

Debriefing is a crucial aspect in simulation and is as important as the exercise itself. Through feedback the participants gain insight into their performance and to what extent the learning goals have been met. Ideally the debriefing should be carried out by an instructor immediately or shortly after each exercise, allowing them to discuss the outcomes and lessons learnt.

The following points are particularly relevant to debriefing sessions:

- A self-reflection period immediately after the exercise should be considered.
- Debriefing should be carried out in a structured, co-ordinated and well-prepared way.
- Debriefing should be participant centred.
- Consider an appropriate location and approach of debriefing, preferably using peer-debriefing to increase learning effect.
- Ensure participant involvement.
- Encourage self-analysis, if possible, in a structured and positive manner.
- Ensure a focus on key outcomes that should be learned from the exercise, e.g.:
 - emphasize the good points; and
 - explain thoroughly what could have been done differently.
- Sum up and evaluate performance against objectives.
- Summarize the end results of the participant performance.
- Document and report the results of the participant performance.

Annex A provides a practical approach and examples of the process of debriefing.

7.4.4. ASSESSMENT

The assessment of participant performance is important to assess whether the competency requirements and learning objectives have been met. It will identify the participant's strengths, areas for improvements as well as possible shortcomings.

Assessors conducting evaluations should meet the requirements mentioned in G1156 and have sufficient knowledge of the principles of simulation training.

Results from simulation exercises may also be used for periodic assessments of VTS personnel, which are part of the process of maintaining qualifications mentioned in IALA G1156. This ensures that established standards continue to be met and indicates whether other training (e.g. update training) is required. It should be noted that the participant's performance during the simulation training may differ from the operational performance.

Assessment results should be recorded and retained in accordance with national and/or organizational requirements as evidence to indicate the competence levels that have been attained. Documentation is important for accountability, liability, and legal purposes, and should include details of simulator exercise conduct, the

participants, duration, and results. Further, these results should be reviewed prior to future simulation exercises or other training activities.

7.5. REVISION OF THE SIMULATION EXERCISE

Revision of the simulation exercise is necessary to:

- verify whether the exercise meets the objectives defined in the planning phase;
- identify ongoing improvements based on participant feedback and observations;
- update exercises when changes have occurred in the VTS environment (procedures, area etc.)
- review requirement for equipment modifications to meet training objectives.

8. DEFINITIONS

The definitions of terms used in this Guideline can be found in the International Dictionary of Marine Aids to Navigation (IALA Dictionary) and were checked as correct at the time of going to print. Where conflict arises, the IALA Dictionary should be considered as the authoritative source of definitions used in IALA documents.

9. REFERENCES

- [1] IALA. R0103 Training and Certification of VTS Personnel
- [2] IALA. G1156 Recruitment, Training and Certification of VTS Personnel
- [3] IALA. C0103-1 VTS Operator Training
- [4] IALA. C0103-2 VTS Supervisor Training
- [5] IALA. C0103-3 VTS On-the-Job Training
- [6] IALA. C0103-4 On-the-Job Training Instructor
- [7] IALA. C0103-5 Revalidation Training for VTS Personnel
- [8] IALA. G1178 An introduction to Artificial Intelligence (AI) from an IALA perspective

ANNEX A DEBRIEFING PROCESS

This Annex provides a practical approach for instructors when debriefing simulation exercises.

Participant centred debriefing

During the debriefing process, participants analyse and reflect on their performance. This enhances the learning process. Debriefing offers the opportunity to reflect and comment on the simulation activity. A self-reflection and peer-monitoring form should be encouraged.

Instructors facilitate this process and encourage participants in their analysis. This approach not only stimulates learning, but also improves a participant's ability to analyse, reflect on and evaluate their own performance.

The debriefing activity should be focused on the learning objectives of the exercise. If the learning objectives have not been met, the debriefing process should highlight the areas of improvement. In such a case it is especially important to provide positive feedback as well.

Reflecting on their own and others' performances allows them to review the exercise and address the learning objectives. Participants' active involvement provides them the opportunity to consider alternative solutions.

Questioning techniques to facilitate debriefing

The instructor may use the following questions to prompt discussion during the debriefing process:

- What went well?
- What would you do differently?
- What did you learn?

To complement the debriefing instructors may:

- identify learning objectives not discussed;
- address incorrect statements of the participants;
- provide necessary information;
- give positive feedback;
- encourage quiet participants; and
- provide all participants with sufficient time for their analysis

What instructors should avoid:

- making it an instructor-oriented session;
- analysing before the participant has done so;
- giving the impression that the participant is guided towards an answer as this will reduce their motivation to self-analyse significantly;
- giving the impression that only the opinion of the instructor counts;
- interrupting the participant; and
- making it a cross-examination.

Table 1 Examples using the self-analysis technique

	A good example	A bad example
Example 1	<p>Participant: I don't know what went wrong. Did I see it too late?</p> <p>Instructor: Did you see it too late?</p> <p>Participant: Well, I saw it, but I thought he was going to starboard?</p> <p>Instructor: Why did you think that?</p> <p>Participant: Well, I told him that, I assumed that he would do it?</p> <p>Instructor: What would you do differently next time?</p> <p>Participant: Well, I'd rather check whether he really is going to do it.</p>	<p>Participant: I don't know what went wrong. Did I see it too late?</p> <p>Instructor: Well, I think so. Next time check whether he really intends to go starboard.</p>
Example 2	<p>Participant: I thought it was going well in the traffic separation scheme.</p> <p>Instructor: Yes? Why did it go well?</p>	<p>Participant: I thought it was going well in the traffic separation scheme.</p> <p>Instructor: Yes, I agree. Next point then.</p>
Example 3	<p>Participant: I think that it went well with that tanker. What do you think?</p> <p>Instructor: Why do you think it went well?</p>	<p>Participant: I think that it went well with that tanker. What do you think?</p> <p>Instructor: Yes, I agree.</p>