Photo: Brit-Eli Danielsen

1. What is DP
2. Sensemaking challenges
3. HMI improvement ideas

"Sensemaking in high-risk situations. The challenges faced by dynamic positioning operators", Hurlen, Skjerve, Bye. ESREL 2019

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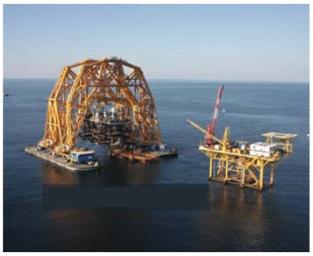
Dynamic Positioning: Application areas (examples)

Cable/pipe laying



Construction

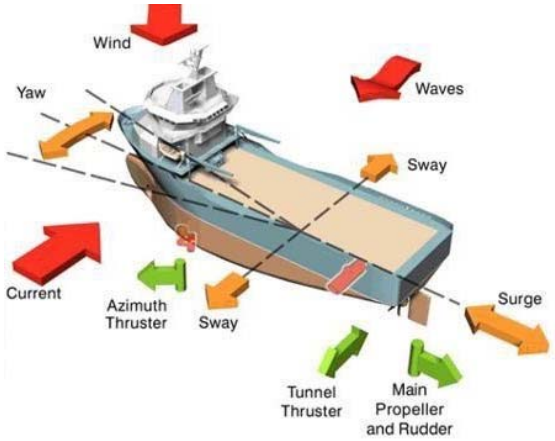
Cargo operations

Floating petroleum rigs

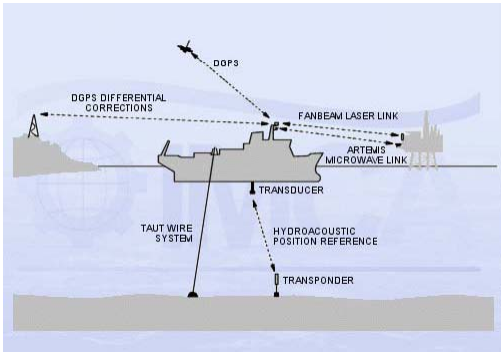
Photos: Thrustmaster

2

Dynamic Positioning: System structure & functions



Photos: Shipseducation.com



Reference systems:

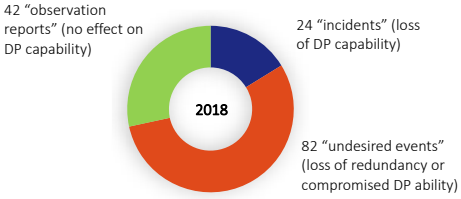
GPS
Laser links
Microwave links
Hydroacoustic position reference
Taut wires

Wind
Current
Gyros

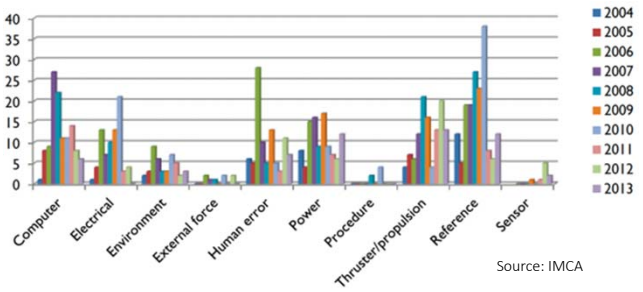
DP-related incidents

Frequency

- 2977 to 3911 annual hours of DP operation between events is reported for the years 2015 to 2018.
- In 2018, a total of 238301 hours of DP operation was recorded for 100 member vessels which together reported 147 events:



Causes



Source: IMCA

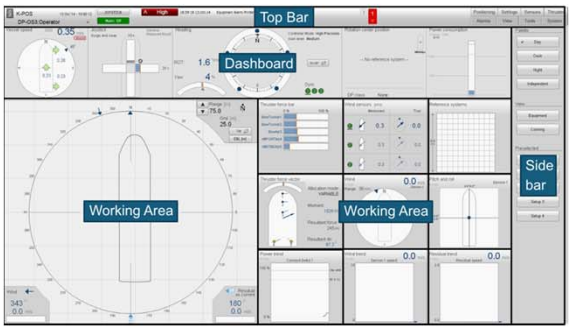
"… no accidents/incidents were a result from single technical failure or human action, while seven out of nine accidents and incidents were due to a combination of technical, human, and organizational failures".

Dong, Y., Vinnem, J.E., Utne, I.B. (2017). Improving safety of DP operations: learning from accidents and incidents during offshore loading operations.

DP HMI

Example: Kongsberg K-POS

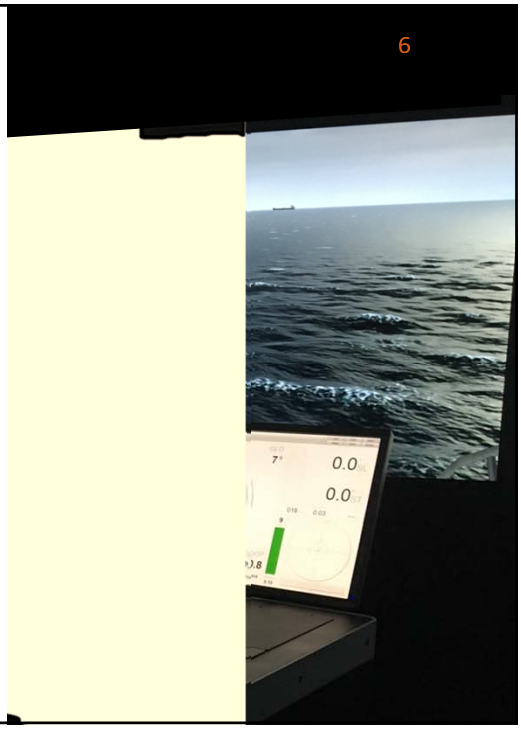
Physical buttons for key DP-mode selections



User configurable status screens (1-3)

The challenges faced by dynamic positioning operators (DPOs)

- Alarms/Alerts: Too many or too few
- Mode surprises
- Critical information hidden from view
- «Private» HMI limits shared SA
- Deskilling
- Out-of-the-loop



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- *Alarm presentation.* Numerous alarms in lists with much text to read seem ineffective as the only means of informing operators that need to make decisions fast.
- *Important alarms are missing or not salient enough.* Even though alarms are presented in the HMI they are not always noticed, especially if there are many of them.
- *Rare alarms are not understood.* Some alarms occur so rarely that operators struggle with their meaning even if they notice them.

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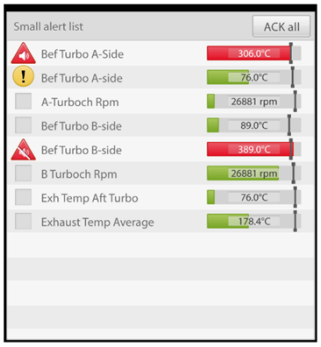
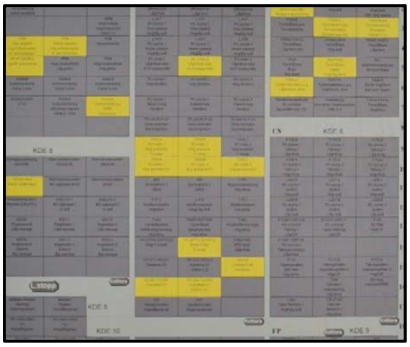
Alarm presentation





List

- Support slow sensemaking based on filtering and sorting
- Exception: Few alarms

Tiles

- Supports fast sensemaking based on pattern recognition

Mimic

- Support sensemaking based on visible cause-effect relationships
- Can be fast or slow sensemaking depending on interface management scheme / layering

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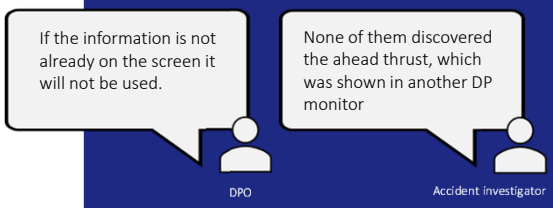

- *Surprises do occur.* "Of the 42 incidents recollections analysed (Martinsen, 2013) 19 were unexpected, and in five cases the DPO had no previous experience with the particular situation."
- *The risk of personalization.* When individual DPOs are responsible for selecting and arranging the information visible on the DP screens, critical information may be hidden from view and not used when an unforeseen situation occur.

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At-a-glance overview support

Petroleum control room

Nuclear control room

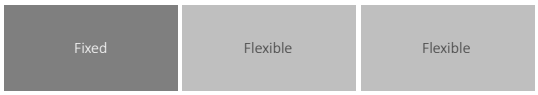
Can this HMI principle be utilized to improve safety in DP operations?

K-POS HMI practice

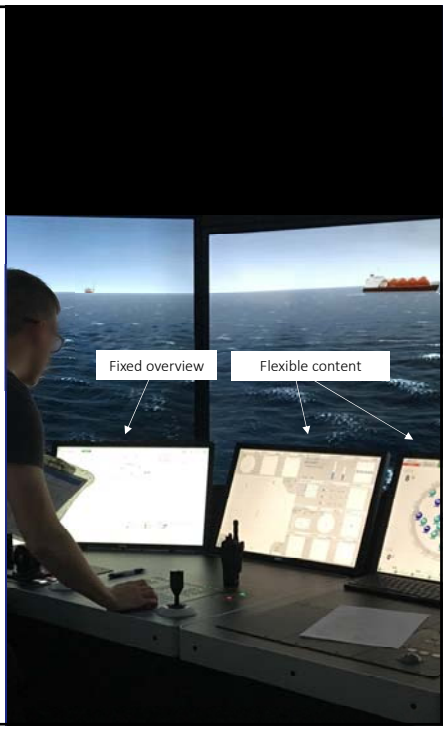
Alternative design

"At-a-glance" (fast) sensemaking support

2-screen setup



3-screen setup



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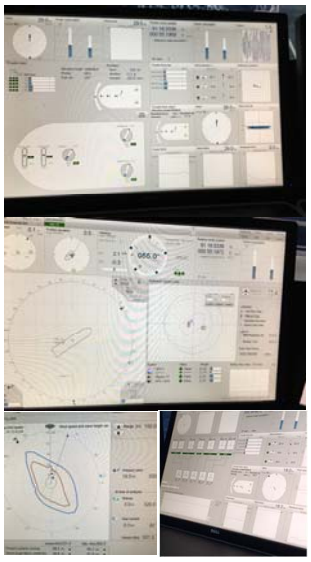
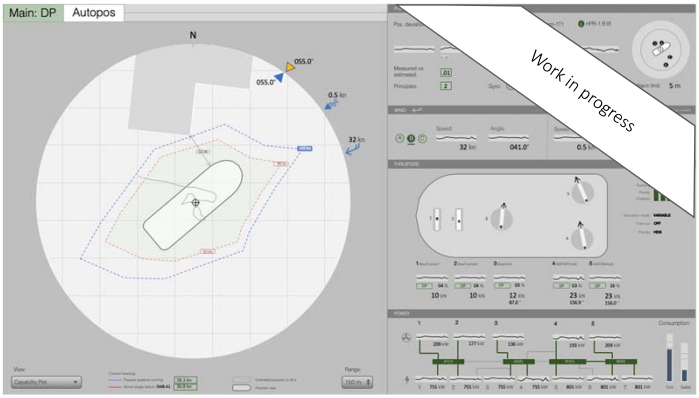
Design explorations: Fighting «SA demons»



Designing for Situation awareness, Endsley:

- Attentional tunneling
- Data overload
- Misplaced salience
- Complexity creep
- Design for stressed operators



Overall DP status and functional capability:

- DP status/mode
- Vessel position
- Forces acting on the vessel
- Resulting vessel movement
- Surrounding structures
- Capability plot
- Key alarms & alerts

Quick system status and diagnostics:

- Position reference systems
- Wind, wave and current
- Thrusters
- Power

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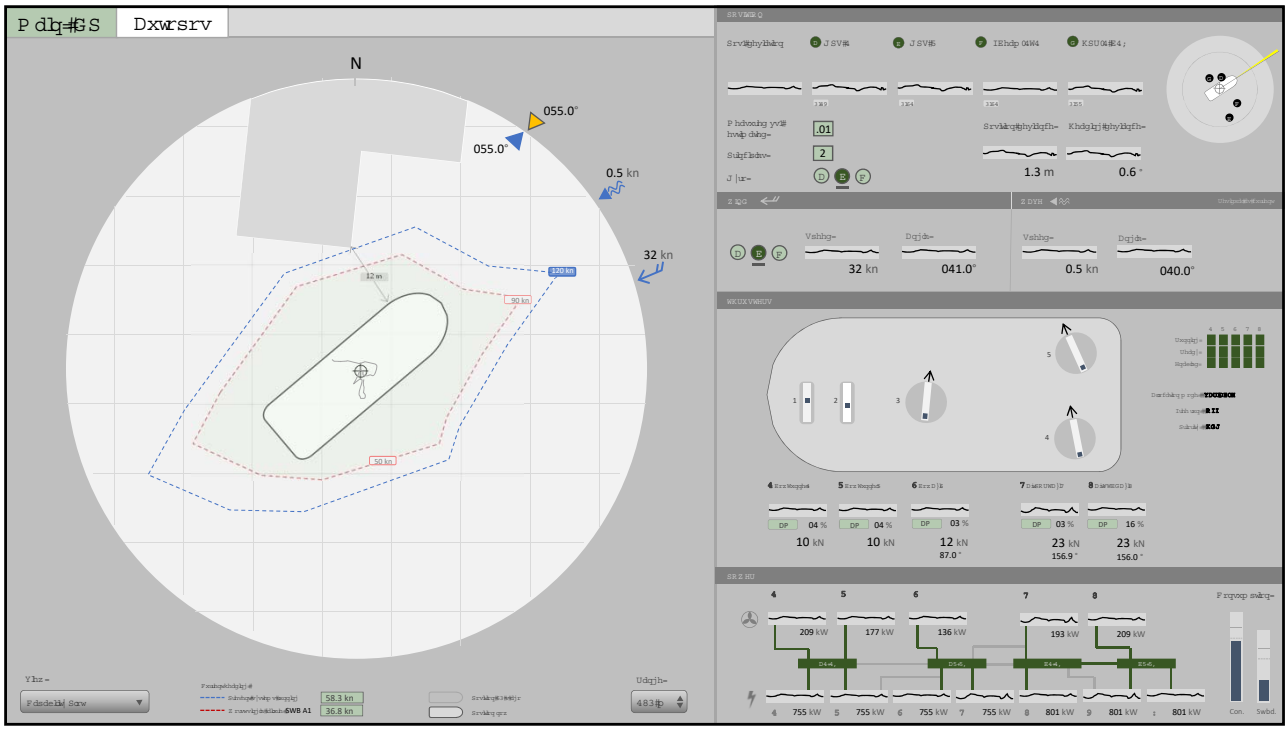
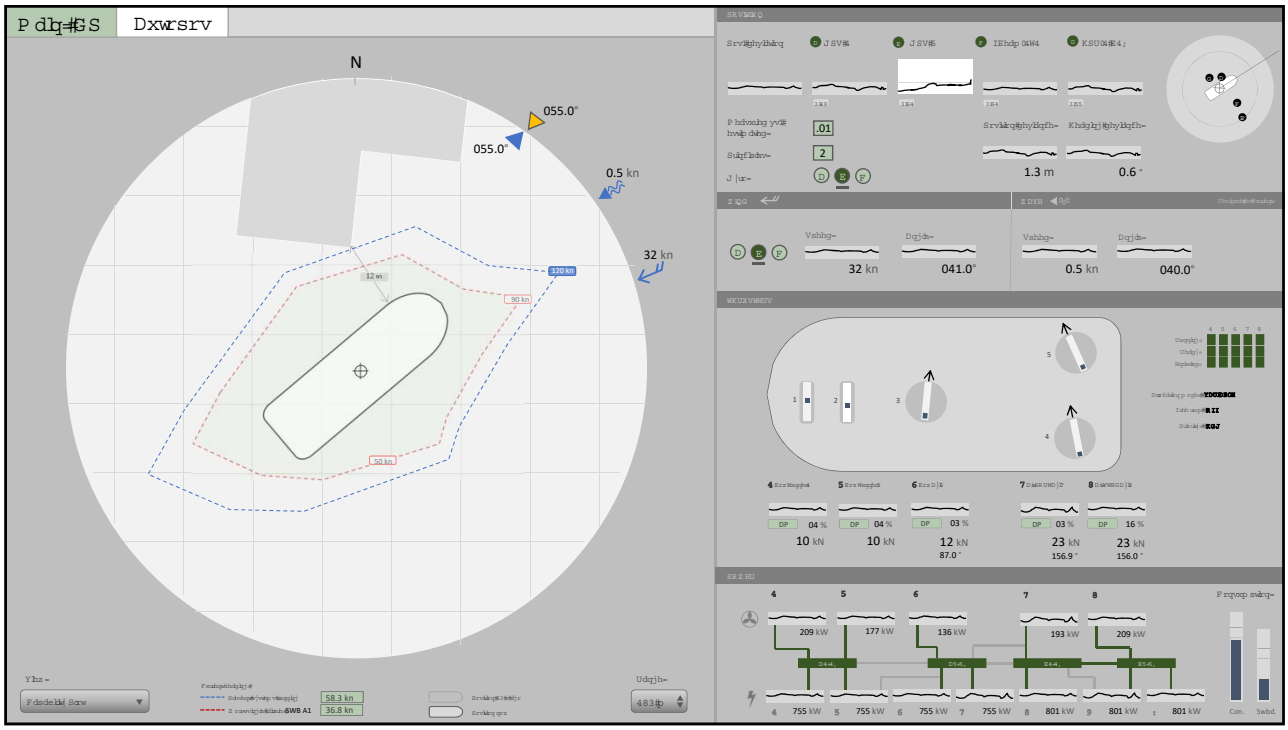

Pdq#GS
Dxwrsrv
N
055.0°
055.0°
0.5 kn
32 kn
32 kn
0.5 kn
041.0°
040.0°
1.3 m
0.6 °
10 kN
10 kN
12 kN
87.0°
23 kN
156.9°
23 kN
156.0°
209 kW
177 kW
136 kW
193 kW
209 kW
755 kW
755 kW
755 kW
755 kW
801 kW
801 kW
801 kW

13


Pdq#GS
Dxwrsrv
N
055.0°
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0.6 °
10 kN
10 kN
12 kN
87.0°
23 kN
156.9°
23 kN
156.0°
209 kW
177 kW
136 kW
193 kW
209 kW
755 kW
755 kW
755 kW
755 kW
801 kW
801 kW
801 kW

14


N
055.0°
049.0°
0.5 kn
32 kn
15,1 kn
3.0 m
1.3 m
6.0 °
32 kn
041.0°
0.5 kn
040.0°
24 kn
24 kn
32 kn
87.0 °
59 kn
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209 kW
755 kW
755 kW
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801 kW
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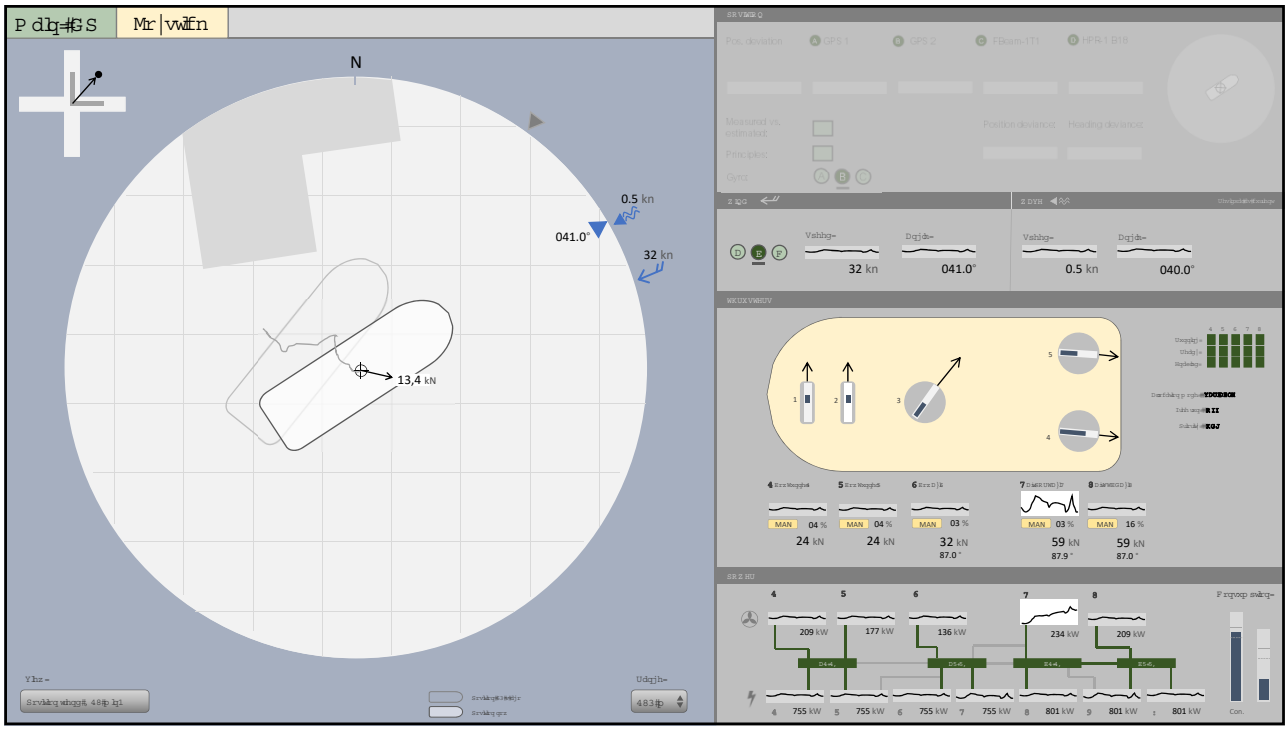
15


N
0.5 kn
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041.0°
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59 kn
87.9 °
59 kn
87.0 °
209 kW
177 kW
136 kW
234 kW
209 kW
755 kW
755 kW
755 kW
755 kW
801 kW
801 kW
801 kW

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Next steps

1. Adjust and refine these and other improvement ideas through dialogue with DP users, vendors and peers
2. Proof-of-concept excercise with end users
3. Summarize recommendations for the industry

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Thank you

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