Western Norway University of Applied Sciences

Maritime autonomy

MarSafe Group

Researching maritime safety and Human Factors

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Everyone is doing it…

- YARA Birkeland will initially operate as a manned vessel, moving to remote operation in ~~2018~~, ~~2019~~, 2020
- Japan's largest container line will test a remote-controlled vessel across the Pacific Ocean in 2019
- Finnish Maritime Fully Autonomous by 2025
- Maritime Unmanned Navigation through Intelligence in Networks
- KONGSBERG is developing autonomous / unmanned / self-driving ship control systems…
- BHP Billiton pushes for autonomous ships in the coming decade
- MOL Expands Artificial Intelligence Research
- Rolls-Royce, DNV GL, NTNU And SINTEF Ocean Simulation Platform For Creating Future Ships
- Wärtsilä remote vessel control from 8,000 km

- 22 March 2018 the Uber fatality
- 3 April 2018 - Airports across Europe warned of disruptions on Tuesday after a technical problem at Eurocontrol, the agency that runs the EU's air traffic control system.

  "there has been a failure of the Enhanced Tactical Flow Management System", which compares traffic demand with local air traffic control regions.
- Kongsberg and Wilhelmsen join for autonomous ships – April 2018

– It looks like they are crashing, said Torbjørn Røe Isaksen, minister of Trade and Industry, when he took control of a so called autonomous ship in Trondheimsfjorden.

Source: https://www.dn.no/ Per Thrana

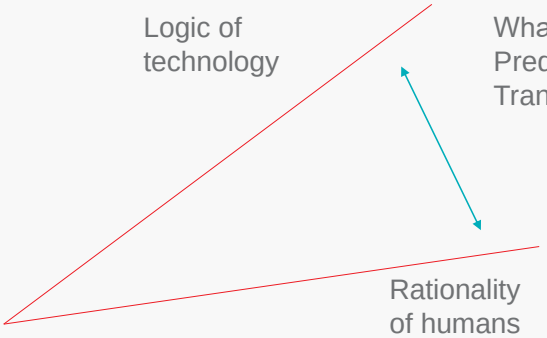
Why autonomy?

- Early on
  - Safety (Human error)
  - Cost saving
- Then
  - Environment/fuel
  - Crew safety
- Really?
  - The narrative
  - Sexy tech

The Captain and the maritime

- Ultimate authority
- Total responsibility
- Much automation added
- Why are there still people onboard?
- Why are there still manual alternatives?

We don’t mind the gap



What is the gap…
Predictability?
Transparency?

Closing it…
Quality of use?
HCD?

Why can't we have the gap?

Autonomy and humans

- Automation
- (Remote control)
- Autonomy

- Is autonomy the endpoint of automation?

- Are they even steps on a continuum?
  - Engineering perspective?
  - Human factors perspective?

…the Society of Automotive Engineers (SAE) has decided to put the term “autonomous” in their section of deprecated terms.

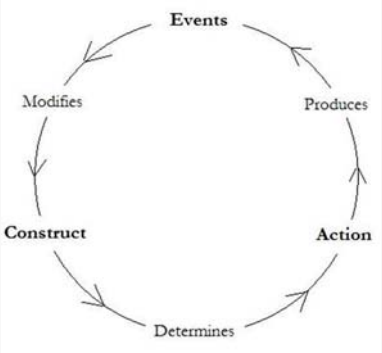
… the term has become synonymous to automation since the use of it has broadened to encompass decision-making and the entire system functionality

- Including the human in the ‘entire system’
  - Control
  - Resilience

Control

- … any changes to operating parameters, set points, software, etc. that have either a direct effect on the ship's operation or an indirect effect on the ship's operation (LR)
- … control is a situation where a controlling system (a controller) keeps the output from a controlled system within a specified performance envelope (Ashby, 1956).

- Hollnagel (2002) - the basic cyclical model of control. The model presupposes that the controller has a clear goal – a state of the controlled system that should be achieved and maintained.

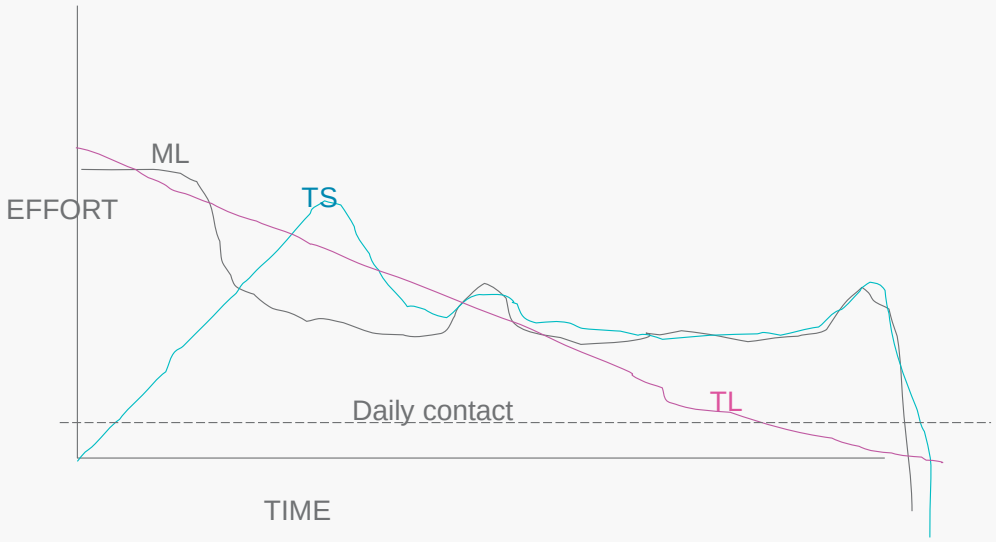


Control, resilience and automation

- The law of requisite variety expresses the principle that the variety of a controller should match the variety of the system to be controlled.
  - Controller/system must have a goal
- Individuals and organisations must always adjust their performance [anticipate the changing shape of risk] to the current conditions… such adjustments are approximate.

- Knowledge of automation logic requires extensive operator interaction with the automation and system feedback on the effectiveness of such interactions
- Automation use leads to a decrease in both system knowledge and system feedback
  - Bainbridge, Strauch

Balancing autonomy and control



Levels, control, autonomy

Are “levels” discrete steps?

Are methods better?

- Who is the default controller – is the role better defined from a human standpoint?
- To be in control?
- To have control?
- Being controlled?
- How much must the controller know about the goal?

(Method 5) Autonomous
- The UMV will sense environment, define actions, decide and act. On-board system invokes functions without informing the operator.

(Method 4) Monitored
- On-board system invokes functions without waiting for (or expecting) a reaction from the operator.

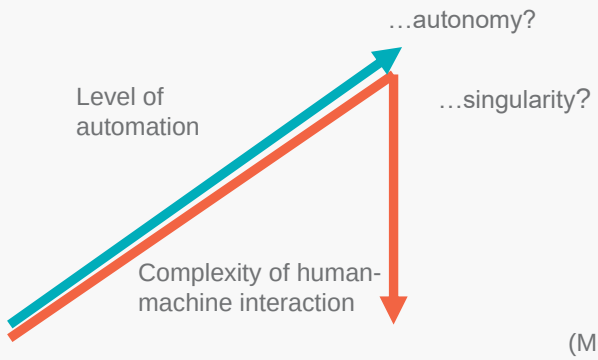
(Method 3) Delegated
- Authority to invoke functions is transferred to on-board system. The operator has the option to object (veto) intentions declared by the UMV during a certain time.

(Method 2) Directed
- UMV has degree of on-board cognitive capability and suggest one or several actions. The authority to make decisions is with the operator.

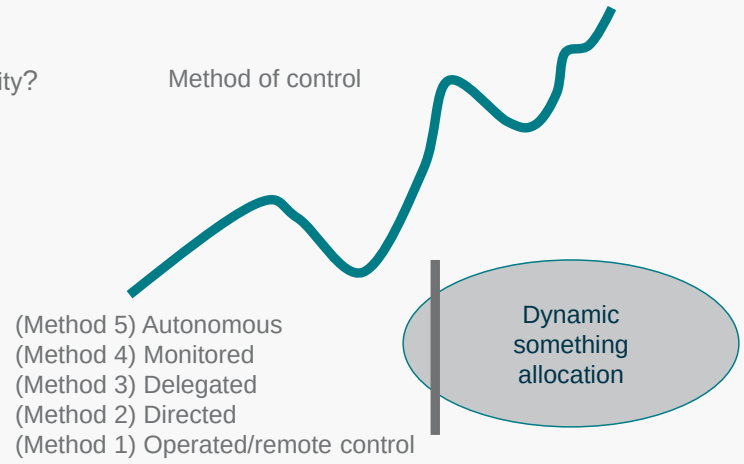
(Method 1) Operated/remote control
- Cognitive functionality is within the human operator. The operator makes all decisions, directs and controls all vehicle and mission functions.

Engineering is a linear development - Human factors is not?

The engineering approach

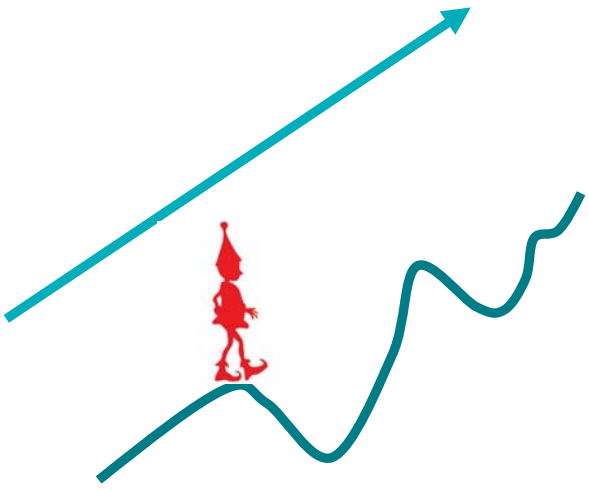


The systems approach



Remember

- Is there a continuum?
- The human roles shift but stay
- Control is needed

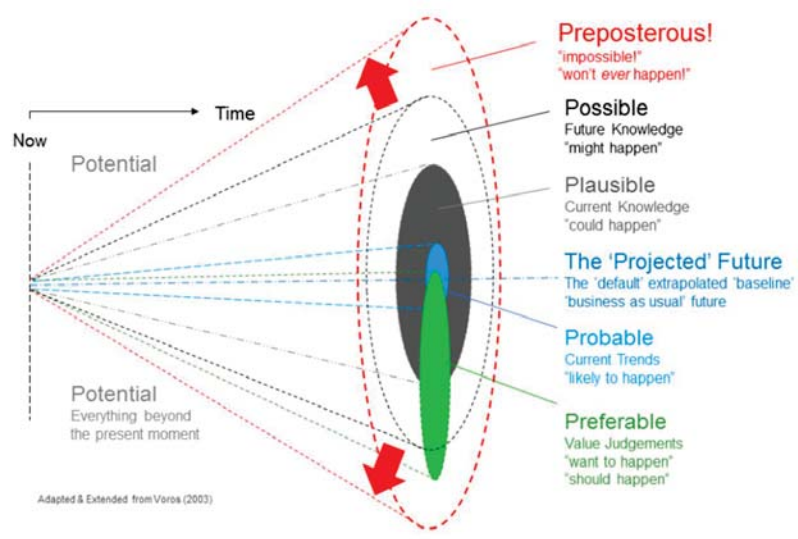


HUMANE project

- Hardware reliability & cyber security
- Skill sets, competence and knowledge
- Legal implications
- Organisational & job design issues

- Why?
  - Most of the technology is in place…?
  - Some bits are missing
  - What can we do to support and enable?
  - Everyone wants safe and efficient shipping

Futurism…



Source: Joseph Voros