

Research in progress / preliminary findings:
A study of the mental models of ship masters and
VTS officers regarding ship traffic in the SOMS



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e-Navigation
Intelligent Ship
Traffic Management

- University College of Southeast Norway (HSN), at the Faculty of Engineering and Maritime Sciences
- 8 years industrial practice/maritime instrumentation
- Involved in various national and regional development projects for maritime industry and education
- Teaching innovation course in HSN Master in Maritime Management
- Research interests and activities
 - Maritime human-technology (sociotechnical) systems
 - User centered design
 - WP2 in the SESAME Straits project, survey

The SESAME Straits project goal



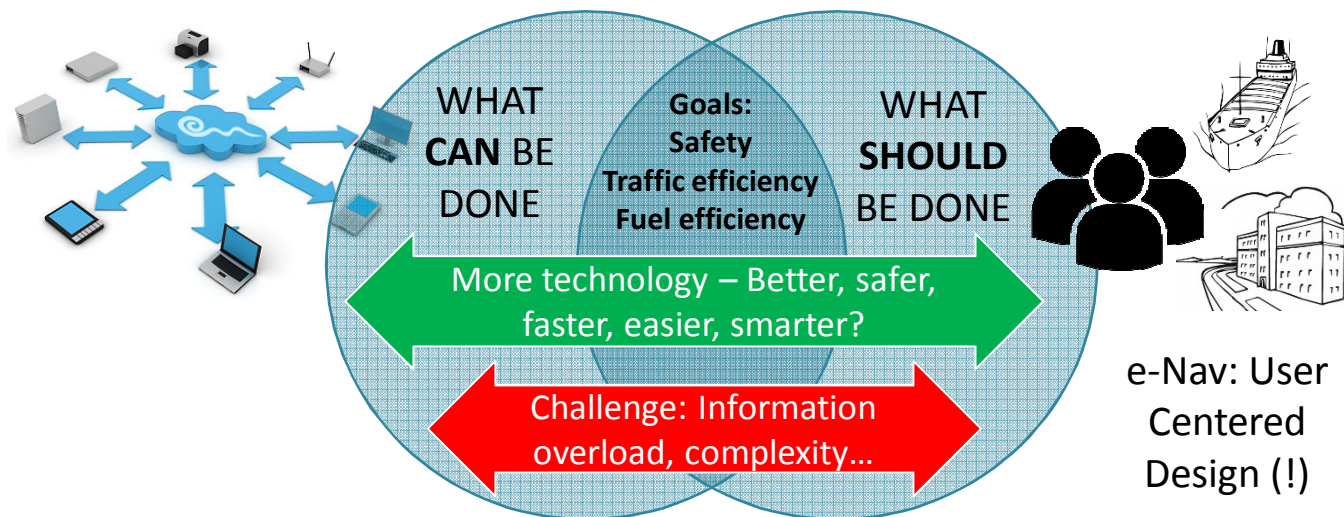
- Improve **safety** and **efficiency** of ship navigation in the Straits of Malacca and Singapore (SOMS)
- Addressing vessel traffic **hot spots**
- Focus on ship – shore **cooperation**
- Take into account the **voyage** of the vessel



How to improve safety and efficiency of ship traffic in the SOMS?



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So what to do? Examine the «context of use», such as....

SOMS ship-shore survey

- The nature of the ship traffic (types and criticality of situations)
- How much information is already available
- Variance in ship-shore perception (**mental models**)

What are mental models?

“The image of the world around us, which we carry in our head, is just a model.

Nobody in his head imagines all the world, government or country.

He has only selected concepts, and relationships between them, and uses those to represent the real system.”

Legasto, A. A., Forrester, J. W., & Lyneis, J. M. (Eds.). (1980). *System dynamics*. New York: North-Holland publishing company.



Example:
Think of a
«ship»

Concepts:

- Size
- Weight
- Era/age
- Cargo space
- Type
- Facilities
- Etc etc



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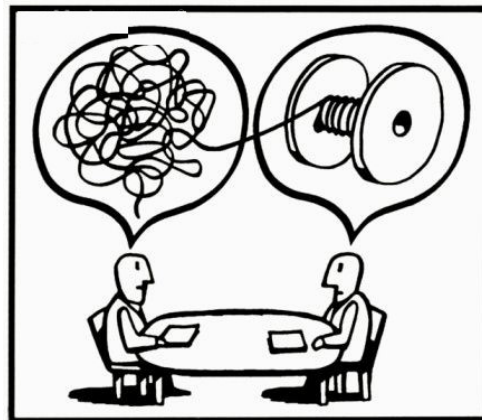


Why are mental models relevant for ship traffic management (STM)?



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- “Working cooperatively requires that team members coordinate by anticipating and predicting each other’s needs, through common understandings of the environment and expectations of performance”
(Salas et al, 2011)



**Without shared mental models,
team members...**



- may be headed toward different goals, leading to ineffective feedback or assistance
- have reduced ability to anticipate each other's actions or needs

(Cannon-Bowers, Salas, & Converse, 1990, 1993, Burke, & Fowlkes, 1996)

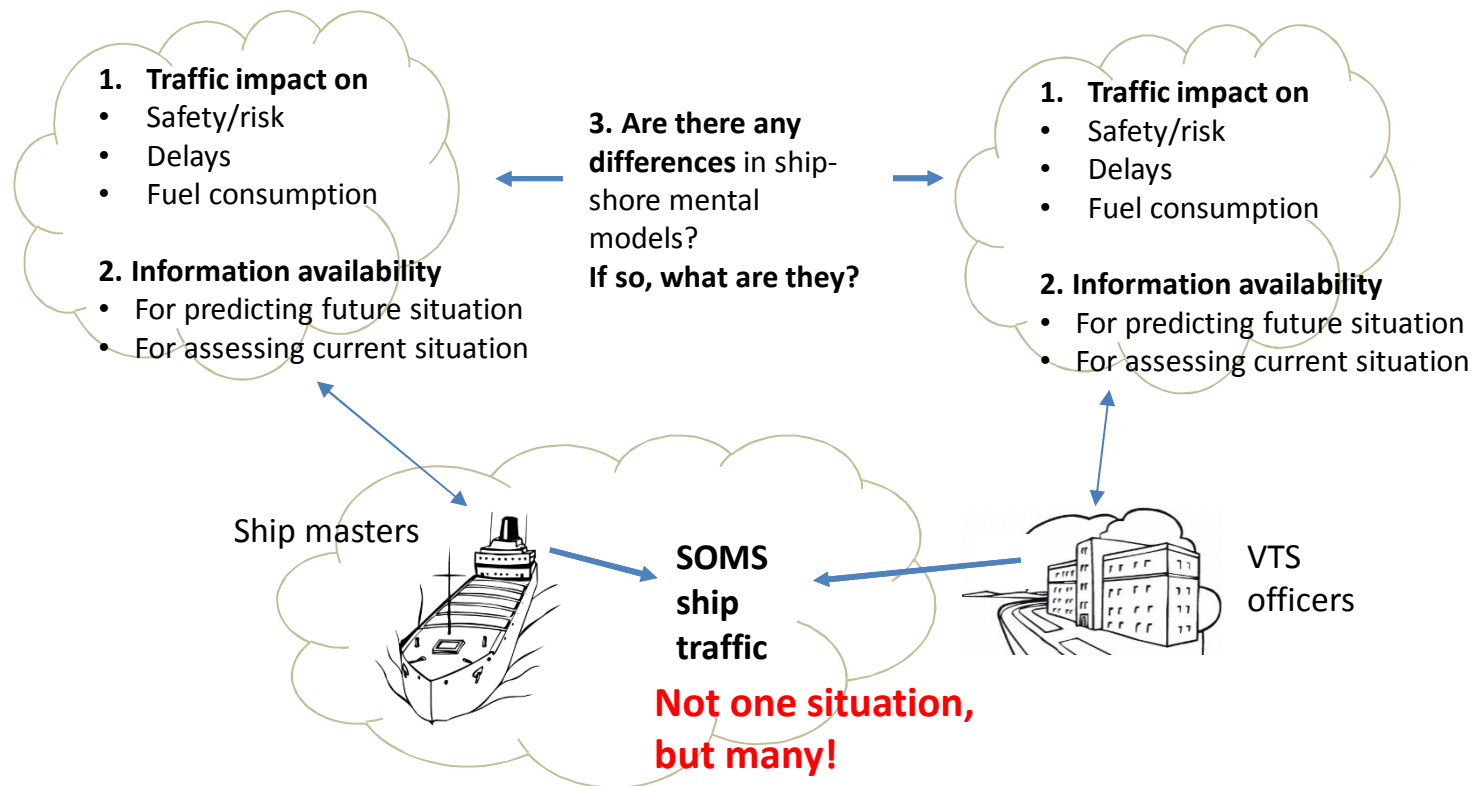
**While teams that
enjoy shared mental models...**



- communicate more effectively
- perform more teamwork behaviors (i.e., backup)
- are more willing to work with team members in the future
- **generally perform better**

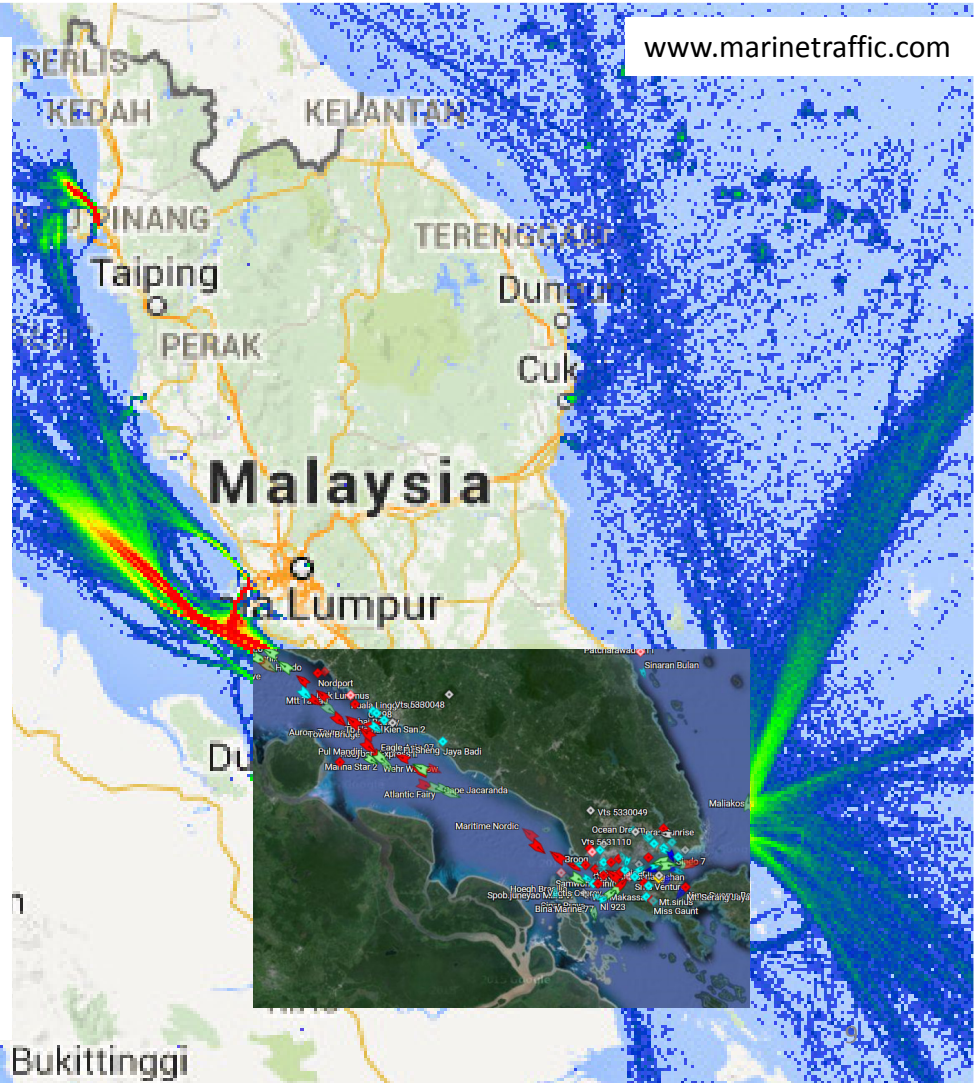
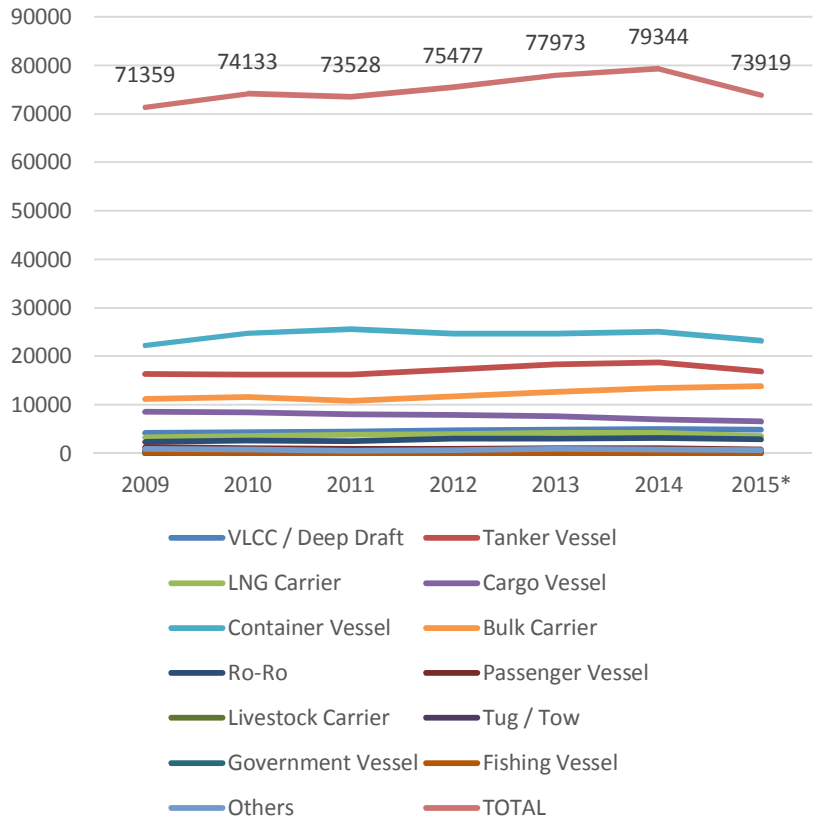
(Rentsch & Klimoski, 2001, Griepentrog & Fleming, 2003; Mohammed, Klimoski & Rentsch, 2000; Stout et al., 1999)

Mental model aspects examined in the survey



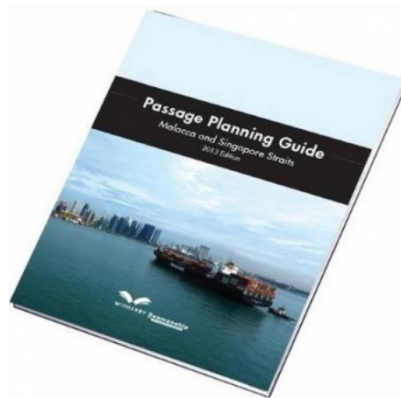
Number of ships

reporting in STRAITREP (until nov 2015)
Source: Marine Dept of Malaysia



Bukittinggi

12 identified, challenging traffic situations in the SOMS



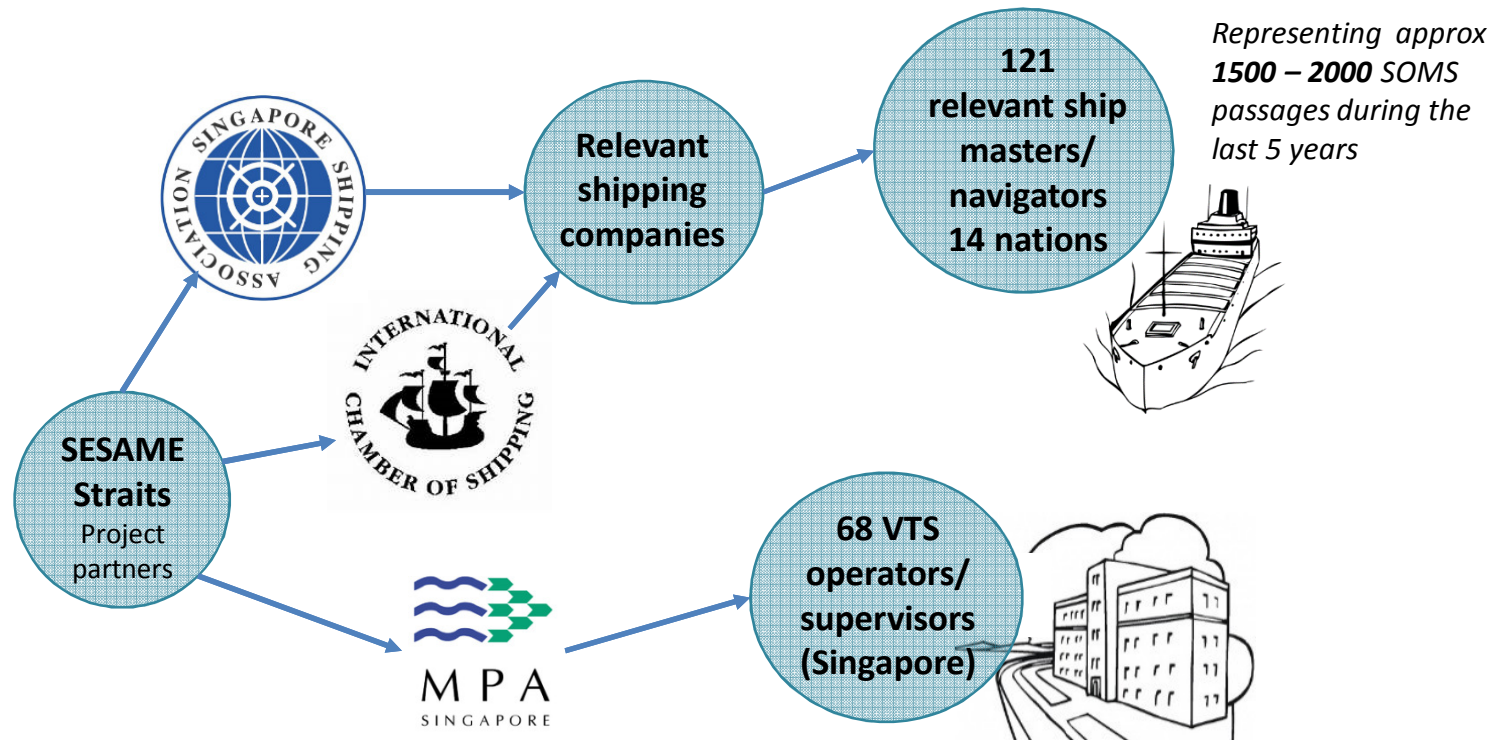
1. Local fishing activities
2. Local ship traffic (incl ferries etc)
3. Changes in fairway depth/width
4. Presence of deep draught vessels / VLCCs
5. Delayed / reduced availability of port services
6. Complex/dense fairway traffic (hotspots)
7. Inappropriate behaviour of ships
8. Communication challenges with ships
9. Ship movement in anchorage areas
10. Presence of ships with reduced manouverability (tows etc)
11. Problems with navigation aids (buoys, beacons etc)
12. Challenging weather conditions

Survey distribution

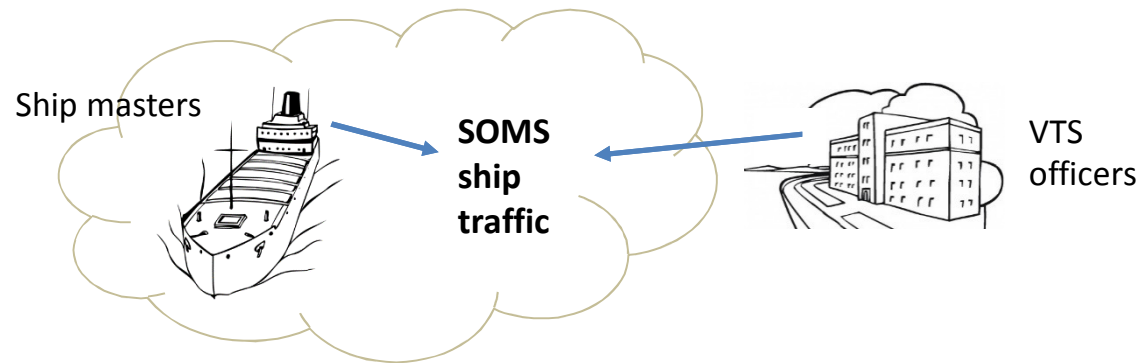


Electronic survey

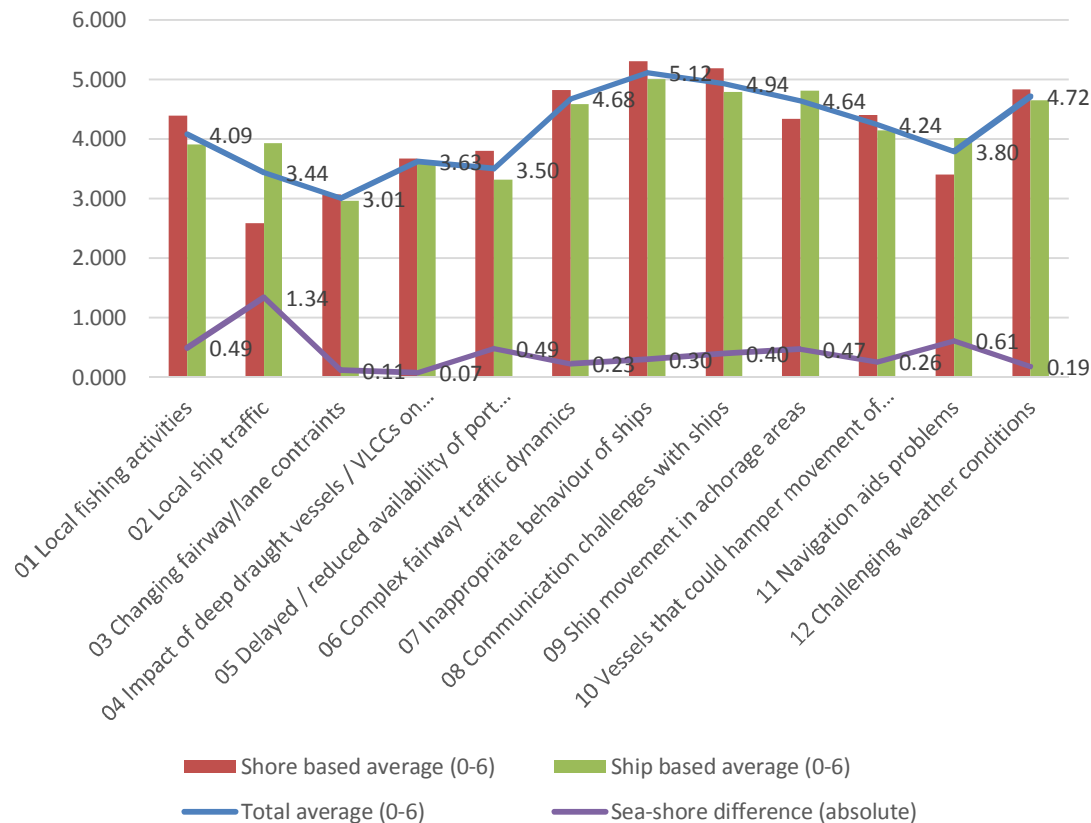
Strongly agree
 Agree
 Disagree
 Strongly disagree



Survey findings



Impact of situations on incidents/accidents



Situations that are considered to have most impact on safety are:

- 07 Inappropriate behaviour of ships (5,12)
- 08 Communication challenges with ships (4,94)
- 12 Changing weather conditions (4,72)
- 06 Complex fairway dynamics / hotspots (4,68)

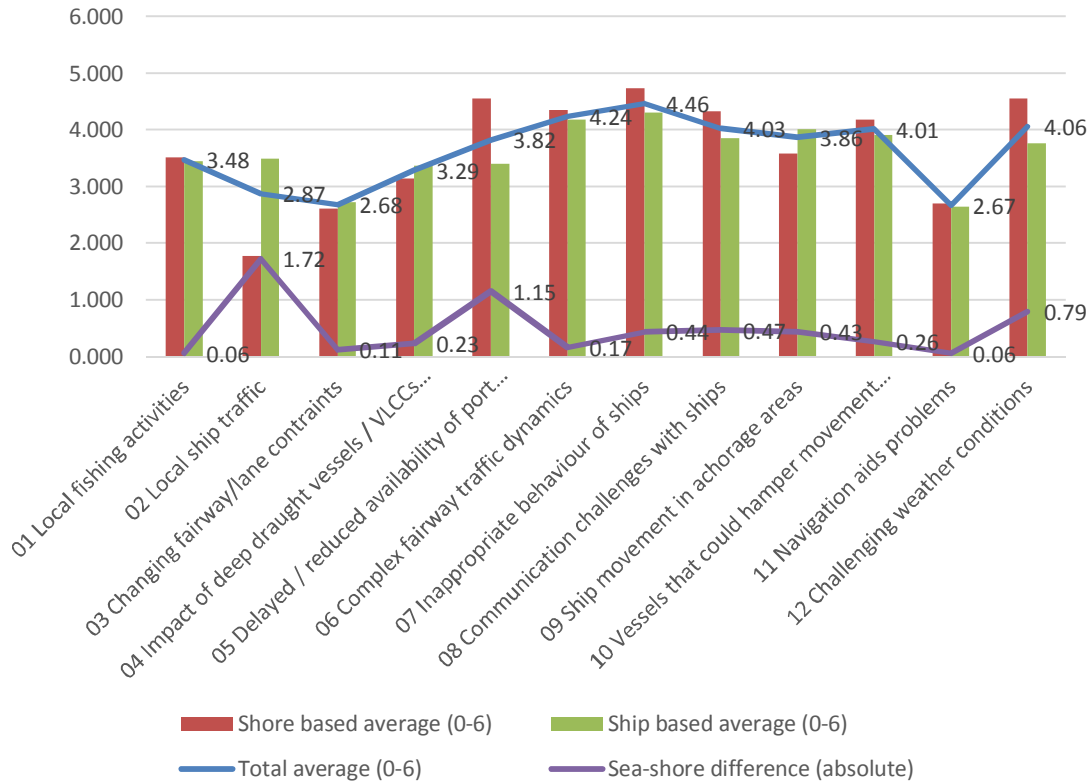
Situations that sea personnel consider more risky than VTS personell:

- 02 Local ship traffic (1,34)
- 11 Navigation aid problems (0,61)
- 09 Ship movement in anchorage areas (0,47)

Situations that VTS personnel consider more risky than ship personnel

- 01 Local fishing activities (0,49)
- 05 Delayed/reduced availabilityof port services (0,49)
- 08 Communication challenges with ships (0,40)

Impact of situations on delays



Situations that are considered to have most impact on delays are:

- 07 Inappropriate ship behaviour (4,46)
- 06 Complex fairway dynamics / hotspots (4,24)

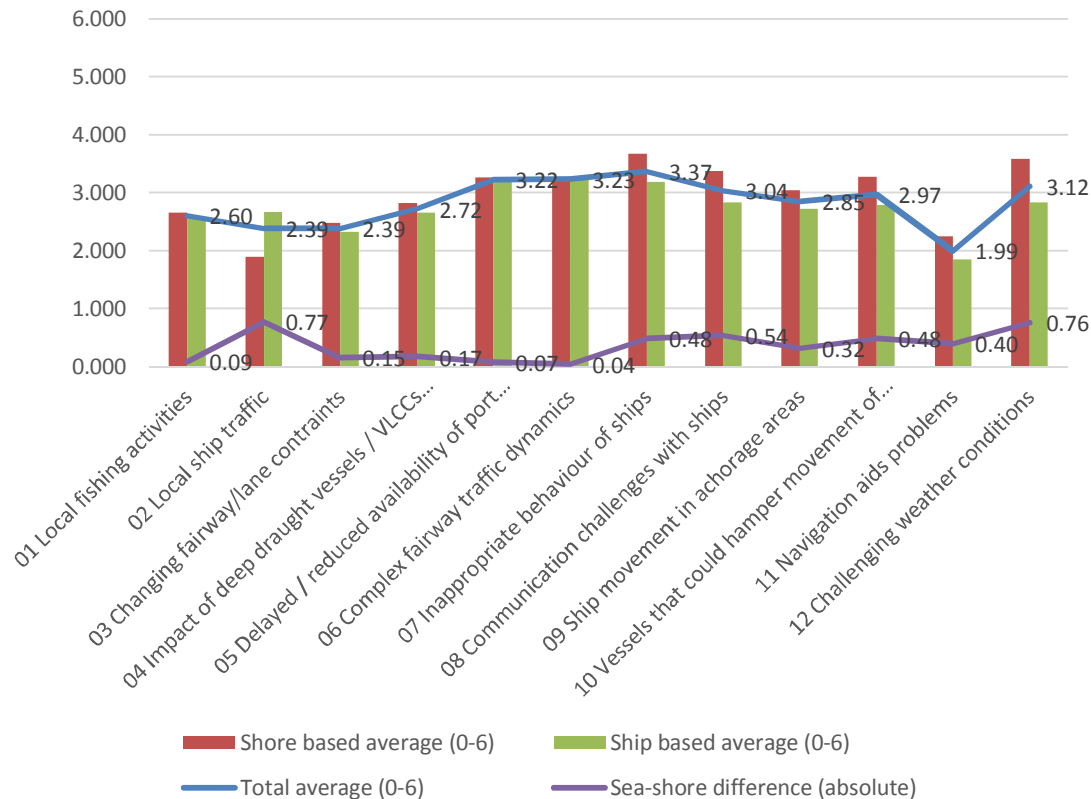
Situations that ship personnel consider more delaying (than VTS officers)

- 02 Local ship traffic (1,72)
- 09 Ship movement in anchorage areas (0,43)

Situations that VTS personnel consider more delaying

- 05 Delayed /reduced availability of port services (1,15)
- 12 Challenging weather conditions (0,79)
- 08 Communication challenges with ships (0,47)

Impact of situations on extra fuel consumption



Situations that are considered to have most impact on fuel consumption

- 07 Inappropriate ship behaviour (3,37)
- 06 Complex fairway dynamics / hotspots (3,23)
- 05 Delayed/reduced availability of port services (3,22)

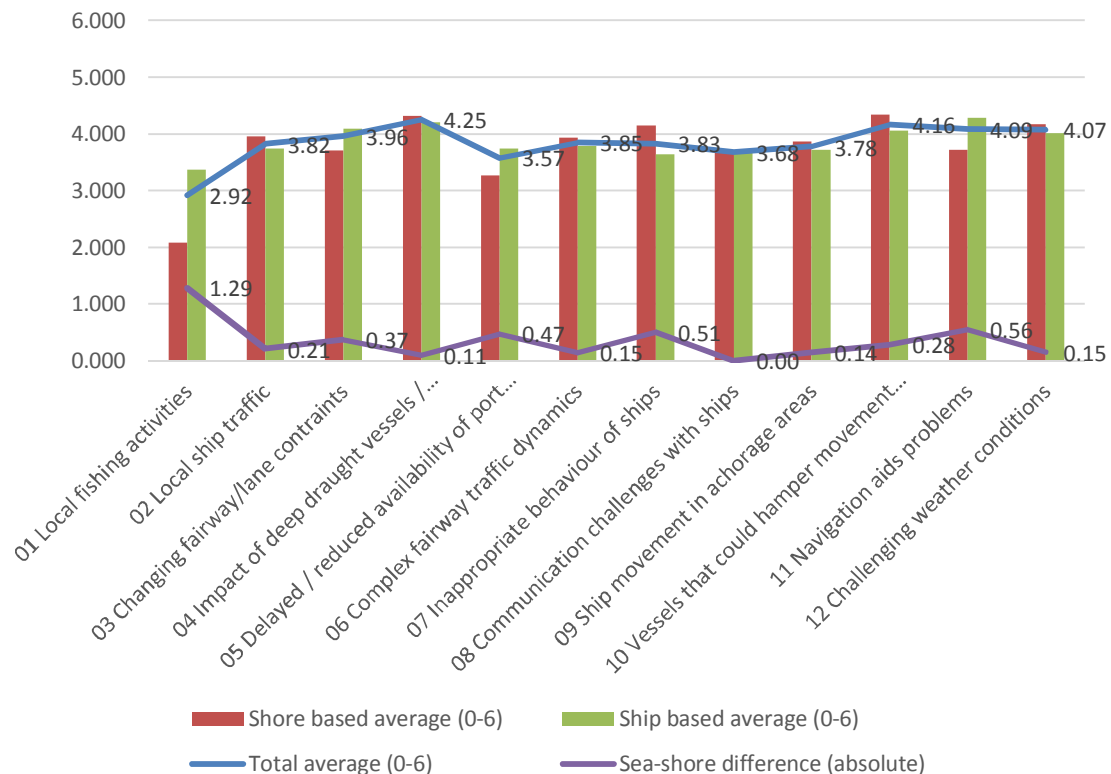
Only one situation that is considered more critical by ship personnel

- 02 Local ship traffic (0,77)

Situations that VTS personnel consider more fuel consuming are

- 12 Challenging weather conditions (0,76)
- 08 Communication challenges with ships (0,54)
- 07 Inappropriate ship behaviour (0,48)
- 10 Vessels that could hamper other traffic (tows etc) (0,48)

Availability of information about situations



Data indicate there is least information available about:

- 01 Local fishing activities (2,92)
- 05 Delayed/reduced availability of port services (3,57)

Ship personnel indicate they have more information about:

- 01 Local fishing activities (1,29)
- 11 Navigation aid problems (0,56)

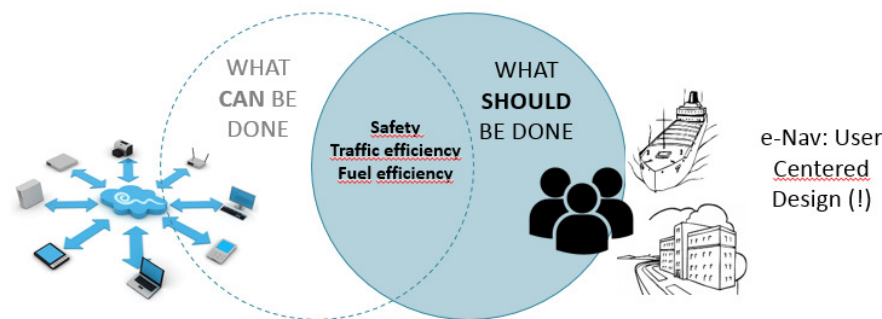
Shore personnel have more information available about:

- 07 Inappropriate behaviour of ships (0,51)
- 10 Vessels that could hamper other traffic (tows etc) (0,28)

Summary



- Ship and shore personnel seem to have a shared mental model about ship traffic, but there are also differences that should be explored in more depth (causes)
- The findings provide focus areas for STM improvement in terms of:
 - Situations with the most perceived impact on safety, delays and fuel consumption
 - Situations with little/less available information
 - Situations where there are differences in ship-shore mental models



Further research progress



- To collect survey data from Singapore pilots
- Finalize data analysis and dissemination
- Apply same survey/approach in other high traffic areas (?)

Thank you!

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