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| IALA Guideline |

G1110

Use of Decision Support Tools for VTS Personnel

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# INTRODUCTION

According to IMO Resolution *A.857(20)* [1], Vessel Traffic Services should be implemented to improve the safety and efficiency of vessel traffic and protection of the environment. The Vessel Traffic Service should have the capability to interact with traffic within its area of responsibility and to respond to developing situations as necessary.

Decision Support Tools (DST) are used to help enhance situational awareness and the decision-making process of VTS personnel by providing analysis and insight to developing or emergency situations, in real time, near real time and for long-term planning.

Due to the perpetually evolving nature of VTS related concepts and technologies, consideration should be given to the continual development and refinement of DSTs as appropriate to meet future needs.

## Purpose

The purpose of this guideline is to assist authorities on the use of decision support tools to manage identified risks, enhance situational awareness and support VTS personnel providing timely and relevant information, monitoring and managing ship traffic and responding to developing unsafe situations.

## Relationship to other documents

IALA Guideline G1110 Use of Decision Support Tools for VTS Personnel is associated with Recommendation *R0127 VTS Operations*, a normative provision of IALA Standard *S1040 Vessel Traffic Services*. To demonstrate compliance with the Recommendation the provisions of this Guideline need to be implemented.

# UTILIZATION OF DECISION SUPPORT TOOLS

## General principles

Depending on the needs of the VTS authority, DSTs may require user interaction to fully realize the capabilities of the DST or may be set to run autonomously until the set parameters trigger an alert for the VTSO to attend to.

The operational procedures of the VTS should clarify the use of DST according to the local environment of the VTS area.

The DST can be implemented during or after the establishment of VTS, and if necessary, should be based on the outcome of a formal risk assessment.

## DST User perspective

Decision Support Tools may be implemented in different ways and with differing levels of complexity. In general DSTs provide assistance to the VTS operator by integrating a mechanism to alert the operator in real time or near real time to bring awareness and the opportunity to take action where and if required.

In some situations, a DST may provide some suggestions regarding an appropriate course of action. These suggestions may be based on pre-defined solutions, previously agreed between the VTS Authority and the DST provider or may be based on machine learning of previous similar situations. It will be for the VTS personnel to decide whether, or not, to make use of such suggestions.

The DST may also prompt the VTS operator for additional input in order to help derive a solution to a current situation. This may be based on pre-defined questions that will help to guide the VTS Operator’s thought process or based on machine learning of previous similar situations.

Long term planning of DSTs involves the implementation of defined Operational Procedures within a VTS system in order that the DSTs are correctly configured to address identified risk situations within the VTS area.

## Alerts and indicators

The use of different levels of alerts could increase the situational awareness for VTS operators. In accordance with IALA Recommendation *R0125* [5]*,* it is recommended that the terminology used for alerts (alarm, warning and caution) reflects the maritime standards contained in IMO Resolution *A.1021(26) Code on alerts and indicators* [2] unless particular local circumstances require otherwise.

The increasing levels of alerts provided by the DST are emergency alarm, alarm, warning and caution (Figure 1).



1. DST increasing alerts

### Emergency alarms

For conditions which indicate immediate danger to human life, vessels or the environment that require the immediate initiation of emergency procedures, the DST should provide emergency alarms. Emergency alarm alerts may remain after acknowledgement indicating the alert situation still exists, until the alert parameters are no longer detected.

*Example of emergency alarm:*

“Vessel is not able to avoid shallow water.”

### Alarms

For conditions requiring immediate attention and immediate interaction, the DST should provide an alarm. Alarms are presented to make the VTS personnel aware of a situation that requires an immediate response. Alarm alerts may remain after acknowledgement indicating the alert situation still exists, until the alert parameters are no longer detected.

*Example of alarm:*

“Vessel approaching shallow water with minimum time and manoeuvring space to avoid shallow water.”

### Warnings

For conditions requiring immediate attention, but not immediate interaction, the DST should provide a warning. Warnings are presented for precautionary reasons to make the VTS personnel aware of changed conditions which are not immediately hazardous but may become hazardous if no action is taken. These warning alerts may disappear once the alert has been acknowledged.

*Example of warning:*

“Vessel approaching shallow water with sufficient manoeuvring space to avoid shallow water.”

### Cautions

In a routine condition, the DST should provide a caution alert. A caution alert is a condition of awareness which does not warrant an alarm or warning condition, but still requires attention out of the ordinary consideration of the situation or of given information.

*Example of caution:*

“Speed vector gives basic information which can be set by the VTS personnel.”

## Administration of decision support tools

Administrator functionalities should be provided to authorised users to enable the adjustment of alert thresholds and management of other pre-determined requirement parameters. Alert parameters should be set at levels appropriate to support the goals of the VTS service, being careful to avoid excessive notifications that may cause operator fatigue, distraction, and other factors that may negatively impact overall safety and efficiency.

Management reports may be generated from alert statistics and/or VTSO actions for analysis.

## Operational requirements of decision support tools

DSTs may be based upon real-time, near real-time and long term planning assessment of risks associated with navigational safety and efficiency and the prediction of traffic situations. The DST should:

* provide alerts and indicators (audible and / or visible);
* reduce the workload;
* enhance efficiency;
* be accurate and in real time;
* be configurable with local VTS operational procedures;
* facilitate the result-oriented decision making by VTS personnel in accordance with the purpose of the VTS;
* comply with IALA Recommendation *R0125 The use and presentation of symbology at a VTS centre* [5]
* have recording capacity; and
* analyse data for the prediction of future situations.

When the risk level exceeds a pre-defined threshold, the VTSO may be advised of the recommended risk mitigation options.

## Training

The VTS Authority should ensure that VTS personnel are adequately trained in the use of DSTs.

General training on the general principles of, types and common uses of DSTs should be provided in IALA Model Course *V-103/1 Vessel Traffic Services Operator Training* [13].

Specific training on the use and application of DSTs within specific VTS centres should be provided as a component of IALA Model Course *V-103/3 Vessel Traffic Services On-The-Job Training* [14]*.* Additionally, further training should be provided when new DSTs are introduced, or modifications are made to existing DSTs and covered within *V-103/5 The Revalidation Process for VTS Qualification and Certification* [15].

Emphasis should be given on the inputs and limitations of the DSTs.

# EXAMPLES OF WHEN DECISION SUPPORT TOOLS MAY BE USED

The following table provides examples of where DSTs may assist in ensuring the safety and efficiency of navigation, through route and traffic management, monitoring and protection of assets, environmental and fairway monitoring, incident response and anomaly detection.

The table demonstrates the harmonized relationship between the pre-requisites necessary for the alert to work, the type of alert which may be appropriate and the user interface for each use case. These are further categorised according to whether they are deemed long term planning, near real-time or real-time, which indicates how the system may be used for analysis to identify risks, quantify throughput, and adjust operational procedures as well as real-time incident and situational awareness.

1. Examples of DST use

| No | DST Group | Description | Pre-requisites | Alert Type | User Interface/ comments |
| --- | --- | --- | --- | --- | --- |
| **1** | Route management | |  |  |  |
|  | Long term (Planning) | Long term traffic flow management solutions | Route plan entry and management for each voyage and long term planning of vessel arrivals (previous port to next port) | None | Identification of vessel route from port to port, association of route plan for each vessel arrival |
|  | Near real-time | Following schedule on route | Vessel position updates outside of VTS area and configuration of vessel estimated time of arrival (ETA) tolerance | Caution | Identification of vessel prior to entry and time to VTS area and notification of vessel not meeting scheduled route plan |
|  | Draft/ air draft on route alert | On route risk situation analysis | Warning / Alarm | Identification of vessel exceeding draft/ air draft |
|  | Berth occupation | Berth occupied at time of intended arrival | None | Berth availability |
|  | Convergence prediction alert | Calculation of vessel speed and identification of convergence/ overtaking points on route | Warning | Optimal corrected speed for vessel |
|  | Vessel outside expected route alert | Configuration of expected route and vessel course alteration in relation to time thresholds | Emergency Alarm | Notification of vessel meeting course alteration and speed thresholds |
|  | Real-time | Traffic Separation Scheme (TSS) route compliance alert | Configuration of expected course, time to entry and exit of the TSS | Warning | Identification of vessel not following TSS |
|  | Cross Track Error limits alert | Configuration of cross-track error limits on each section of route | Warning | Identification of vessel exceeding set cross-track error |
|  | Speed alert | Configuration of speed thresholds | Warning | Identification of vessel exceeding speed threshold. Revised ETA calculation |
|  | Approaching waypoint alert | Time and distance to waypoint | Warning | Notification of vessel's time and distance to waypoint |
|  | Large alteration of course alert | Configuration of vessel course thresholds | Alarm/ Emergency alarm | Identification of vessel exceeding course alteration threshold |
| **2** | Traffic Management | |  |  |  |
|  | Long term (Planning) | Long term active traffic management | Identification of traffic management requirements (time slots, Just-in-time, separations etc.) for advance planning of vessel arrivals | None | Analysis of Traffic patterns to determine and identify risks, quantify throughput, and adjust operational procedures |
|  | Close quarter collision avoidance planning | Human or machine learning to develop and define alerting mechanism and alert thresholds (definition of close quarters situation for high-risk areas of the VTS area) | None | Determining near miss risk areas and determining near miss thresholds and to support IALA requirements for publication of near miss |
|  | Grounding avoidance planning | Identification of areas where grounding risk exists by vessel type and size. Human or machine learning to develop and define alerting mechanism and alert thresholds | None | Identification of grounding risk areas by vessel type and determining grounding limits for vessel types |
|  | Anchorage management | Planning of anchorage capacity and layout | None | Size, spacing and limits of vessels within anchorage |
|  | Vessel portrayal classification /grouping | Configuration of rules for classification groups (e.g., tankers, cargo, vessels of interest) | None | Simple identification of vessels by group |
|  | Near real-time | Tactical prediction of traffic situations | Assessment of timely arrival in VTS area and risks to route timing in VTS area | Warning | Identification of vessels arrival to VTS and risk to route timing |
|  | Air draft limits monitoring alert | Configuration of air draught thresholds | Advisory | Identification of vessel exceeding air draft thresholds. Maybe real-time when real time height measurement is possible |
|  | Real-time | Close quarter collision avoidance alert | Configuration of collision thresholds (CPA, TCPA) | Warning / Alarm / Emergency alarm | Notification of vessel exceeding collision thresholds |
|  | Grounding avoidance alert | Configuration of grounding warnings in relation to maximum draft data | Warning / Alarm | Identification of vessel with risk of grounding |
|  | Grounding alert | Configuration of distance and time to coast/ hazard threshold or system analysis of minimum distance and time to coast/ hazard | Emergency Alarm | Notification of vessel below minimum distance and time to coast/ hazard |
|  | Anchor watch alert | Configuration of drift limit thresholds | Warning | Identification of vessel exceeding drift limit thresholds |
|  | Speed alert | Configuration of speed thresholds | Warning / Alarm | Identification of vessel exceeding speed thresholds |
| **3** | Monitoring and protection of assets | |  |  |  |
|  | Long term (Planning) | Historic patterns, analytics, reporting | Analysis of traffic patterns to determine and identify risks, quantify throughput and adjust, operational procedures. Analysis of near misses / violations of protected areas. Human or machine learning to develop and define alerting mechanism and alert thresholds | None | Awareness of traffic patterns in VTS area and alert requirements for VTS area. Will support IALA requirements for publication of near miss |
|  | Near real-time | Approaching protected area alert | Configuration of protected/ sensitive areas, time to approach | Warning | Identification of vessel approaching protected area |
|  | Real-time | Entering / inside protected area alert | Configuration of protected/ sensitive areas | Warning / Alarm | Identification of vessel entering or inside protected area |
|  | Anchoring within pipeline / cable area alert | Configuration of protected/ sensitive areas | Warning / Alarm | Notification of vessel anchoring in vicinity of pipeline or cable |
|  | Violation of International or local regulations alert | Configuration of regulations | Warning | Notification of vessel appearing to violate regulations |
| **4** | Environmental and fairway monitoring | |  |  |  |
|  | Long term (Planning) | Weather forecasts for the planning of operations | Analysis of effects of weather on regular operations, weather limits (wind, currents, visibility etc) | None | Awareness of effects of weather on VTS area |
|  | Tidal predictions | Configuration of tidal window | None | Awareness of tidal prediction effect on VTS area |
|  | Near real-time | Dynamic under keel clearance systems | Modelling of area, data collection from vessel /fairway | Warning | Identification of vessels due to pass through areas, of which they will exceed under keel clearance |
|  | Real-time | Oil spill detection alert | Oil spill detection equipment available | Warning / Alarm | Notification of potential oil spill |
|  | Weather alert | Real-time sensors available | Warning / Alarm | Notification of adverse weather |
|  | AtoNs malfunction or off-position alert | Fairway equipment available | Warning / Alarm | Notification of loss of AtoN |
| **5** | Incident response | |  |  |  |
|  | Long term (Planning) | Incident analysis and debriefing | Ability for system to record and playback traffic situation | None | Playback available for analysis |
|  | Near real-time | Incident recording | Data from sensors available and recorded | None | Playback of data from sensors available for incident analysis |
|  | SAR planning tools | To assist in the execution of SAR procedures | None | Overlay of SAR tools |
|  | Real-time | Not under command | System identification of navigational status change | Caution | Identification of vessel switching navigation status to ‘not under command’ |
|  | Distress call alert | System identification of distress alert received | Alarm | Notification of distress received |
| **6** | Anomaly detection | |  |  |  |
|  | Long term (Planning) | Risk index systems | Configuration of rules for risk index calculation | None | Vessel classification for vessels which reach specified risk measurement |
|  | Long term history analytics | Human or machine learning through historical data sets, to identify vessel patterns and areas of interest | None | Use of historical data to determine likely vessel patterns and areas of interest |
|  | Near real-time | Abnormal route alert | Standard route patterns available based on the historical data, thresholds set | Warning | Identification of abnormal route |
|  | Real-time | Abnormal behavior alert (ship-to-ship operations, sudden change of speed, sudden turn) | Standard route patterns available based on the historical data, thresholds set | Warning | Identification of abnormal behaviour |
|  | AIS anomalies alert (loss of track or transmission) | Availability/ unavailability of the AIS data | Warning / Alarm | Identification of loss of AIS data |

# 

# ACRONYMS AND DEFINITIONS

To assist in the use of this guideline, the following acronyms and definitions, mainly based on IMO Resolutions, have been used:

## Acronyms

AIS Automatic Identification System

CPA Closest Point of Approach

DST Decision Support Tools

ETA Estimated Time of Arrival

IALA International Association of Marine Aids to Navigation and Lighthouse Authorities

IMO International Maritime Organization

SAR Search and Rescue

TCPA Time to Closest Point of Approach

TSS Traffic Separation Scheme

VTS Vessel Traffic Services

VTSO VTS Operator

## Definitions

The definitions of terms used in this Guideline can be found in the *International Dictionary of Marine Aids to Navigation* (IALA Dictionary) at <http://www.iala-aism.org/wiki/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.

Alarm A high priority alert requiring immediate attention and action (IMO Res. A.1021(26)).

Alert An announcement of abnormal situations and conditions requiring attentions (IMO Res. A.1021(26)).

Caution Lowest priority of an alert. Awareness of a condition which does not warrant an alarm or warning condition, but still requires attention out of the ordinary consideration of the situation or of given information (IMO Res. A.1021(26)).

Decision-maker A person or group authorized to make decisions.

Decision support tool (DST) A tool to assist the decision-maker at an operational, tactical and strategic level. This may be in real-time or at a tactical or strategic level.

Emergency alarm Highest priority of an alert. Alarms which indicate immediate danger to human life or to the ship and its machinery exits and require immediate action (IMO Res. A.1021(26)).

Long term planning Refers to the action of analysing currently available information to proactively manage predicted future events.

Near real-time Refers to predictions of developing situations.

Real-time Refers to the immediate action taken to respond to current or developing situations.

Warning Condition requiring immediate attention, but not immediate action (IMO Res. A.1021(26)).

# REferences

1. IMO. (1997) Resolution A.857(20) Guidelines for Vessel Traffic Services
2. IMO. (2009) Resolution A.1021(26) Code on Alerts and Indicators
3. IALA. (2021) VTS Manual
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13. IALA. (2016) Model Course V-103/5 Vessel Traffic Services Revalidation Process, Ed 1.0