# Applying FRAM to enhance Formal Safety Assessment in the Maritime Domain


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# Formal Safety Assessment (FSA)

- Systematic & structured methodology
  - Considers organizational, human and technological aspects
  - Help decision makers to identify most efficient safety measures
- 5 steps:
  - Hazard Identification – What can go wrong?
  - Risk Assessment - How bad and how likely?
  - Risk Control Options - Can matters be improved?
  - Cost Benefit Analysis - What would it cost &how much better would it be?
  - Recommendations on Decision Making -What actions should be taken?
- Encourages use of expert judgement
- Mostly application of quantitative assessment methods

# Aim of this study

- Explore if & how FRAM can offer a way of formalizing expert input to complement more traditional assessment methods

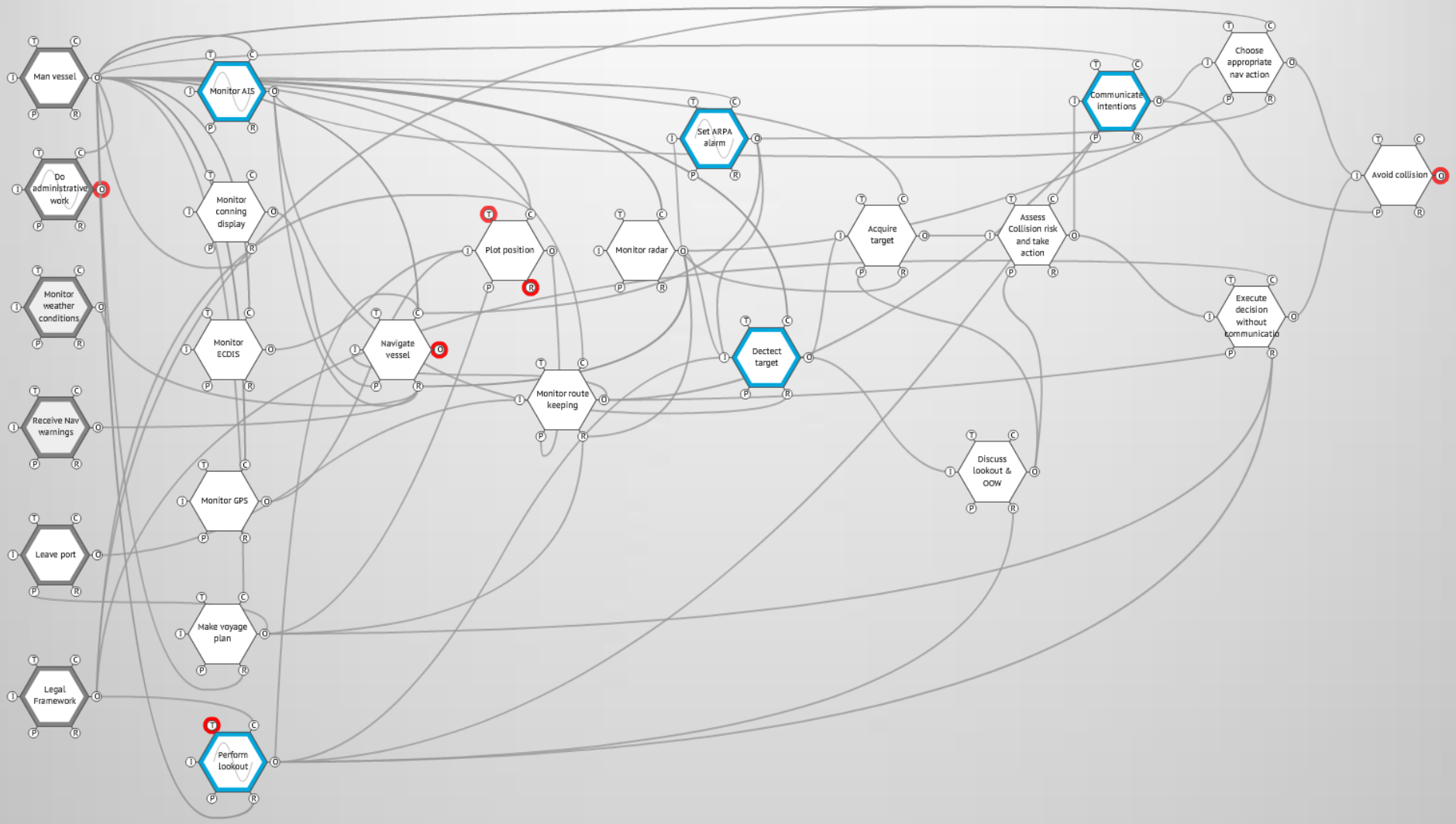
- Three main questions:
  - Can FRAM be used to compliment the traditional approaches to risk assessment used within the settings of the FSA?
  - If so, what are the benefits of applying FRAM within hazard identification and risk control options?
  - How can results of a FRAM analysis best be communicated to maritime stakeholders?

# Methodology

- FRAM-model based on task analysis & expert input
- ”Success”- tree
- Two focus groups with 3 participants with a maritime background
- Focus on ”Hazard Identification” and ”Risk Control Options”
  - Identify hazards, consequences & potential risk control options

# Results I: FRAM-model and the success tree

- Identify functions based on task analysis & expert input from 3 researchers  with navigator background
- Identify potential variability through data from accident analysis
  - Which functions are most likely to vary?
  - Which are the critical couplings for the system to succeed?

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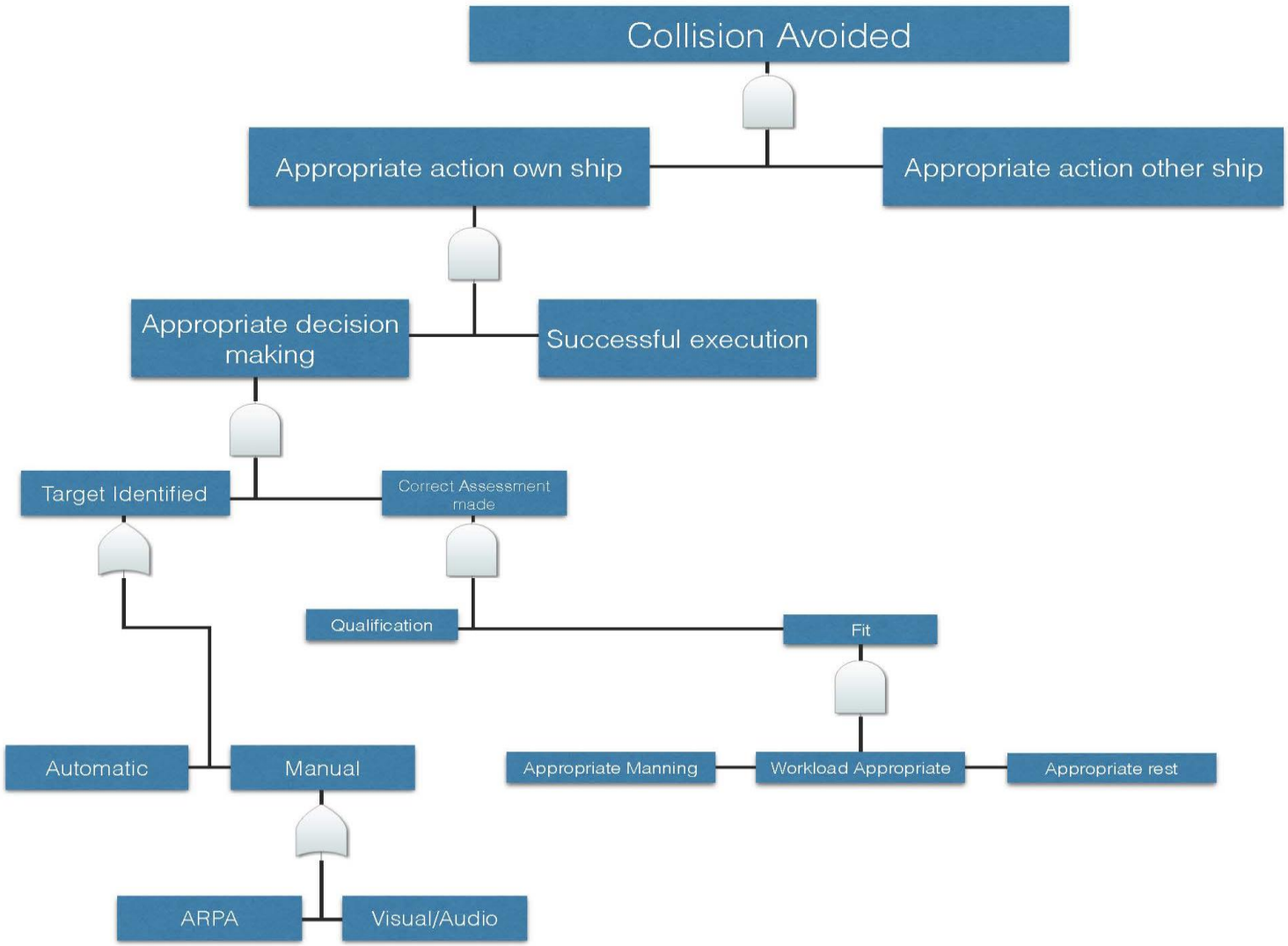
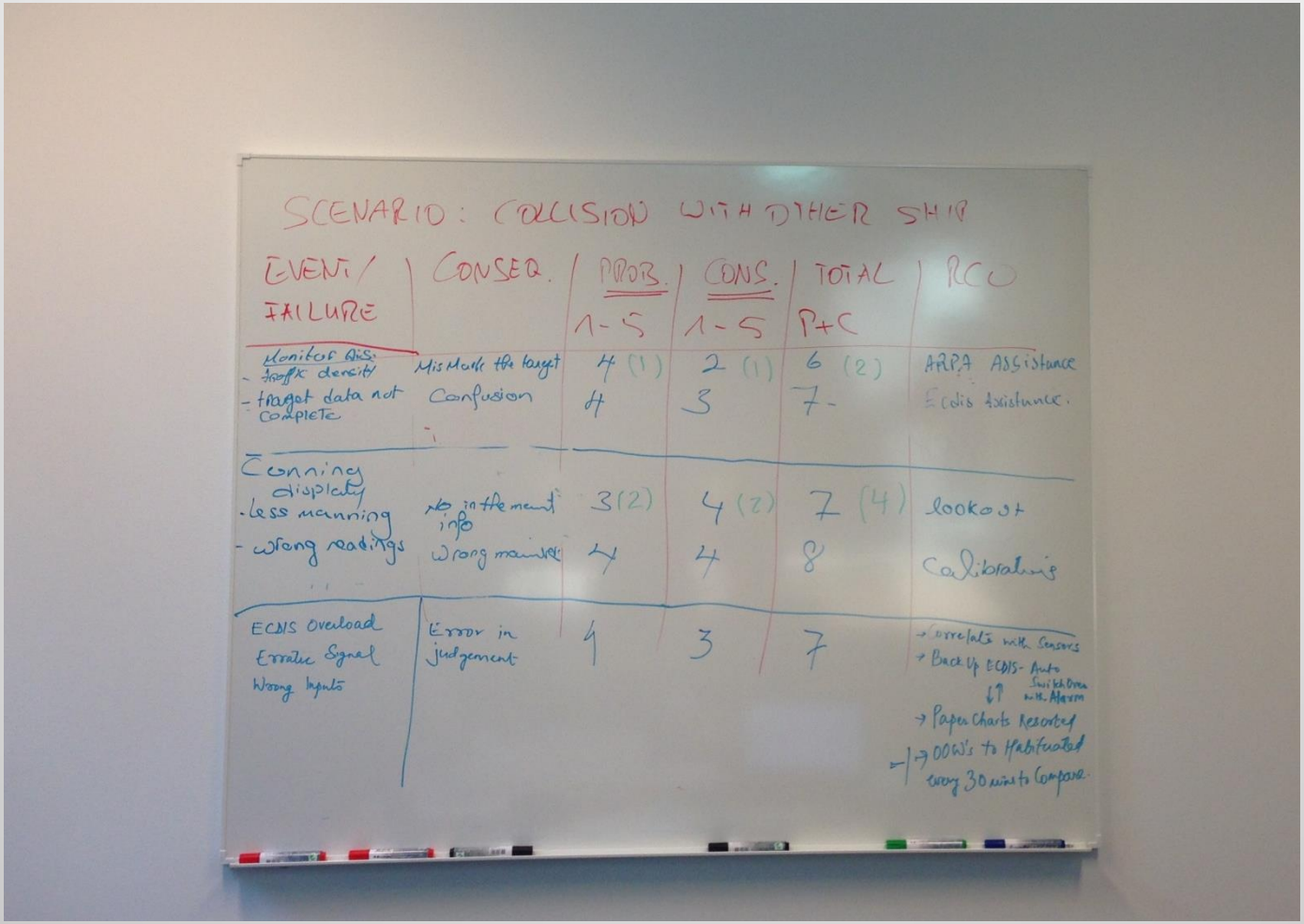
# ”Success” - tree




SCENARIO: COLLISION WITH OTHER SHIP
EVENT / FAILURE
CONSEQ.
PROB. 1-5
CONS. 1-5
TOTAL P+C
RCO
Monitor dis: traffic density
- target data not complete
Mismark the target
Confusion
4 (1)
4
2 (1)
3
6 (2)
7
ARPA Assistance
Ecdis Assistance.
Conning display
- less manning
- wrong readings
No instrument info
Wrong marking
3 (2)
4
4 (2)
4
7 (4)
8
lookout
Calibrating
ECNS Overload
Erratic Signal
Wrong Inputs
Error in judgement
4
3
7
→ Correlate with Sensors
→ Back Up ECDIS- Auto Switch Over with Alarm
→ Paper Charts Resorted
→ OOW's to Habituated every 30 mins to Compare.

# Results II

- Wide range of identified hazards and scenarios
- Generally little focus on ”error”
  - Hazard ”Monitor navigation equipment stand alone”
  - Consequence ”OOW needs to walk a lot & does not have time to check the visual”
  - RCOs ”Better integration of technical equipment”
- Function-based approach helped to identify wide range of potential RCOs
  - Design of equipment, manning, training

# Results III

- Participants in general were more positive towards FRAM-model than towards the success tree
  - Shows the complexity of work onboard
  - Shows interdependencies among functions
  - Helps to track effects of RCOs
  - Offers a macro-level for analysis
- BUT:
  - Not quantifiable -> hard to have a standalone method within the FSA
  - Fault-tree better for isolated problems/micro perspective
  - FRAM requires a lot of time

# Discussion

- Models need to be comparable to identify potential for hazard identification
  - FRAM can model positive and negative output
  - Problem to adapt fault-tree to ”positive” outcome
    - Collision Avoided
- Problems to make ”generic” FRAM
  - Stuck to instantiation to make a case
- FRAM requires more ”creativity”
- Difficulties to create and work with the fault-tree after FRAM discussion (cannot be ”unseen”)

# Conclusions

- FRAM enriches the assessment & triggers a different type of discussion
  - Function-based vs. error-based
  - Complexity & interdependencies
- Facilitates to identify the consequences of risk control options and presents a new perspective on the ”cost” of an option
- Need to test models further and iterate both for next set of focus group

# Acknowledgements


- MaRiSa research group
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## Thank you for your attention!


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