



# Changing roles and responsibilities in human-automation teams

Jelle van Dijk & Rosa van Tuijn

SASG meeting 2025

# Overview



1. Introduction
2. Human Machine Teaming
3. Designing for Human Machine Teams
4. Human Machine Teams for uncrewed systems
5. Summary

# Who are we?



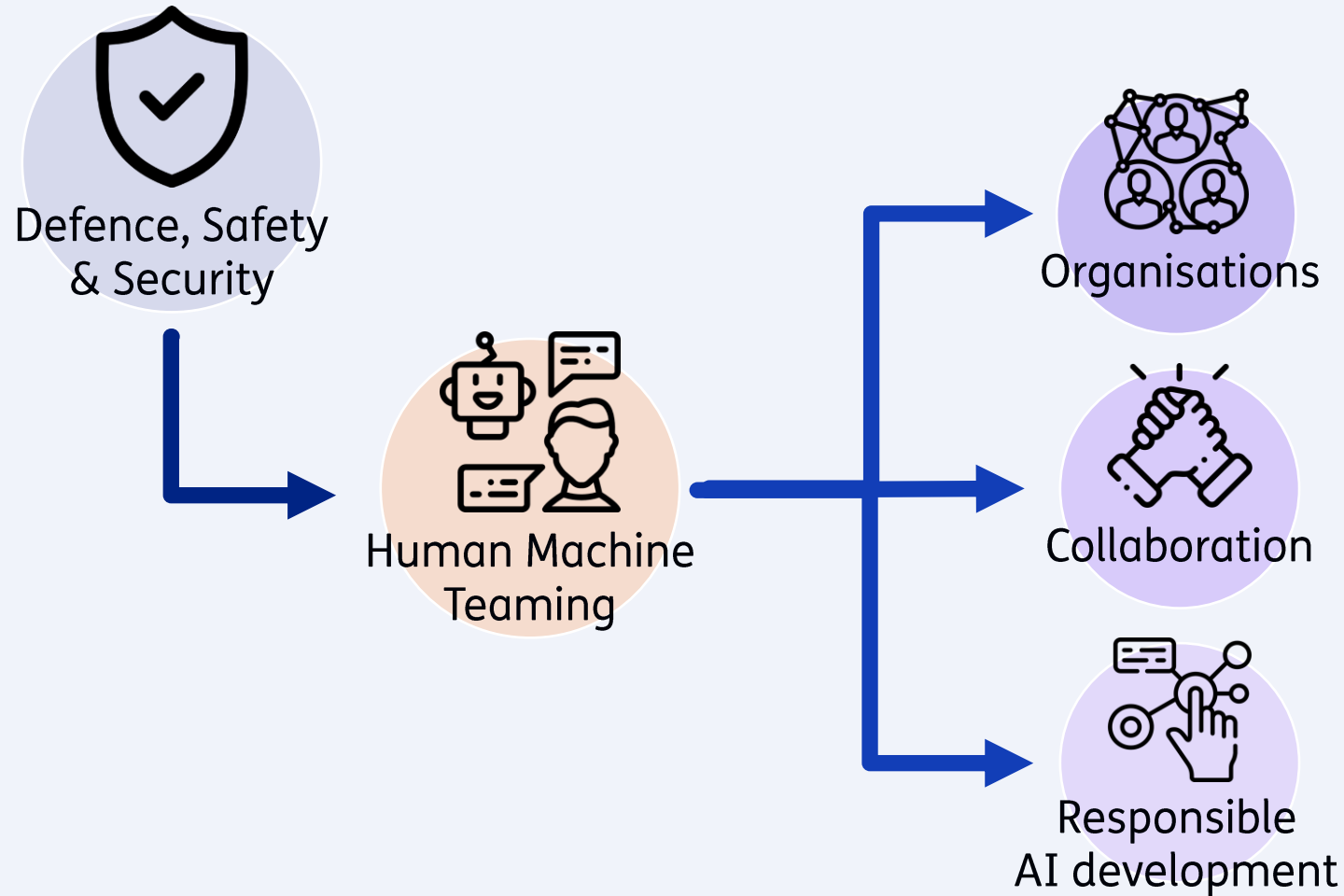
**Jelle van Dijk, PhD**  
Cognitive psychologist  
*Cognitive neuroscience*



**Rosa van Tuijn, MSc**  
Interaction designer  
*Industrial Design, TU/e*



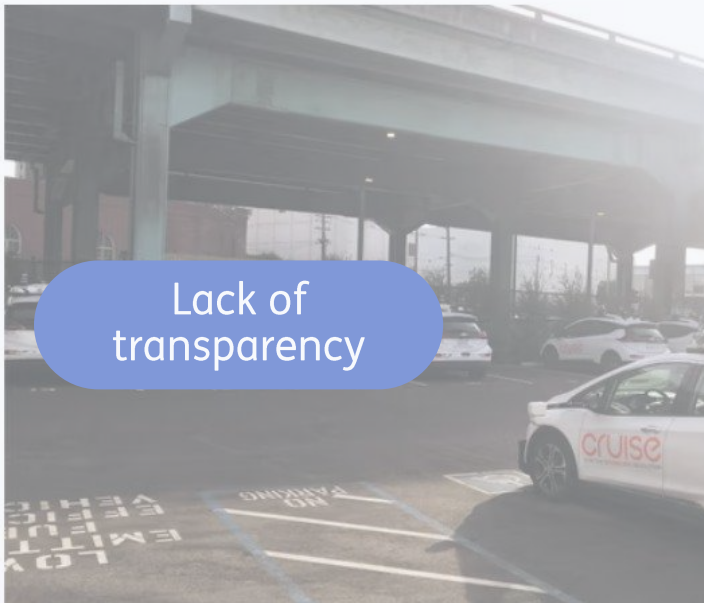
# Human Machine Teaming



# Why Human-Machine Teaming?

## Cruise recalls all self-driving cars after grisly accident and California ban

All 950 of the General Motors subsidiary's autonomous cars will be taken off roads for a software update



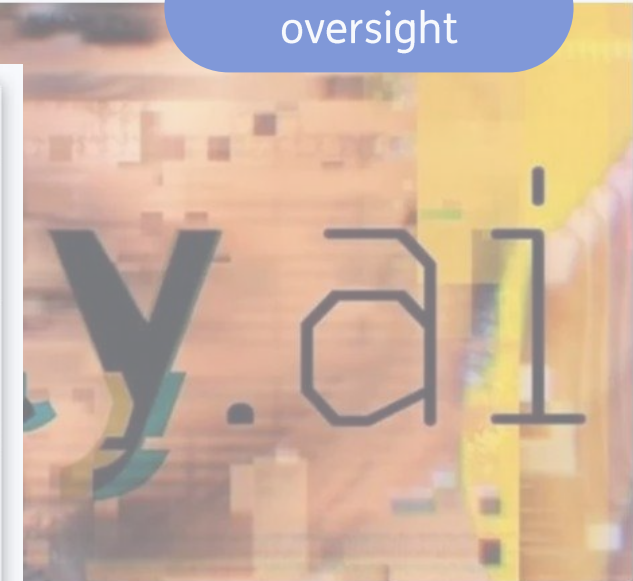
Lack of transparency

## Tay: Microsoft issues apology over racist chatbot fiasco

25 March 2016 · 385 Comments

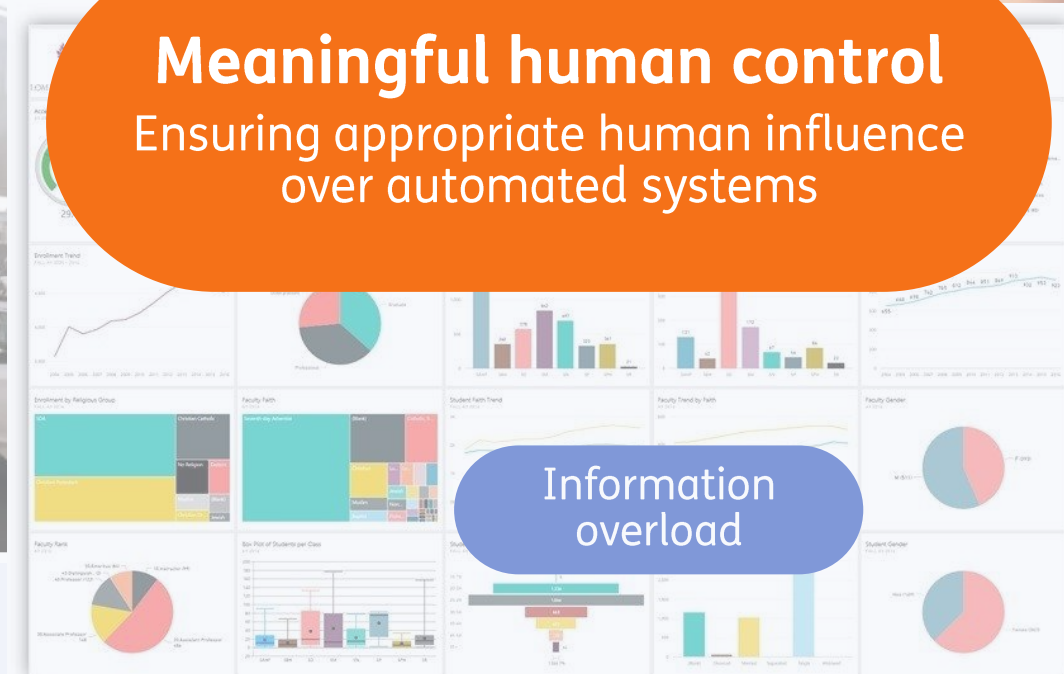


Lack of human oversight



**Meaningful human control**  
Ensuring appropriate human influence over automated systems

Information overload



# How to design Human-Machine Teams?

- Socio-Cognitive Engineering (SCE) Method

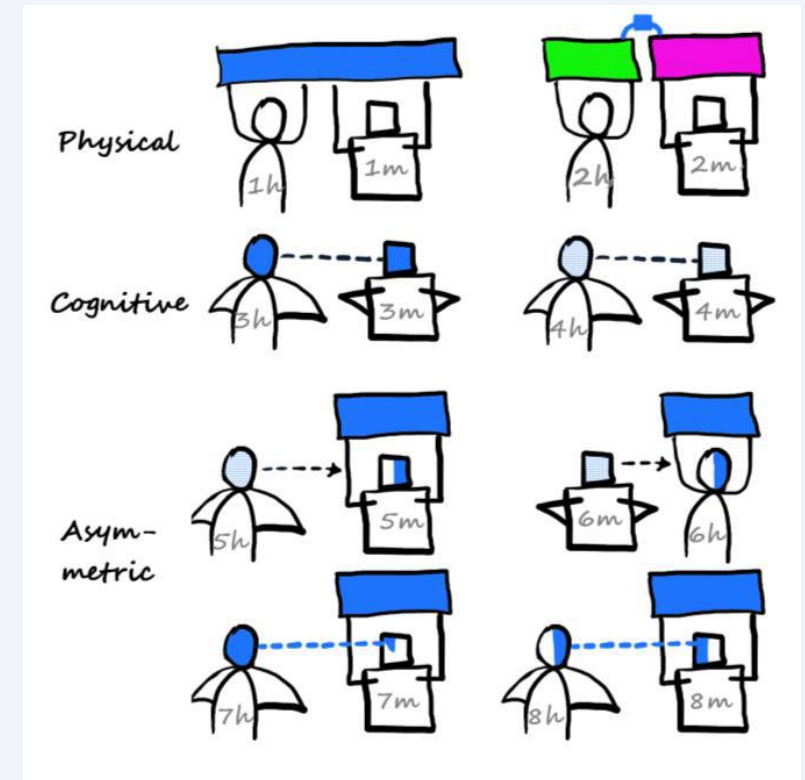
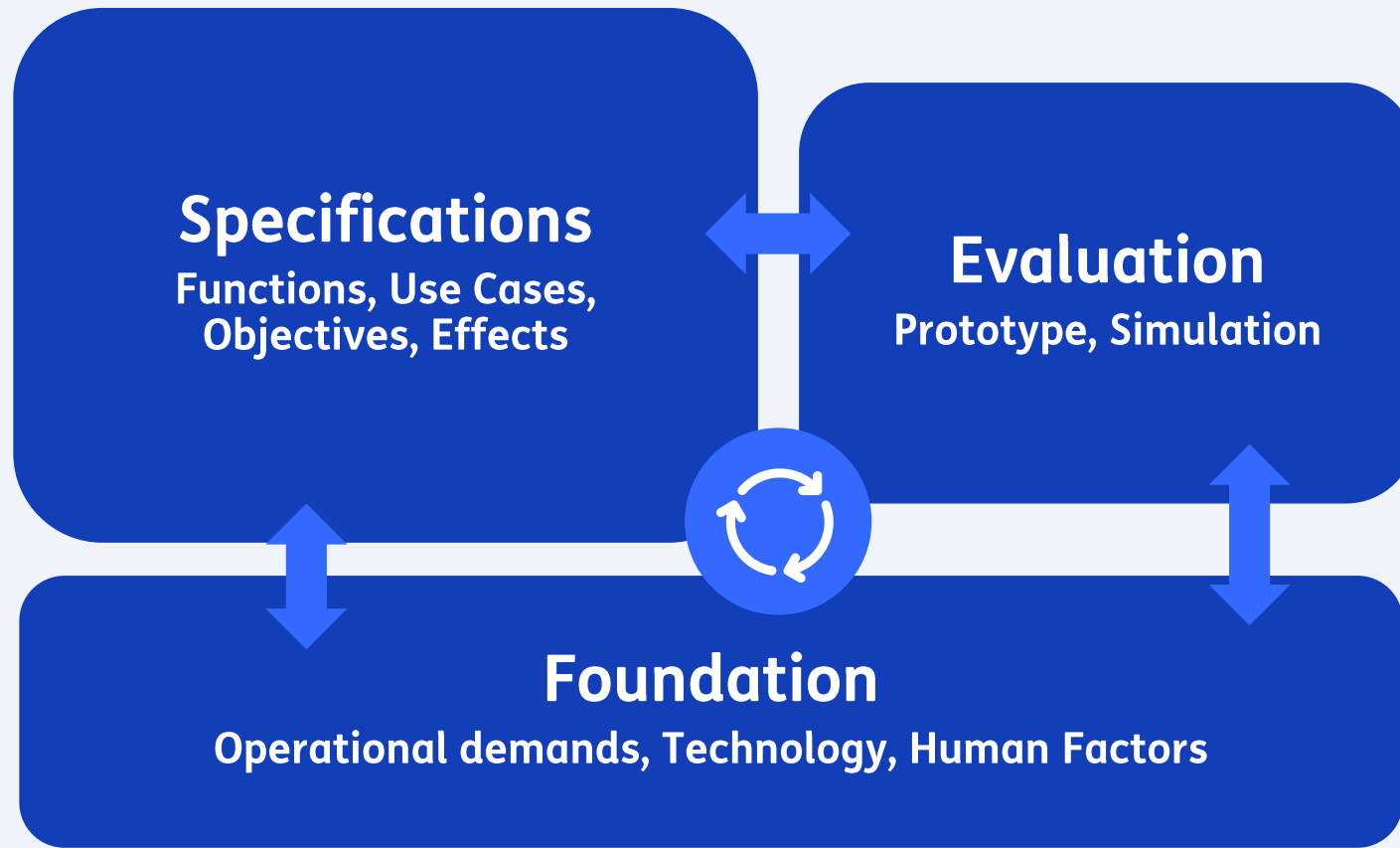


Image credits: Jurriaan van Diggelen, TNO

# Levels of Automation



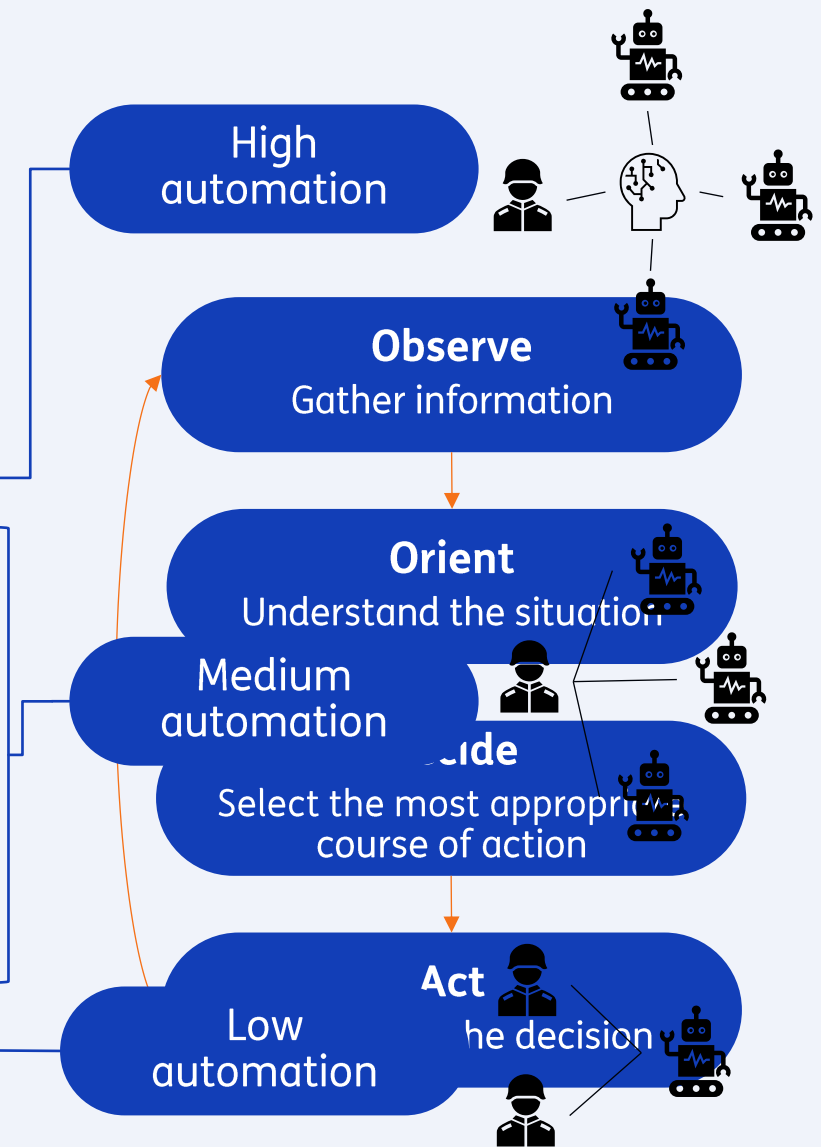
Young, L. A., Yetter, J. A., & Guynn, M. D. (2005, September). System analysis applied to autonomy: Application to high-altitude long-endurance remotely operated aircraft. American Institute of Aeronautics and Astronautics. <https://doi.org/10.2514/6.2005-7103>

European Defence Agency. (2022). Best Practice Guide for Unmanned Maritime Systems Handling, Operations, Design and Regulations (SARUMS BPG 2022) (Public Version). European Defence Agency. <https://www.eda.europa.eu/>

# Types of Human-Machine Teams

TNO Innovation for life **Levels of automation** Version 1.0 Contactperson: rosa.vantuijn@tno.nl

	Leading role in taking initiative and having authorization	Supporting role by giving feedback	Internal reasoning and cognitive capability	Observe	Orient	Decide	Act
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(On site) Goal delegation



(Remote) Delegation



Teleoperating



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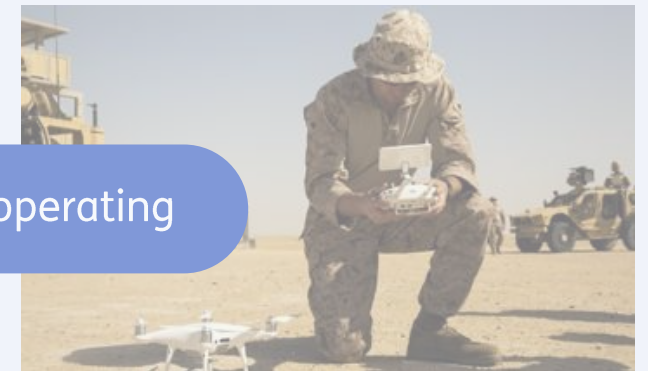
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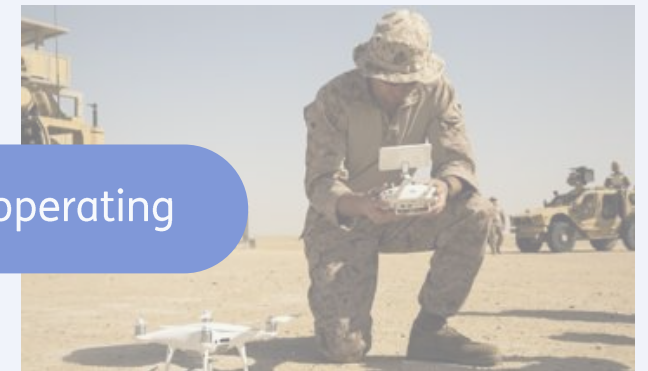
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# Uncrewed systems (UxVs)

Uncrewed Surface Vehicle (USV)



Uncrewed Aerial Vehicle (UAV)



Uncrewed Underwater Vehicle (UUV)



Uncrewed Ground Vehicle (UGV)



# Why UxVs?

## Opportunities

Reduced risk to personnel

UxVs can perform dull, dirty, and dangerous tasks

Do more

UxVs reduce the workload for personnel

Cost efficiency

A cheap UAV can have similar capabilities as a much more expensive helicopter

## Challenges

Complex environments

UxV capabilities are reduced in complex environments, e.g. bad weather, hilly terrain

Scalability

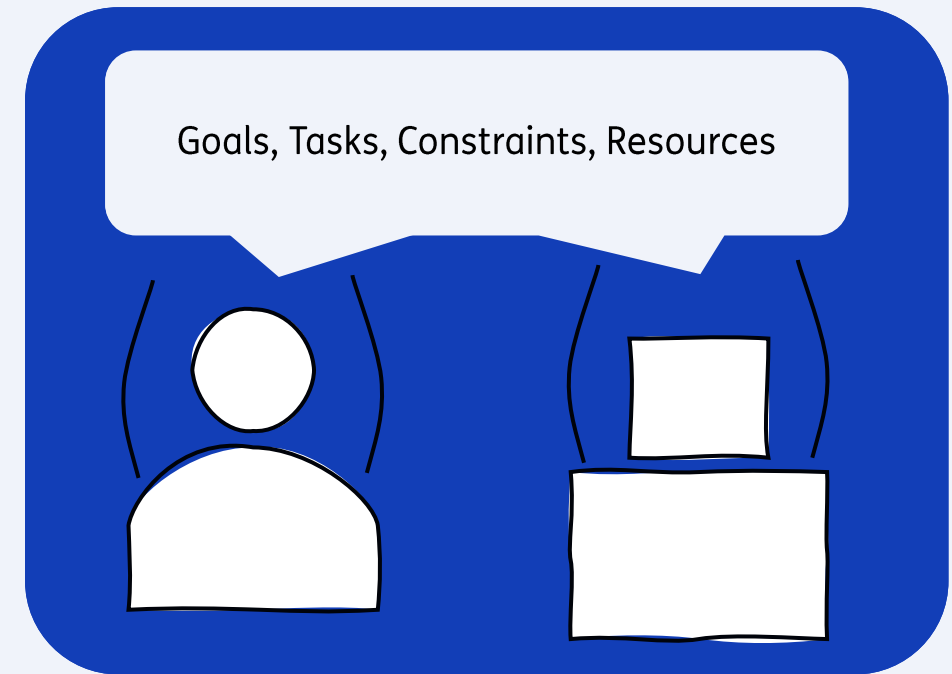
Operating 1 UAV: 3+ people  
Operating 2 UAVs: 5+ people

Reduced meaningful human control

A diminished overview of what the system is doing and what is happening, may lead to impaired decision making

# Team Design Patterns

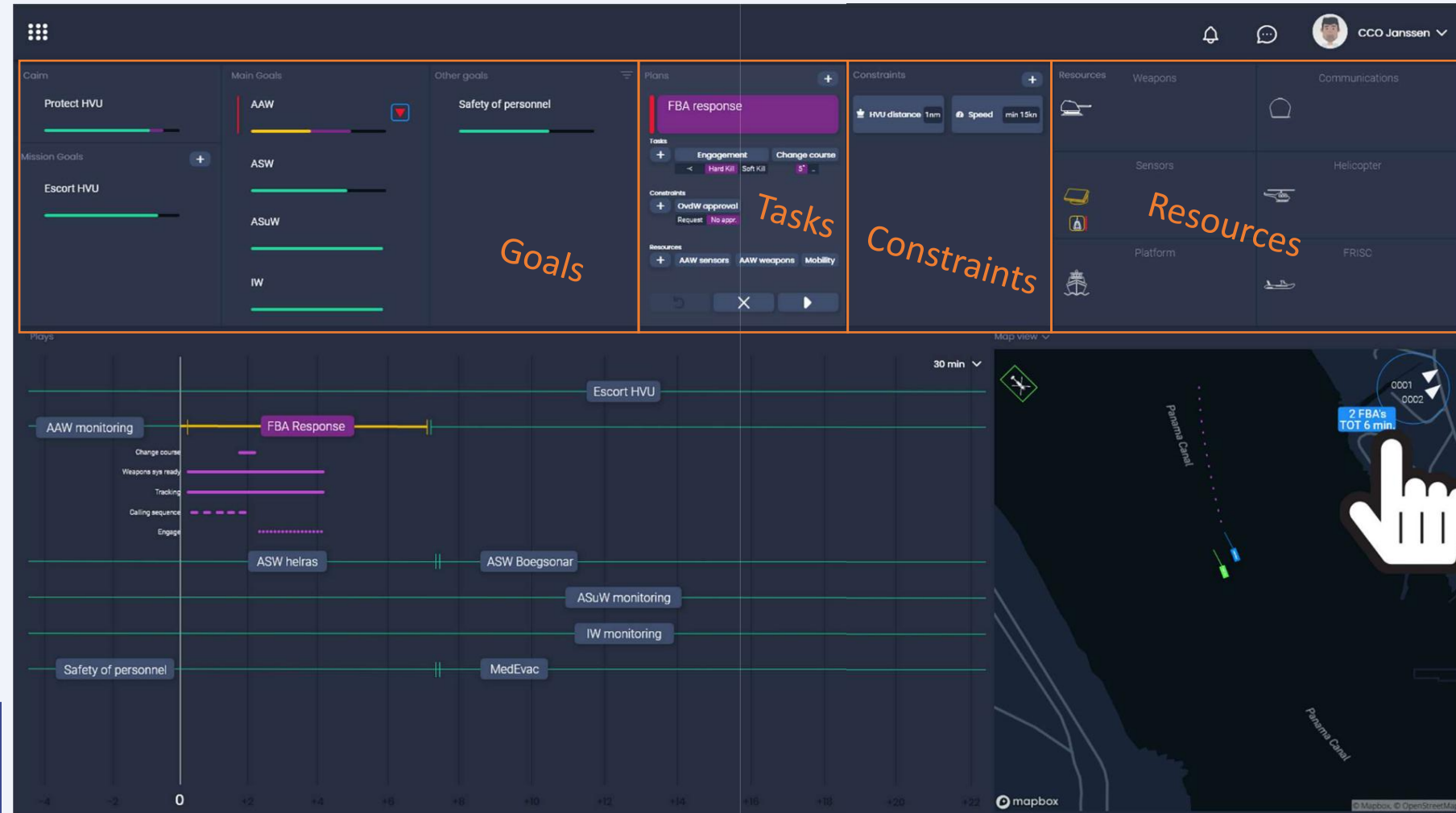
- Team Design Patterns are reusable solutions that describe how humans and intelligent agents can collaborate within teams. Each pattern includes:
  - **Design problem:** What are we trying to solve?
  - **Design rationale:** Why would this pattern work in this context?
  - **Design solution:** How do we try to solve it?
  - **Example:** A concrete illustration of the pattern in use
- TDP: Play-based delegation



(Diggelen et al, 2021)

# Team Design Pattern: Play-based delegation

- **Design problem:**
- How can users quickly and effectively communicate complex instructions?
- How can systems be given varying levels of autonomy depending on the situation?
- **Design rationale:**
- Plays are templates with **goals, tasks, resources, and constraints.**
- They can be customized and simulated before execution.
- **Design solution:**
- Play-based delegation
- **Example:**



**Level 5**  
Play delegation



# Summary

We discussed

- What Human-Machine Teaming is
- Human-Machine Teaming at TNO
- Why Human-Machine Teaming is important
- How to design for Human-Machine teams
- Design solution: play-based delegation





**Thank you for  
Your attention**

**TNO** innovation  
for life