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Technical Domain / Task Number 2 1

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Measuring the effectiveness of VTS and introducing a

multi-layered risk approach

# Purpose of the document

The purpose of this paper is to inform members of research activities being undertaken by the Australian Maritime Safety Authority (AMSA) which, amongst other things, will examine the intervention effects of risk control options, including VTS.

The paper provides a brief introduction and then highlights the relevant aspects for VTS.

# background

The Australian Maritime Safety Authority (AMSA) has engaged academic institutions to collaboratively develop a conceptual framework to minimize potential harm based on a multi-layered risk approach. Given the complexities involved, an interdisciplinary approach has been adopted. While the main emphasis of this framework is enhancing medium and long term strategic planning aspects, including the quantification of uncertainties, some of the components being developed may contribute to VTS operations.

In order to estimate risk, the concept of total risk exposure is introduced. Total risk exposure (potential harm) can be best described as the combination of risk layers (see Figure 1) as follows: 1) ship specific risk as proxy to safety quality, 2) vessel traffic densities, 3) location specific physical environmental parameters such as wind, wave, currents and bathymetry, 4) other environmental factors such as sensitivities to pollution; and 5) intervention effects of risk control options (RCO) which can be deployed to mitigate risk. Each maritime administration can choose from a set of RCO’s to mitigate total risk exposure to an acceptable level of residual risk.

There are many types of risk exposure endpoints one could consider such as expected numbers of incidents, oil on water or on the coast or damages quantified in monetary terms. The risk exposure endpoints can also vary depending on whether a regulator is interested in real-time aspects (eg. collision candidates or any potential near miss situation) or medium to long term strategic planning aspects (eg. collisions leading to a serious or very serious incidents).

So far, integration of layers 1 and 2 has been achieved and tested and is currently implemented into AMSA’s IT systems. It will enable AMSA to estimate risk exposure using a fully automated process. In this context, most relevant to VTS operation is the estimation of risk at the individual ship level – that is for each vessel that enters the EEZ, incident type probabilities are estimated at the individual ship level which is used as proxy to the safety quality of a vessel. These probabilities are estimated using statistical models. Having more information about a particular vessel trading in an area of interest can also enhance VTS operations since it can provide additional information about a particular vessel and perhaps be used to trigger automatic alerts. In the future, this concept could also be expanded to integrate expert knowledge.

Further work is currently being carried out with respect to layer 3 which includes the development of software to simulate trajectories of large drifting vessels which can also be used by VTS operators in the future. A methodology for layer 4 was developed by means of expert knowledge for the Victorian coastline with the plan to develop the so derived ‘knowledge’ layer for the rest of Australia.

**Figure 1: Conceptual framework of the multi-layered risk approach**

**RISK LAYERS (FACTORS):**

**Layer 1:** Ship specific risk (as proxy to safety quality)

**Layer 2:** Vessel traffic densities (e.g. nautical miles travelled, days at sea, collision candidates)

**Layer 3:** Physical environmental layer (currents, wind, waves, bathymetry, other geographical conditions such as difficult areas to navigate)

**Layer 4:** Environmental sensitivities (social, cultural, economics, ecological)

**TOTAL RISK EXPOSURE**

**(POTENTIAL HARM) to:**

* Property
* Life
* Marine environment

*Measured as:*

*probabilities*

*expected numbers/ incident rates*

*monetary value at risk*

*quantities (oil on water, oil on water)*

**ACCEPTABLE RESIDUAL RISK**

**Layer 5: Intervention effects of risk control options (RCO)**

* Navigational aids/Aids to navigation
* Vessel traffic services
* Under keel clearance
* Emergency response
* Inspections and audits/training
* Pollution preparedness
* General surveillance

**Risk Management**

**(feedback loop)**

Of particular interest to VTS operation is layer 5 in Figure 1 – that is how can intervention effects be measured? Historical data cannot really provide an answer to the question due to the various interaction effects of RCO’s. In May 2014, AMSA engaged the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to develop a methodology to estimate the effect of various RCO’s of interest including the following:

1. Vessel Traffic Services
2. Traffic Separation Schemes
3. Pilotage
4. Under Keel Clearance Management and
5. AToNs

The project is still in its early stages but will use methods of expert elicitation with the aim to derive probability distribution functions and used an approach backed by science. The effect could in theory also include cost functions in order to quantity the effect of VTS or any other RCO’s on decreasing risk or saving incident type costs..

An update on the outcomes of this research will be provided at the April 2014 meeting.

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-1)
2. Leave open if uncertain [↑](#footnote-ref-2)