Sharing mental models

Bridge Resource Management is founded on sharing mental models. What does this mean when navigating and manoeuvring in confined waters?

Is the level of information exchanged on the bridge detailed enough to enable unambiguous and timely challenge and response?

Accidents in confined waters are often the result of intentions and actions not challenged in due time, despite all formal Bridge Resource Management tools being applied. So, what is missing?

A new concept to plan critical navigational elements is required for navigation and manoeuvring in confined waters.

The idea is that defining critical navigational elements (i.e. cross track distance, speed, rate of turn, drift angle etc.) in terms of an interval of values – rather than single values – may remove the ambiguity to challenge who is conning the vessel.

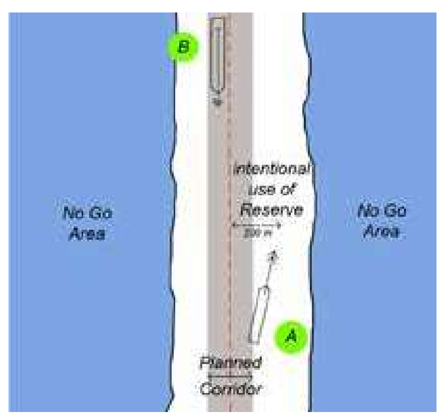
Critical navigational elements need to be controllable and observable through monitoring by the bridge team, and are determined by:

• An interval of planned values that represent the normality of operations. If everything goes according to plan, none of the planned values would have been exceeded.

• No go area/values that cannot be exceeded (i.e. non-navigable waters, breakwaters, speeds beyond or below which it is impossible to control the vessel). If the no go value is exceeded, then the ship is either aground, has had an allision or collision.

• The reserve that is the difference between planned values/areas and no go values/areas. It represents the safety margin available for a specific critical element. The reserve can be used intentionally, in order to reasonably adapt to unplanned situations (i.e. traffic, changes in environmental conditions etc.) or not intentionally because of conning errors.

In order to clarify this concept, let us consider an example where the reserve is used intentionally. Indeed, the reserve can and should be used as soon as the person conning believes it is reasonable to do so. This could happen to avoid impeding the passage of a ship constrained by her draft.



In the figure above the ship A is leaving the planned corridor as a result of an alteration of course to starboard.

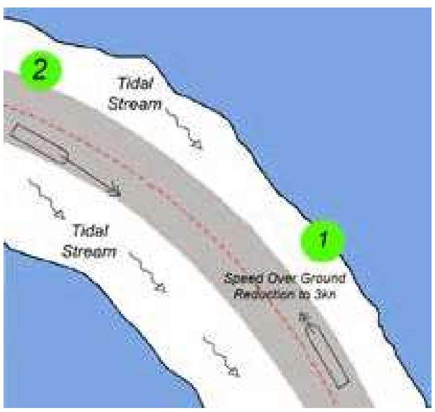
The person conning is making the bridge team aware of his/her intention to use the reserve by using the thinking aloud technique. Such technique is based on verbalising the intention (of the person conning), the motivation behind an action before its execution and its expected outcome. In this way the elements are given for either confirmation or for a challenge made by other team members.

With reference to ship A, an example of thinking aloud could be:

Plan: I intend to alter course to starboard.

Reason: To avoid impeding the passage of ship B which is constrained by her draft.

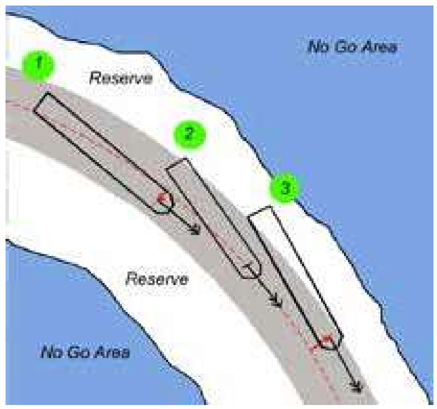
Outcome: I will navigate outside the planned corridor with a Cross Track Distance not more than 200 m right of the track.



Another example of reasonable use of the reserve is the necessity to slow down the speed over ground when approaching another vessel at a difficult bend in a tidal river (figure above). Vessel 1 with the tidal stream against her may need to slow down to 3 knots until vessel 2 has passed clear. If the reduction of speed over ground is outside the interval of planned values – say between 5 to 6 knots – such reduction would certainly be considered a reasonable use of the reserve.

This example shows that reserves are not only of a spatial nature. Also the drift angle can be defined by an interval of planned (normal) values and by an extreme value, which – once exceeded – causes unacceptable swept path in a narrow channel. In other words, all drift angle values outside the normal interval and still within the extreme ones, make up a safety margin to use only under abnormal or emergency conditions.

This planning methodology aims to remove the ambiguity to challenge the team member conning the vessel. At the same time it is allowing the necessary flexibility any shiphandler needs to manoeuvre without being constrained by unrealistically strict parameters.



When the ship is in position 1 in the figure above, the Cross Track Distance (measured from the conning position) is right of track and the entire ship is within the Planned Corridor, without using the reserve. When the ship in position 2, the Cross Track Distance is zero (conning position on track), but the stern is on the edge of the planned corridor. When the ship is in position 3, the Cross Track Distance is only slightly left of track but the ship's port quarter is well within the reserve, with not so much space left before crossing the safety contour and entering the No Go Area with the stern.

In principle, critical elements planned according to this concept, can be used as baseline not only for thinking aloud, but also for challenge and response.

Before turning, the person conning would expressed his/her intentions as follows:

Plan: I intend to turn keeping the conning position right of track.

Reason: Because I want to keep the port quarter within the planned corridor.

Outcome: The Cross Track Distance will be between 0 and 40 m right of track.

Now let us assume that the ship is drifting into position 2 due to an unexpected current and the person conning is not promptly acting on it. As soon as it is apparent that the Cross Track Distance will move left of track, any other team member should intervene by probing: "What is your intention?" and/or alerting: "The Cross Track Distance is now zero and the port quarter is going outside the corridor".

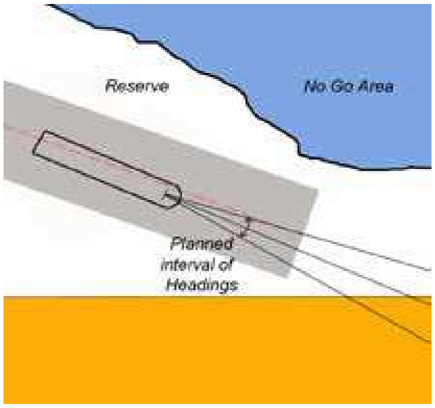
However, if probing and alerting does not satisfy the team member who has concerns, then the challenge needs to be expressed using words which raise attention such as "I suggest" or "I recommend". The following expression would constitute an outcome based challenge:

"I recommend to bring the conning position right of track as initially planned".

Need to focus

It is important to understand that the challenge needs to focus on the outcome rather than on the specific action to control the ship. This is in order to avoid that the person conning is psychologically anchored to specific instructions given by the person challenging, especially if he/she has more authority to do so within the team. In this case if the challenge included specific instructions it could lead to a situation where the person with the conn waits for the next one. This could mean a 'de facto' but not formal taking over of the conn.

Moreover, to avoid distractions and keep the level of communication essential on the bridge – especially during critical navigational phases, any challenge should be timely and triggered by the intended/potential use of the reserve. This is particularly useful during manoeuvres to berth/unberth the ship. For example, a critical element during an approach to a berth could be the ship's heading. An interval between two headings – rather than a single heading value – would define the interval of reasonable angles of approach to the berth.



An example of this situation is shown in the figure above.

If the heading is outside the interval of planned values, suggesting to adjust the ship's heading may be more convenient than suggesting how to specifically achieve the end result. If the outcome based challenge is carried out in due time, it may be possible to let the shiphandler give orders as independently as possible.

In conclusion, the concept presented in this article aims to share detailed mental models and achieve essential, timely, and unambiguous challenges and responses between bridge team members. By no means is the concept meant to constrain shiphandling within fixed limits. On the contrary, the interval of planned values (rather than single values) as well as any reasonable use of the reserve allows the necessary flexibility and discretion to handle a vessel in confined waters.

For this concept to work effectively though, critical navigational elements should be planned, agreed and shared in due time before navigating in confined waters. The analysis of real world data from ships sensors, as well as high fidelity simulators are essential tools to define the critical elements of a challenging manoeuvre to such a level of detail. However, it is also important to keep the number of critical elements as low as possible. Applying the concept of the interval of values to all possible navigational elements in confined waters may defeat the overall aim of the concept itself, which is the prevention of accidents caused by intentions and/or actions not challenged in due time, or not challenged at all.

In conclusion, the concept addresses the concerns raised by safety investigators around the world. A recent accident report of the Canadian Transport Safety Board maintained that "the absence of a detailed, mutually agreed-upon passage plan deprives bridge team members of the means to effectively monitor a vessel's progress, compromising the principles of Bridge Resource Management".

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