**HFC – forum for human factors in control**

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# RAPPORT

TITTEL

**Nye driftsformer i oljeindustrien - hva gjør andre industrier - utfordringer og erfaringer;**
**Resultater fra HFC forum, 16. til 17.oktober 2013. (Møte nr 18)**

FORFATTER/REDAKTØR

Stig Ole Johnsen

OPPDRAGSGIVER(E)

HFC forum

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SAMMENDRAG

Denne rapporten inneholder agenda, deltakerliste, presentasjoner og relevante artikler fra HFC forum møtet den 16. til 17.oktober 2013 i Trondheim. Det er møte nummer 18 i regi av HFC forum. Det vedlagte materialet er fra:

| | |
|---|---|
| U. Muellerschkowski | Complex operations on the International Space Station |
| T. Stene | Human operated systems in space – erfaringer og nye initiativer |
| J. I. Ornæs | The Role of the Human Operator In future drilling operations |
| R.Waraich | Minimizing human factors mishaps in unmanned aircraft systems |
| R.H.Grønning | Emergency preparedness and response (Beredskap) - Lundin |
| A. Evensen | Telemedisin som integrerte operasjoner – støtte fra land |
| A. Balfour | NTNU Course: An Introduction to Human Factors - 2014 |
| Ø. Berg | Nye driftsformer i kjernekraft: "Small Modular Reactors |
| A. Transeth | Offshore robotics – Remote inspection/ maintenance of oil platforms |
| T. Wærhaug | Distribuert kontroll av produksjon i olje og gass |
| R. Pikaar | The need for guidelines using Closed Circuit Television (CCTV) |
| E. Brekke | Omvisning SIEMENS |
| P. Schäring | Inblick i framtidens kontrollrum |

| STIKKORD | NORSK | ENGELSK |
|---|---|---|
| GRUPPE 1 | Menneskelige faktorer | Human factors |
| GRUPPE 2 | ISO 11064 | ISO 11064 |
| EGENVALGTE | Sikkerhet | Safety |

# INNHOLDSFORTEGNELSE

# 1 Evaluering av møtet og innspill fra møtedeltakerne

## 1.1 Innledning

I denne rapporten gis en oppsummering av HFC møtet den 16. til 17.oktober i 2013 i Trondheim, hos SIEMENS. Tema var "*Nye driftsformer i oljeindustrien - hva gjør andre industrier - utfordringer og erfaringer*". Rapporten dokumenterer hovedbudskap, presentasjoner, relevante fagartikler (”papers”), oppsummering av evaluering fra deltakerne og liste over alle deltakere.

I det nedenstående har vi oppsummert evalueringene som deltakerne leverte inn.

## 1.2 Hovedbudskap

Møtet ga nyttige perspektiver, forskningsresultater og eksempler fra andre industrier som kunne deles. Automasjonsmiljøet (bruk av roboter) bør ha stor nytte av å utnytte teori fra Human Factors.

Behov for retningslinjer og god praksis for CCTV ble diskutert, og det har kommet til interessenter som vil prioritere etablering av god praksis/standarder for bruk av CCTV. De vil engasjere seg i prosjektet og bidra til finansiering – det er derfor satt i gang prosjekt for å utarbeide retningslinjer og god praksis for CCTV innen offshore.

I arbeidet med CCTV vil det være fokus på human factors og det å ivareta behovet for operasjonell sikkerhet. Vi vil se på god praksis for arbeidsbelastning, oppløsning, situasjonsforståelse (hvilke scener/ scenarioer er viktige), plassering/avstander/presentasjon, spesifikke tema som hvordan utnytte CCTV i kraner så du kan ha oversikt over både last og omgivelser, bruk av CCTV i lavbemannede situasjoner (for overvåkning av sikkerheten, personellsporing etc..).

CCTV prosjektet vil starte i løpet av 2014. Målet er å samle inn data, gjennomføre prosjektet og presentere rapporter og anbefalinger i løpet av 2014, bl.a. ved å legge inn referanser til relevante CCTV standarder i CRIOP.

## 1.3 Evalueringer

Møtet ble arrangert hos SIEMENS i Trondheim som stilte med møterom, arrangementsstøtte, lunsj og omvisning i sine områder. Tilbakemeldingene fra deltakerne var stort sett god på innhold, form og plassering.

Høstmøtet i HFC forum samlet ca. 60 deltakere, og både tema og foredragsholdere ble positivt mottatt. Det norske HFC forumet er en møteplass med mange forskjellige deltakere med forskjellige interesser, så vi har en utfordring med å gi alle deltakerne noe av interesse. Vi får derfor mange forskjellige tilbakemeldinger, alle konstruktive og gode kommentarer som bidrar til å påvirke møteform og møteinnhold i de påfølgende møtene.

Denne gangen var det mange forskjellige presentasjoner fra forskjellige industrier med perspektiver fra forskning, undervisning, anskaffelse, drift osv. Presentasjonene ble generelt positivt mottatt. Balansen mellom presentasjoner, diskusjoner og pauser synes å være bra.

"Workshopen" som ble arrangert ble oppfattet som god, med nyttige og engasjerte diskusjoner i gruppene. Felles middag og sosiale samlinger er vurdert som en viktig del av et slikt nettverk, og ble vurdert som bra – en skulle imidlertid ha satt av mer tid til det sosiale for å videreutvikle det faglige nettverket innen human factors.

### 1.4 Formen på HFC møtene

Formen på møtene, dvs. over to dager med hyppige pauser mellom forelesningene, fungerer bra. Forelesningene, workshop og muligheten for å diskutere i et fagnettverk ble trukket frem positivt. Det ble påpekt at det var viktig med tid til debatter og pauser slik at det blir tid til å utveksle erfaring med andre, og at en bør sette av mer tid og plass til det sosiale nettverket.

### 1.5 Samarbeid med HFN i Sverige

Det norske HFC forumet har et løpende samarbeid med human factors nettverket (HFN) i Sverige. Medlemmer fra HFN deltar aktivt på HFC møtene og de inviterer medlemmer i HFC til sine seminarer og møter. Aktuelle HFN samlinger kan være:

- "HFN-kurs, "*Safety differently - a new era for human factors and just organizational cultures*" Lecturer: Professor Sidney Dekker , Griffith University, Brisbane, Australia 7-8 January 2014, Linköping 2013. Ytterligere informasjon: www.humanfactorsnetwork.se

### 1.6 Tema og forelesere til de neste HFC møtene

Av tema som ble trukket frem som spesielt interessante til neste møte, kan nevnes:

- Helhetlig tenkning for Human Factors i bedrifter og fra tilsynsmyndigheter. Det virker som om Human Factors fokuset er på lys, ventilasjon og sittestillinger – men kognitive faktorer og grensesnitt menneske maskin eller organisatoriske faktorer ikke blir ivaretatt godt nok.
- Human Factors kommer ofte inn i driftsfasen – men kommer Human Factors inn i tidligfase – FEED fase, slik at systemene blir planlagt og utformet med tanke på Human Factors? Spesielt når kritiske systemer blir utformet?
- Hvordan ulike disipliner tilnærmer seg oppgaven å designe for sikkerhetskritiske miljø. Tema som går på tvers av disipliner– det blir ofte enten et rent teknisk perspektiv eller et psykologisk perspektiv.
- Hvorfor er det ikke opplæring innen Human Factors på universitets eller høgskolenivå i Norge?
- Gjennomgang av datastøttet samhandling – hva er status og utfordringer?
- Prosedyrer, arbeidsprosesser og etterlevelse – hvorfor har vi avvik?
- Oppsummering av status for Human Factors, og videre utvikling av fagområdet: Hva har vi oppnådd / bidratt med innen O&G siden 2000? Hvilken retning bør vi gå i framtiden – i et marked med større krav til effektivitet og mindre marginer? Hvordan utvikle fagområdet videre – dvs. stimulere til nytekning innen metode og praksis.
- Status HRA, bruk av HRA i forbindelse med QRA/SIL/LOPA/ barrieretekning. Bruk av HRA i andre industrier f.eks. kjernekraft. HRA - analyser - når benyttes de nå på nye områder? Metoder for Human Reliability Analyser, Human error identification, Presentasjon av PETRO HRA
- HF i barrierestyring – Menneskelige, operasjonelle og organisatoriske faktorer – når har mennesket fungert som barriere?
- HF i kontrollrom er det viktig for sikkerhet, eller det det knyttet til velvære for operatøren?

- CCTV spres og brukes i betydelig grad i forbindelse med nye driftsformer, men CCTV har ikke blitt vurdert som sikkerhetskritisk – hvorfor vurderes ikke CCTV som sikkerhetskritis?
- HF i hendelsesgranskinger; Human Factors i ulykkesgranskinger og granskninger generelt
- Bruk av prosedyrer f.eks. innen flybransjen, kommunikasjonsmønster
- HSI – design og V&V (Verifikasjon og validering).
- Bruken av CRIOP for Integrerte Operasjoner (liste nummer 7(i produksjon))
- Etikk, sikkerhet og risikokommunikasjon, hvordan kommuniseres risiko?
- Oppfølging av bruk av CRM - "Hjelper treningsprogram – som for eksempel CRM" Hvor er bevisene?
- HF i subsea operasjoner (f.eks. vedlikehold)..
- Gjennomgang av gode case - trekk inn erfarne operatører som har vært med på noen hendelser og som kan fortelle hva som gikk bra/dårlig – og hvordan/hvorfor operatørene tar feil valg/beslutninger i en kritisk situasjon

Av nye forelesere ble følgende ønsket til neste møtet. (Listen inneholder navn som har vært trukket frem tidligere uten at de har fått plass):

- Fra Airbus som er kritisk avhengig av Human Factors – forteller hvordan HF er integrert i hele organisasjonen
- Fra miljøetved NTNU/Psykologisk Institutt - Karin Laumann – f.eks. Gunhild Sætren, de som har sett på bruken av Human Factors i tidlig designfase – hva er resultatet?
- Fra fremtidens operasjonssenter (St Olav i Trondheim) – de som begynner å tenke på HF i sykehusene.
- Noen fra vegsentralene som kan prate om Human Factors innen deres domene – tar vi hensyn til Human factors innen vegtrafikk – hva er kriterier fror utforming av kontrollsentre?
- Google – hvilken erfaring har de (kontaktpersoner?)
- Workshop: nytenkning inn fagområdet Human Factors; Xuhong He (Lloyds Register): ny sofware for Human Reliability Analysis;
- Ønskeliste: Human-Automation Interaction: Thomas B. Sheridan ; Raja Parasuraman; Christopher D. Wickens;
- Noen fra AMOS? Har de tenkt noe i baner av HFC?
- Noen med erfaring fra organisatoriske intervensjoner, eller med praktisk kompetanse – f.eks . som har gransket en ulykke
- HRA eksperter fra IFE; eller PETORO – HRA
- DnV: HRA i MPD, HF/HRA vurderinger i forbindelse med "blowdown"; HF i SIL vurderinger – presentere krav i IEC 61508/11 – Presisere krav i forskjellige standarder at HF skal vurderes i forbindelse med barriereintegritet
- Andrew Hopkins – DwH ulykkesgransking. Få inn David D Woods eller Dekker eller noen som har sett på cognitive engineering . Behind Human Error: David D Woods;
- Dra inn noen av «pionerene» innen HF fagområdet i Norge (f.eks. Throndsen, Eskedal, etc.), og høre litt historie / oppsummeringer, råd.
- Ron Westrum - resilience, K. Mearns, Sidney Dekker, Rhona Flin, M.Endsley (Situational awareness), E. Hollnagel, R. Woods, J. Reason, C. Weick, K. Haukelid, Cato Bjørkli, Frode Heldal eller Stig O. Johnsen. Fra Telenor eller DNV f.eks Nalini Suparamaniam-Kallerdahl fra DNV, Gary Klein, Gorry, (Decision Making), J.Frohm (f.eks. automasjon eller lean production), G.R. Hockey fra Univ of Leeds, Mark Young.
- Interessant å utvide HF mot community of practice og praksisfellesskap som J.S.Brown, P.Duguide - hvordan mobiliserer man et praksisfellesskap?

- Fra andre forskningsmiljø vi ikke hører så mye fra: MiT – "user interface group", Google – erfaring ubemannede kjøretøyer eller fra miljøer som: Fraunhofer FKIE (Tyskland)

## 1.7 Kurs og forelesninger innen human factors

Ved NTNU arrangeres et innføringskurs innen human factors i vårsemesteret 2014, se: videre.ntnu.no/link/nv13444

## 1.8 Kontakt opp mot Human Factors fagnettverket i Europa og USA

Human Factor nettverket i Europa og USA, se: *www.hfes-europe.org* – som er den europeiske Human Factors and Ergonomics Society. HFES er tilknyttet den internasjonale Human Factors and Ergonomics Society, Inc. Se *www.hfes.org*.

# 2 Agenda og deltakerliste

## 2.1 Agenda for HFC møtet 16-17.oktober 2013

Vedlagt ligger agenda for HFC møtet.

| Dag 1 | Innlegg og diskusjon | Ansvar |
|---|---|---|
| 11.00-12.00 | Lunsj SIEMENS (og registrering) | P. Gundersen/ SIEMENS |
| 12.00-12.30 | Velkommen til seminaret og runde rundt bordet | |
| 12.30-13.00 | Complex operations on the International Space Station - training and execution in manned and unmanned situations | U. Muellerschkowski/ ESA |
| 13.00-13.30 | Diskusjon og pause | |
| 13.30-14.00 | "Human operated systems in space" – erfaringer og nye initiativer | /CIRIS,NTNU |
| 14.00-14.15 | Diskusjon og pause | |
| 14.15-14.45 | Hvilken rolle har mennesket i framtidens boreprosess, og hvordan påvirkes det tradisjonelle rollemønstret i bore-organisasjonene? | J. I. Ornæs/ NOV |
| 14.45-15.15 | Diskusjon og pause | |
| 15.15-15.45 | Minimizing human factors mishaps in unmanned aircraft systems | R.Waraich/ USA |
| 15.45-16.15 | Diskusjon og pause | |
| 16.15-16.45 | Emergency preparedness and response (Beredskap) - Lundin | R.H.Grønning/ Lundin |
| 16.45-17.00 | Diskusjon og pause | |
| 17.00-17.30 | Telemedisin som integrerte operasjoner – støtte fra land ved sykdom offshore | A. Evensen/ Statoil |
| 17.30-17.45 | HF kurs ved NTNU våren 2014 – Introduksjon til Human Factors teori & CRM (Del av mastergrad eller PhD) | NTNU/ A. Balfour |
| 18.00- | Middag (og Revy) | |

| Dag 2 | Innlegg og diskusjon | Ansvar |
|---|---|---|
| 08.00-08.30 | Kaffe og noe å bite i | SIEMENS |
| 08.30-09.00 | Nye driftsformer i kjernekraft: "Small Modular Reactors, Generation III+ and IV" | Ø. Berg/ IFE |
| 09.00-09.30 | Offshore robotics – Remote inspection and maintenance of oil platforms | A. Transeth/ SINTEF |
| 09.30-10.00 | Diskusjon – Hva er human factors utfordringene? | |
| 10.00-10.30 | Distribuert kontroll av produksjon i olje og gass | T. Wærhaug/ SIEMENS |
| 10.30-10.45 | Diskusjon og pause | |
| 10.45-11.00 | The need for guidelines and standards using Closed Circuit Television (CCTV) - introduction to workshop | R. Pikaar/ ERGOS |
| 11.00-13.00 | Omvisning SIEMENS - Subsea Power Grid (SPG) og Lunsj | E. Brekke/ SIEMENS |
| 13:00-14:00 | ”CCTV workshop, Organisational and human factors requirements related to standards – needs from the industry” | R. Pikaar/ ERGOS |
| 14.00-14.30 | Inblick i framtidens kontrollrum och designverktøy for Human Factors som underlättar den itterativa processen att nå bäst muligt resultat. | P. Schäring/ CGM |

## 2.2 Påmeldte og deltakere

Nedenstående tabell lister opp påmeldte og deltakere i HFC møtet.

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# Complex operations on the International Space Station

**Uwe Müllerschkowski, Columbus Payload Instructor Team Lead, Astronauts Training Division (HSO-UT), European Astronaut Centre - ESA**

**Mer informasjon:**

We are also training an experiment that deals with Ultrasound-Scans on the ISS and remote guidance (like in tele-medicine) or with an experiment called METERON dealing with autonomous and real-time tele robotics
www.esa.int/TEC/Telerobotics/SEM9MYVWVUG_0.html

ECSS Space Engineering; Human Factors Engineering; ECSS-E-10-11A (draft 07-Sep-2007)
http://www.ecss.nl/forums/ecss/dispatch.cgi/home/showFile/100441/d20070925143339/No/ecss-e-10-11A-Draft20%287September2007%29.pdf

Video: Luca EVA#23 critical situation, 16-Jul-2013
http://spaceinvideos.esa.int/Videos/2013/08/Critical_Situation

International Space Station Program; SSP 50253; Operations Data File Standards (current version is Rev. U; January 2013) latest on-line available version is Rev. L, December 2004:
http://spaceflight.esa.int/eo/EOI/esa-odf-site/odf_std/ODF_Stds_RevL.pdf

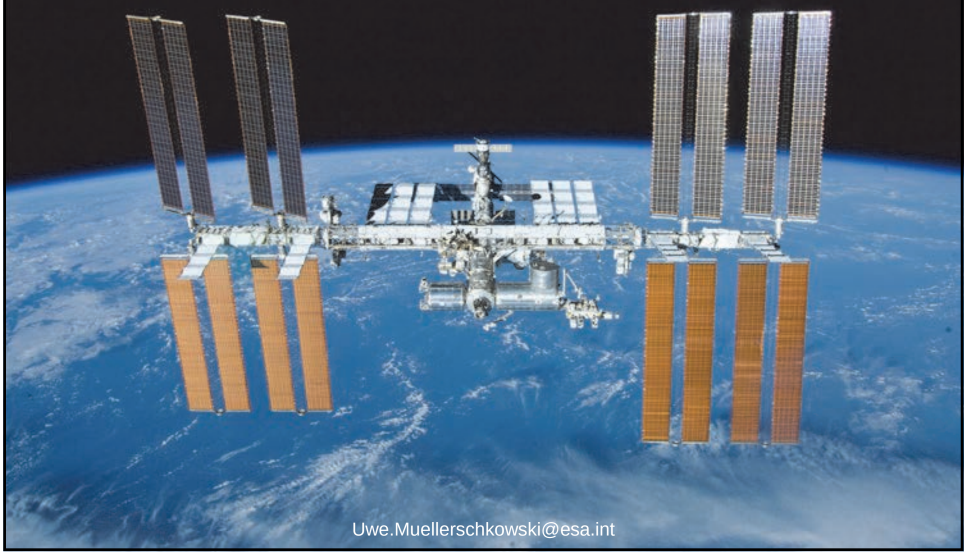
David L. Akin (2013), Spacecraft Habitability, ENAE 697 – Space Human Factors and Life Support
http://spacecraft.ssl.umd.edu/academics/697S13/697S13L10.habitability2x.pdf

ISS Human Factors Support
http://www.nasa.gov/centers/johnson/slsd/about/divisions/hefd/project/iss-human-factors.html

esa Lufthansa Flight Training

## *Complex operations on the International Space Station*

***training and execution in manned and unmanned situations***

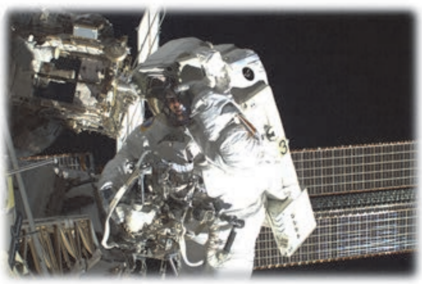


Uwe.Muellerschkowski@esa.int



## Outline

- What makes ISS operations ‘complex’
- Operations based on procedures
- Astronaut training and challenges
- Ground personnel training and challenges
- How is feedback used to improve operations



## What makes ISS operations 'complex'

- Hostile/unfamiliar environment for astronauts on ISS
  *(weightlessness, constricted room, high workload/stress, vacuum outside, permanent risk of emergencies: fire, depress, toxic atmosphere)*
- Relatively short stay (≈ 6 month) of astronauts on the ISS
- Interaction of multiple teams (crew ⇔ multiple Control-Centres)
- Synchronous and asyncronous communication
- Parallel activities/schedules
  *(e.g. about 100 to 140 experiments are running on ISS at the same time)*
- A lot of complicated 'hi-tech' equipment and activities . . .

**Main goal is to successfully perform operations and to bring our astronauts back home safely!**




esa — *Complex operations on the ISS* training and execution — Lufthansa Flight Training

## What makes ISS operations 'complex'

- To continuously operate the ISS a lot of tasks have to be accomplished.
- But crew time on the ISS is rare and precious. Crew time is usually 'over-booked' and still there are 'reserve activities' waiting.
- Therefore the astronauts perform primarily tasks which cannot remotely be done from ground and where physical presence is needed.
- Most of the 'monitoring & commanding' tasks are performed from ground without any crew interaction.

↳ Therefore we have basically three modes of operation:
  - Crew only (independent from ground)
  - Ground only (no crew required)
    *the ISS could be considered "unmanned"*
  - Interactive Crew & Ground (working as one team)

## ‘Complex’ ops: Short stay – frequent crew change

- Relatively short stay (≈ 6 month) of astronauts on the ISS
  - ‘inexperienced’ at increment start
  - learning curve
  - when experienced at the end of 6 month stay: leaving
  - new crew member ☞ new learning curve
  - ↳ also challenging for the support teams

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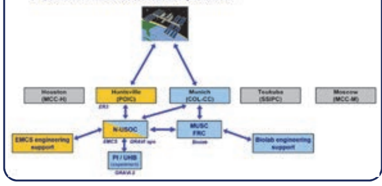
## ‘Complex’ ops: Interaction between different teams

- The ISS is run in ‘segregated’ operations for:
  - Russian Orbital Segment (ROS)
  - US Orbital Segment (USOS)
    incl. Canadian, European and Japanese elements
  - The US furthermore distinguish between:
    - Mission-Control: Houston
    - Payload/Science operations: Huntsville
- The astronauts are in direct contact with <u>five</u> Control-Centres
- But there are numerous additional support centres
  (e.g. eight additional USOCs only in Europe)

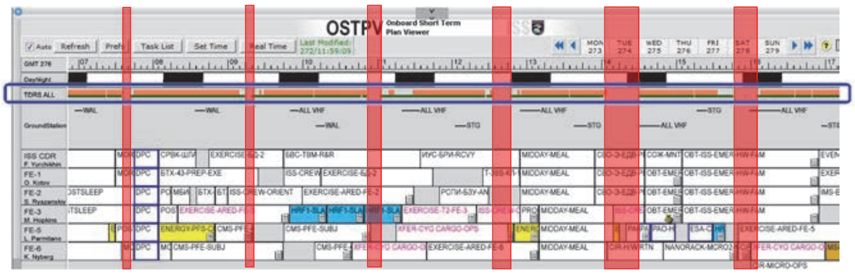
<u>Example:</u> GRAVI-2 experiment

GRAVI-2 is a collaborative IP effort.
In general:
All questions related to **Biolab / GRAVI-2** specific hardware notify **Munich**
All questions related to **ER3 / EMCS** notify **Huntsville**



## ‘Complex’ ops: Synchronous / asyncronous communication

- Communication, telemetry (monitoring) and commanding of the ISS is based on satellite connections (in S-band and Ku-Band)
- During Acquisition Of Signal (AOS) ground is “live on board”
- During Loss Of Signal (LOS) ground is “blind” and the crew is on its own
- ↳ There might be quite significant times where we are in LOS
- ↳ *“to be on the safe side”* this needs to be considered for operations









## ‘Complex’ ops: resilience in AOS and LOS (“unmanned”)

- in AOS:
  - for operations where Ground is nominally “prime”, we might use the crew as back-up and for recovery in case of failures or technical problems
  - therefore most of the procedures have “alternate” crew blocks and ground blocks, which are identical in result
- in LOS (“unmanned”) or when crew cannot take over for recovery:
  - general design principle of our hardware/systems is: ***“safe without services”***
  - meaning each system has an (independent) internal control loop that allows for safe operations (at least temporarily) without need for interaction
  - if safe operation cannot be assured, there must be an automatism to bring the system back into a safe configuration or shut it down completely

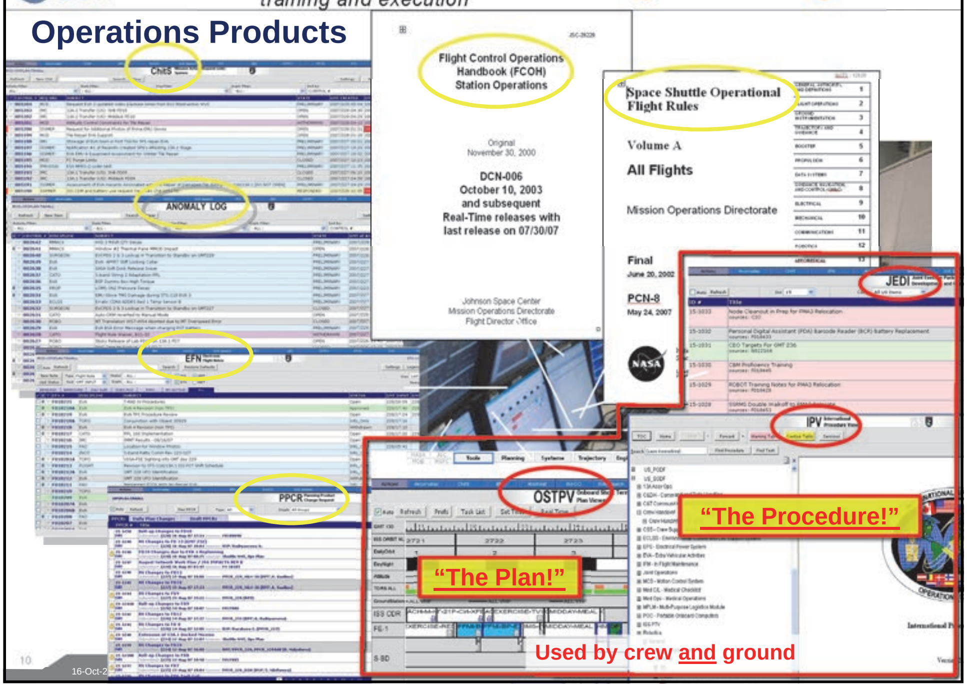
# Outline

- What makes ISS operations ‘complex’
- **Operations based on procedures**
- Astronaut training and challenges
- Ground personnel training and challenges
- How is feedback used to improve operations






# Operations Products



## Operations based on procedures

- "The Plan": Detailed schedule of all activities
  - Showing all crew and all ground activities
  - Displayed electronically in the Onboard Short Term Plan Viewer (OSTPV)

- "The Procedure": Detailed instructions for all tasks
  - Covering all crew and all ground activities
  - Displayed electronically in the International Procedure Viewer (IPV)
  - Procedures are linked directly from activities in OSTPV



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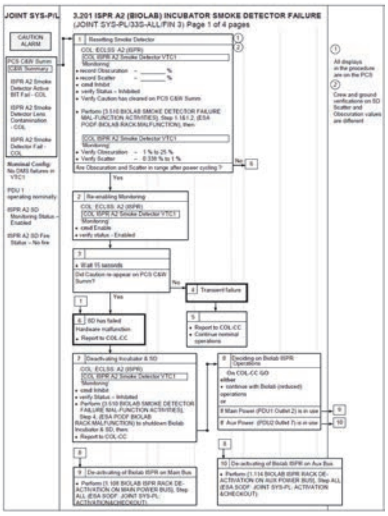
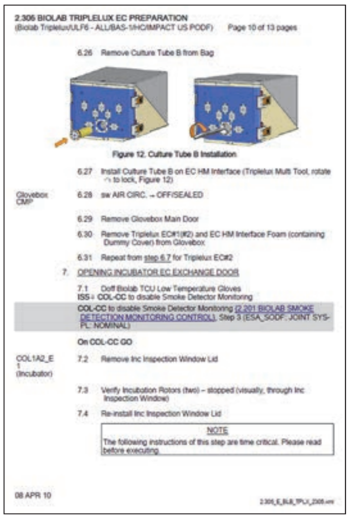
## How do ISS procedures look

Logic Flow Procedures Format




Mainly used:
Checklist Procedures Format




According to SSP 50253 Operations Data File Standards

## How do ISS procedures look

Procedures also contain 'Operations Hazard Controls' in a standardised format (= safety information)

**CAUTION**s shall be used for events that cause loss or damage to hardware that supports on-orbit life sustaining functions, critical mission support capabilities, and emergency systems.

| CAUTION |
|---|
| Keep temperature sensor probes centered in duct opening to avoid damage to probes. |

**WARNING**s shall provide information necessary to ensure crew safety.

| WARNING |
|---|
| CO2 discharge from US PFE is an asphyxiation hazard. Breathing Mask must be worn during and after discharge. |

According to SSP 50253 Operations Data File Standards






## Operational use of procedures

- Crew and ground **strictly** follow procedures
- Procedures are reviewed, verified and validated on ground (also during training) prior to final release
- Depending on the procedure purpose/topic there are several mandatory and/or optional reviewers
  *(e.g. crew representatives, engineering, scientists, flight controllers, trainers)*
- The safety organisation is mandatory reviewer of all procedures

## Operational use of procedures

Why using detailed procedures:

- It's a help for the operator
  - no need to remember details by heart, concentrate on skills instead
  - give confidence that all necessary information is available to successfully perform the activity in time
  - "single source" of information (no need to verify or look-up in other documents)
- the validation process of the procedure should guarantee that the activity works as expected and will be successful
- review by safety organisation makes sure all (known) hazard controls are implemented
- **"situational awareness":** everyone is "on the same page" and knows what comes next (*" … tell us in which step you are …"*)
- Mandatory call-outs in the procedure are used to sync crew and ground

**ISS⇓ COL-CC** to disable Smoke Detector Monitoring

**COL-CC** to disable Smoke Detector Monitoring {2.201 BIOLAB SMOKE DETECTION MONITORING CONTROL}, Step 3 (ESA_SODF: JOINT SYS-PL: NOMINAL)

**On COL-CC GO**

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## Operational use of procedures

Procedures are **not** there to:

- **evaluate the operator** (good / bad execution).
  Procedures are not rating forms!
- **replace training**
  Anyway a procedure cannot replace skills.
- **replace highly qualified operators by "switch monkeys"**
  *" … you don't need to know, just do what's written in the procedure!"*
- **eliminate other ways of solving a problem**
  There are also "alternate nominal" procedures.
- **restrict or limit the freedom to think on your own**
  If you think you have a better way to execute an activity, make a change request to the procedure.

## Operational use of procedures: Example 1

Extra Vehicular Activity: Luca EVA#23 critical situation, 16-Jul-2013

http://spaceinvideos.esa.int/Videos/2013/08/Critical_Situation






## Operational use of procedures: Example 2

During exchange of Water Pump Assembly the noise insulation blanket did not fit . . .

## Operational use of procedures

"Basics" for ISS operations:

- Strictly follow procedures
  *(don't try to be "creative" on your own ☞ there's a high risk to leave the operational agreed envelope and you will "surprise" others)*
- If in doubt, check with ground
- **No operations without procedure!**
- If the situation develops to go outside of an agreed procedure:
  - stop all activities
  - bring the situation/system back into a known safe configuration
  - if this is not possible, start contingency/emergency procedure
  - a new procedure will be developed and validated before continuation of the task
  - **Safety is more important than success!** (requires specific attitude)
- continue with the regular plan






## Outline

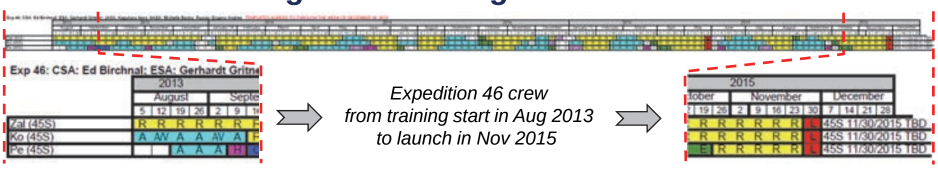
- What makes ISS operations 'complex'
- Operations based on procedures
- Astronaut training and challenges
- Ground personnel training and challenges
- How is feedback used to improve operations

## Astronaut training and challenges






## Astronaut training and challenges




- Long training flow
  two years 'basic training'; waiting for assignment; 28 month flight specific flow
- Training based on skills and procedures
- Huge amount of training content
- From training level/time the crew members are rather 'alrounders'
  (than really  specialists in a specific domain)
- Not everything can be trained close to launch
  (but everyone requests most recent training, e.g. all scientists want to get their experiment trained as late as possible)
- Simulations (nominal ops / emergency) are also used in crew training
- Simulation scenarios 'mimic' interaction with Flight Control Teams

## Astronaut training and challenges

Main challenges are:

- Balanced information between ‘need to know’ and what is covered by procedure
- Main target is ‘skills training’ supported by procedures
- Procedures need to be ready in time for training
  (sometimes difficult due to late hardware development or certification process)
- If the concept of a procedure or important content has changed after training implementation, a “refresher training” or on-board-training (OBT) might be necessary






## Outline

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## Ground personnel training and challenges

**Mission Control Centre, Houston (MCC-H)**

**Columbus Control Centre, Munich (Col-CC)**



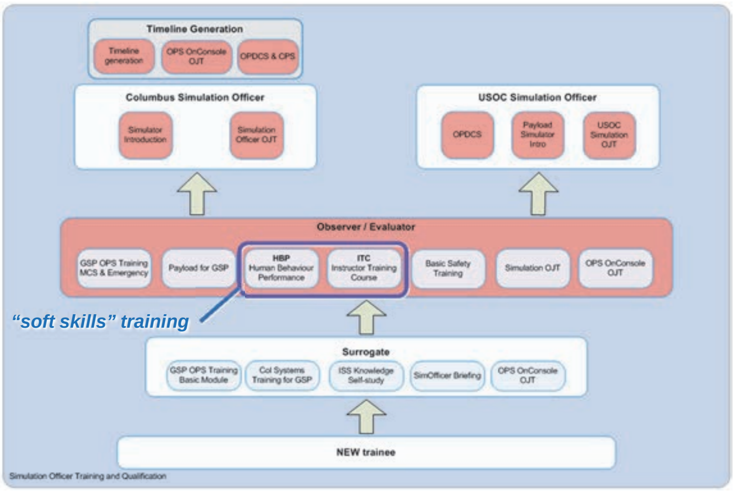



## Ground personnel training and challenges

- Controllers on ground are mainly highly qualified specialists for their system or experiment
- Besides their special field they get also general training courses for topics like ISS Program Overview, Daily Operations, Electronic Tools & Planning
- That includes a Human Behaviour and Performance (HBP) course:
  - Communication
  - Teamwork
  - Situational Awareness
  - Decision Making
  - Behavioural Observations
  - Behavioural Debriefings
- The certification of a Flight Controller is based on the performance during simulations

## Ground personnel training and challenges

To prepare and implement the simulations for Flight Controller and crew specialised 'simulation officers' are trained and certified









## Ground personnel training and challenges

Main challenges are:

- In remote 'ground only' operations the ground controller is the 'owner' of the activity. He is supposed to be the specialist and 'master'.
  But when it comes to interactive operations, the controller has to step back and support the crew.
- Develop an attitude towards working together in a team to support the crew on orbit
  ☞ basically the astronauts on the ISS are our remote 'eyes and hands' to accomplish a common goal
- Being subject matter experts in their domain, sometimes the understanding is missing what a "non specialist" might need as support
- Especially in the beginning of training: Focused rather on technical details (in their own field) than on the situational awareness for the whole Flight Control Team

## Outline

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## How is feedback used to improve operations

As ISS operations is mainly procedure driven there are basically five focal points for feedback:

1. Ops products / procedures (including stowage information)
2. Optimisation of crew-time and planning
3. Hardware
4. Interaction with ground
5. Training (compared to experience on-orbit)

## How is feedback used to improve operations

Feedback is collected throughout the whole process:

- Before mission/operations (e.g. as crew review / feasibility assessment during hardware development)
- During preparation of ops products and procedures (by defined review processes)
- During simulations (e.g. for interaction between crew and ground)
- During training (while a crew member uses a procedure or hardware)
- During real-time operations (direct verbal feedback or crew note)
- During post-flight crew debriefs (scheduled sessions for every crew)




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## Feedback to improve operations: A few examples

1.) Immediate actions to Luca's EVA #23 critical situation (excerpt):

- all further EVAs currently on hold
- Four independent teams established to investigate "Contingency EVA Capability"
- technical investigations on going on how to improve reliability of the suit cooling system
- developing "Water in Helmet: Response Sequence" (including training)
- Proposal for risk mitigation: considering snorkel as additional equipment (favorable trade when considering water inhalation risk)

| Product/Analysis | Type |
|---|---|
| FN 58998: Water in EMU | Procedure |
| FN 58999: Expedited Repress | Procedure |
| FN 59001: Expedited Suit Doffing | Procedure |
| FN 59003: CO2 Sensor Bad | Procedure |
| FN 59000: Airflow Contamination | Procedure |
| EMU Go/No-Go (Pre and During EVA) | Flight Rule |
| Snorkel Build Procedure | Procedure |
| Snorkel Build On-Board | On-Board |
| Snorkel Certification (EMU Safety Only) | Analysis |
| CAM Buckle Inspection - SODF | Procedure |
| Crew CAM Buckle Inspection | On-Board |
| Crew and FCT Training Package Development | Training |
| Crew Training: Implementation | On-Board |
| FCT Training: Implementation | Training |
| Loss of Comm During EVA Protocol | Training |

## Feedback to improve operations: A few examples

2.) OSTPV (plan viewer) allows for direct entries of crew notes for each activity.

Example for a crew note requesting a procedure update:

"procedure X.XXX needs to be rewritten. I have never seen a procedure where a step is explained as a table. I may have done it in training, but I don't recall it at all.
. . .
My strong recommendation is to make a video of it, going through the procedure step by step, showing each individual item (so it's easily recognisable), how and where it's connected, and the final general view."

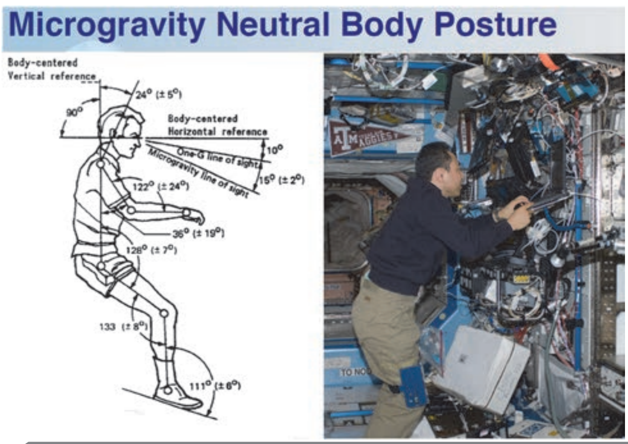





## Feedback to improve operations: A few examples

3.) Feedback for hardware usability from crew review or training

There are quite a number of technical reviews before hardware is delivered for operations or training, e.g.: SSP 57000, Pressurized Payloads Interface Requirements Document (including annex F "Human Factors Implementation Team (HFIT) Verification/ Certification")



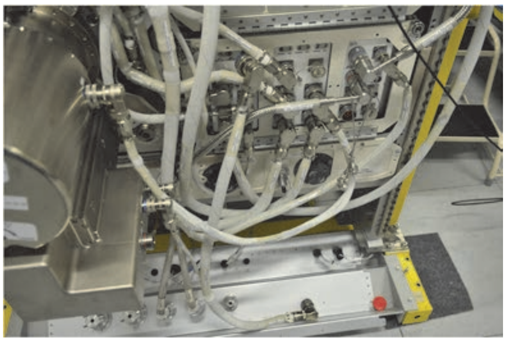

Ref: David L. Akin (2013), Spacecraft Habitability, ENAE 697 – Space Human Factors and Life Support

## Feedback to improve operations: A few examples

3.) Feedback for hardware usability from crew review or training

As this comes quite late in the development process, not all requests can be implemented. Nevertheless frequent updates are:

- Clear, consistent, non-ambiguous labels (text on labels)
- Use of colour codes (e.g. for connector mating to ease identification)
- Removal of temporary obstructions to ease access (e.g. remove tethered connector caps)
- Define "optimal" installation sequence (to be included in procedure)



**H/W installation check using a training model**

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## Summary

- Multiple factors are contributing to 'complex' operations.
- One major driver of complexity is interaction between different teams, regarding situational awareness and communication.
- Strict use of procedures is one key factor to 'streamline' complex ISS operations.
- Procedures are also used to define operational envelops with respect to hazard controls and safety implementation.
- This strict use of procedures usually require a change in attitude and working style for all players (on ISS and on ground).
- Simulation scenarios are used for training and to practise 'complex' operations. Results from simulations are fed back into operations.
- Technical validation and feedback is used throughout training and operations. The attitude to consider feedback as positive trigger for improvement must be established.

***Thanks for your attention!***

*Please feel free to ask questions.*

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## References

1. ECSS Space Engineering; Human Factors Engineering; ECSS-E-10-11A (draft 07-Sep-2007)
   http://www.ecss.nl/forums/ecss/dispatch.cgi/home/showFile/100441/d20070925143339/No/ecss-e-10-11A-Draft20%287September2007%29.pdf
2. Video: Luca EVA#23 critical situation, 16-Jul-2013
   http://spaceinvideos.esa.int/Videos/2013/08/Critical_Situation
3. International Space Station Program; SSP 50253; Operations Data File Standards (current version is Rev. U; January 2013)
   latest on-line available version is Rev. L, December 2004:
   http://spaceflight.esa.int/eo/EOI/esa-odf-site/odf_std/ODF_Stds_RevL.pdf
4. David L. Akin (2013), Spacecraft Habitability, ENAE 697 – Space Human Factors and Life Support
   http://spacecraft.ssl.umd.edu/academics/697S13/697S13L10.habitability2x.pdf
5. ISS Human Factors Support
   http://www.nasa.gov/centers/johnson/slsd/about/divisions/hefd/project/iss-human-factors.html

all images and video courtesy of NASA and ESA

 

HFC

# "Human operated systems in space" – erfaringer og nye initiativer

**T. Stene, CIRIS, NTNU Samfunnsforskning AS**

**Mer informasjon:**

ESREL 2013:
"Human dependability in space control operations—a HOT perspective" S.O. Johnsen, T. Stene & T.Ø. Kongsvik

"Control room training and certification for space operations" B.E. Danielsen & T.M. Stene

"Improving human resilience in space and distributed environments by CRIOP" S.O. Johnsen, T.M. Stene

NTNU
Samfunnsforskning AS

# "Human operated systems in space" – experiences and new initiatives

HFC Forum, 16. – 17. oktober 2013

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# Outline

- N-USOC (Norwegian User Support and Operations Centre)
- Experiences with "Human operated systems in space"
- Challenges and opportunities
- HuDeM project

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- N-USOC (Norwegian User Support and Operation Centre)
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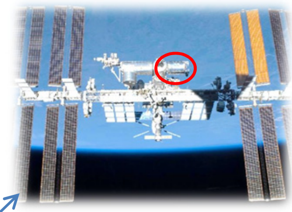
CIRiS CENTRE FOR INTERDISCIPLINARY RESEARCH IN SPACE

# N-USOC

## (Norwegian User Support and Operations Centre)



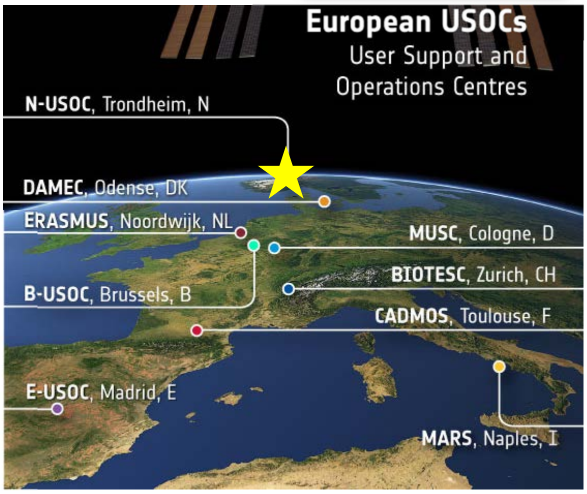
- Ground operations of experiments
- Interactions with ESA and NASA control centres

## N-USOC, Trondheim

- One of 9 centres i Europe
- Operative since 2006

**Focus first years**;
Development of ...

- experimental protocols, methods and equipment
- competent operators

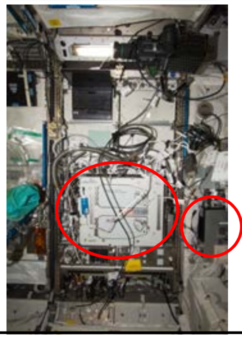



# Outline

- N-USOC (Norwegian User Support and Operations Centre)
- Experiences with "Human operated systems in space"
- Challenges and opportunities
- HuDeM project

# N-USOC experiments

- Cultivation of plants in space
  - Cooperation with astronauts
    - perform experiments based on procedures, dialog and support from control rooms on earth
- Technology demonstrator (VesselID)



**New initiatives**

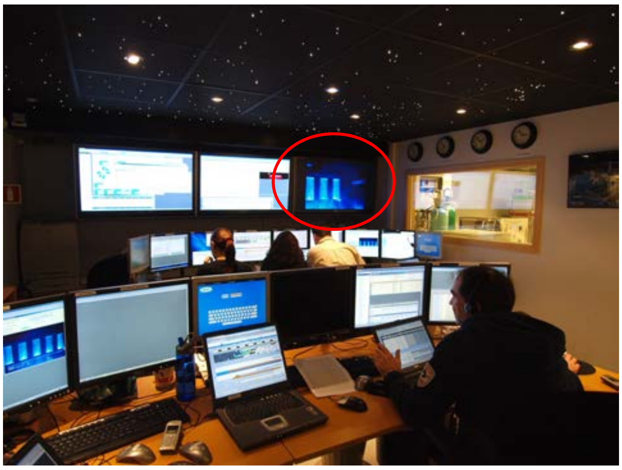
- Future exploration Moon/ Mars
- Spin-out: greenhouse experiments

# "Human operated systems" Experiences from a HFC perspective

- My meeting with N-USOC (some impressions)
- The Control Room context
  - Stars
  - ISS localisation
  - Day and night
  - What is going on (Time schedule; crew, activities and experiments)

## Remote control of ISS experiments

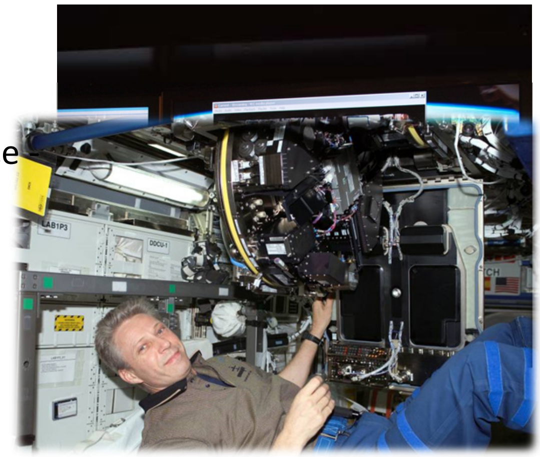
- From ground
- Real time control and pictures





## Cooperation and communication

- Real time video from space activities
- Crew activity
- Communication space ground



- Cooperates with a lot of control centres
- Can hear everything that goes on
- Voice loops
- Complex procedures

- A lot of training and simulations needed



# Outline

- N-USOC (Norwegian User Support and Operations Centre)
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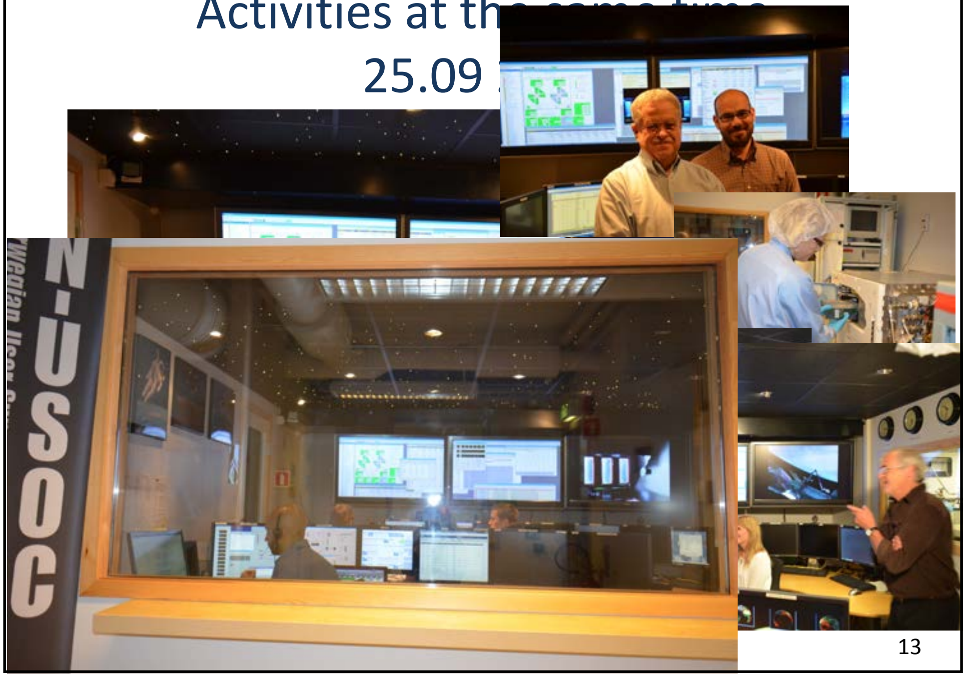
# Activities at th

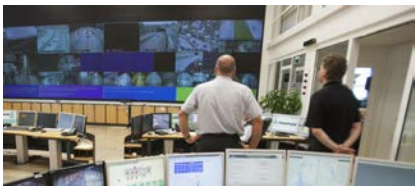
# 25.09






# Control centres as a workplace

A lot of sectors – aviation, maritime, railway and road



# Experiences from other control centres

- A lot of functions, e.g.
  - Integrated operations
  - Remote control and surveillance
- Technology brings several opportunities
- But … how can human be in control?


# Outline

- N-USOC (Norwegian User Support and Operations Centre)
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- Challenges and opportunities
- HuDeM project

# HuDeM project

(Development of a Human Dependability Model)

**Main objective**: Define a human dependability model and to develop an analytical methodology and procedural approach for space application

1. **State of the art** – Other Domains applicable to Space Projects and Activities
2. **Definition of Methodology** for Development of Human Dependability Model(s)
3. **Implementation** of the proposed Methodology
4. **Analyses** for Human Errors Identification and Avoidance
   A. Qualitative Approach
   B. Quantitative Approach

# HuDeM Team

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- Erik Hollnagel (HRA methods and resilience)
- Michael A. Rosen (team work and team collaboration)

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- Fabio Restagno (Technical Officer) Fabio.Restagno@esa.int
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# Complex human operated systems

Technical barriers/ failures

Design

Understand Causes
Risk Management

Safety culture

Communication

Risk perception

Competence

Procedures

Workload analysis
Slips/lapses

Planning

Workload -
Time pressure

Human factors
Organizational factors
Technological factors

Mutual adaptation to avoid accidents and support resilience

# Domains and scientific traditions

| Scientific traditions | Domains | | | | |
|---|---|---|---|---|---|
| | Aviation | Nuclear | Railways | Oil & Gas | Space |
| Cognitive science | | | | | |
| Human factors | | | | | |
| Group psychology | | | | | |
| Organisational theory | | | | | |

# State of the art

## Key issues in Human Dependability

| Key issues explored | Aviation | Nuclear | Oil & gas | Railway | Space |
|---|---|---|---|---|---|
| **Human limitations** (during workload and automation) | X | | | | X |
| Major accidents have **multiple causes** | X | | | | |
| **Team** collaboration and teamwork | X | | X | | X |
| **Accidents and recoveries**: Ability to learn | X | | X | X | |
| **Design and operations** of Control Centres: - Imply key H and O factors | | X | X | | |
| - Verify and validate HF | | X | X | | X |
| Critical H and O **barriers** in operation | | X | X | | |

# ESA-CRIOP Validation

### 1. Checklist Items Validation

- Selection based on applicability in space domain

**BIOLAB:** Facility designed to support biological experiments

### 2. Scenario Validation

- Anomaly report of real human error
- Find critical issues

- Key issues uncovered include training of taking images and time criticality of the fixation process
- Both issues covered in anomaly reports
- Scenario process would have identified and mitigated these issues
- The method is therefore **VALIDATED**

## Recommendations

- Training required for facilitator
- Checklist items required to be rewritten for the ESA domain
- Preparation meeting required to be face to face
- All 4 days of the workshop required
- Perform the method for all phases of a project (design, preparation, performance and review)
- Multiple sessions with different teams required for full validation



## Methodological approaches

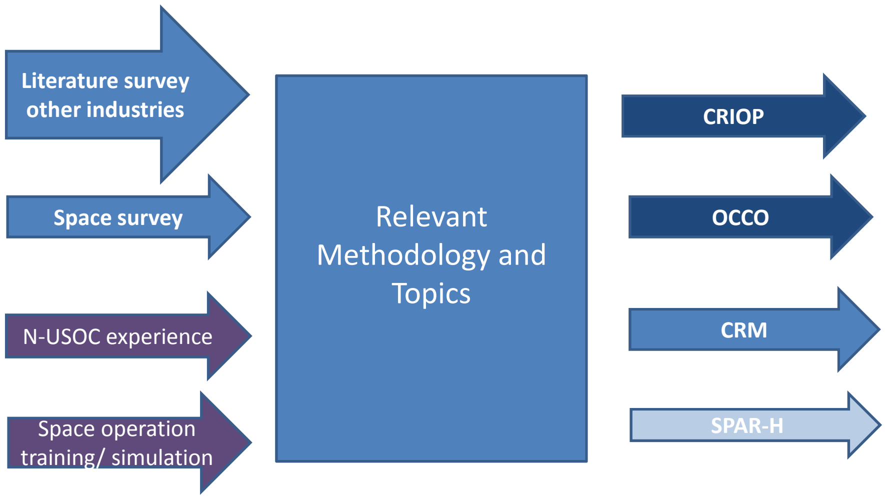
### Space piloted studies in the project

From the petroleum industry

1. **CRIOP**
   - Design phase
   - "To get an overview of present and future challenges"
   - Involve smaller group of experts and operators
2. **OCCO** (Operational Conditions in Control room Organizations)
   - Operational phase ("Operational Safety Condition")
   - "In depth analysis similar to audits"
   - Involve large part of the organisation

# Reflections

## Human Dependability for Space




# Summary

## "Human operated systems in space" – experiences and new initiatives

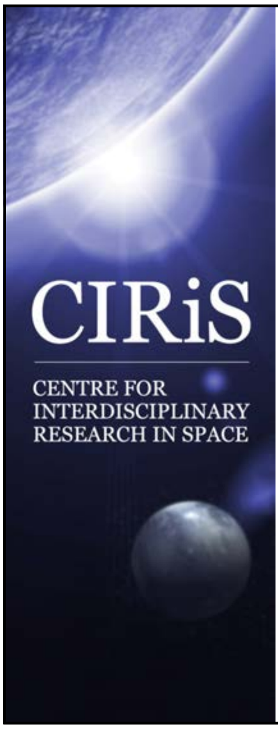
**Spin-out**

- Procedures
- Training and simulation
- Communication and cooperation
- Integrated planning
- Remote control

**Spin-in**

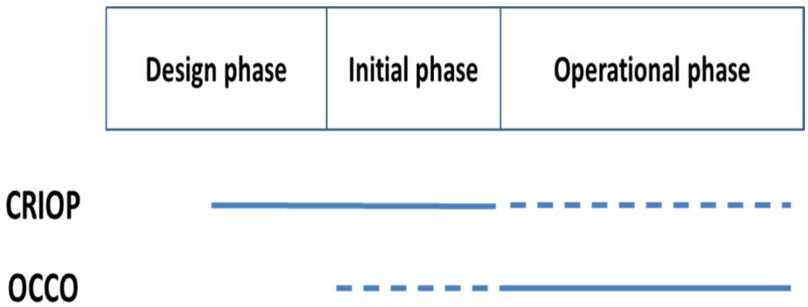
- Design of control centres
- Human Factors/ Dependability perspectives and methodologies

Besøksadresse: Dragvoll Allé 38B | Post: 7491 Trondheim | Telefon: 73 59 63 00 | E-post: kontakt@samfunn.ntnu.no | Web: samforsk.no




**Takk for oppmerksomheten!**

# Main areas of application

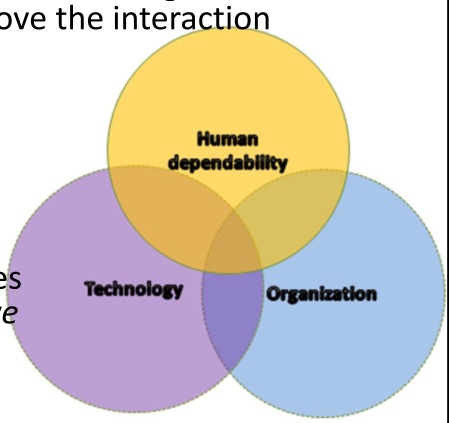


# Theoretical approach

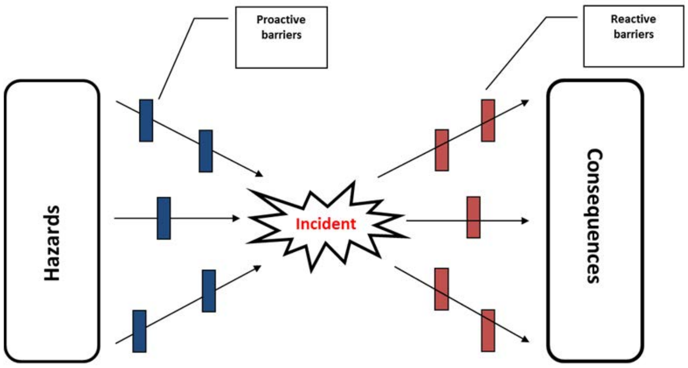
## Human dependability - Key issues

**Human factors/ dependability**

- Apply systematic methods and knowledge about people to evaluate and improve the interaction between
  - **Individuals**
  - **Technology**
  - **Organisations**
- **Aim** is to create a working environment that contributes to achieving *healthy*, *effective* and *safe* operations




# "Bow tie" model of undesired incident




Human actions and interventions

- may lead to hazards (due to human errors)
- are also important mitigating factors both as proactive and reactive barriers

# Recoveries and accidents in complex human operated systems


The Macondo blowout killing 11 workers, releasing 4.9 millions barrels of oil, cost 42Bn$ .



# Space survey and interview


- Get a broad perspective of current problems
- Remove personal bias


- Anonymous, optional survey sent out to all flight controllers
- Survey based on anomaly reports and experience
- Personal interviews with crew members (under NDA)

# Space survey and interview

| Human Causes | Org. Influences (and mitigation) |
|---|---|
| **High workload due to parallel tasks** | **Workload analysis;** Design of procedures to avoid parallel tasks. (*Should be identified by CRIOP*) |
| **Lack of domain knowledge on support systems, and sharing of information related to support systems.** | **Communication, common mental models, Training** (Scenario training). (*Should be identified by CRIOP and CRM*) |
| **Lack of team support, operators does not have support available during their operations.** | **Train to collaboration in teams (CRM),** Communication, Focus on teamwork training. (*Should be identified by CRIOP and CRM*) |

HFC

# The Role of the Human Operator In future drilling operations

**J. I. Ornæs , NOV**

**Mer informasjon:**

Parasuraman, R., T. B. Sheridan and C. D. Wickens (2000). "A Model for Types and Levels of Human Interaction with Automation." IEEE Transactions on Systems, Man, and Cybernetics 30(3): 286-297.


NATIONAL OILWELL VARCO
The Role of the Human Operator
In future drilling operations
APL™ Technology
NOV | Rig Solutions Norway | 2013
Technology and knowledge, since 1841.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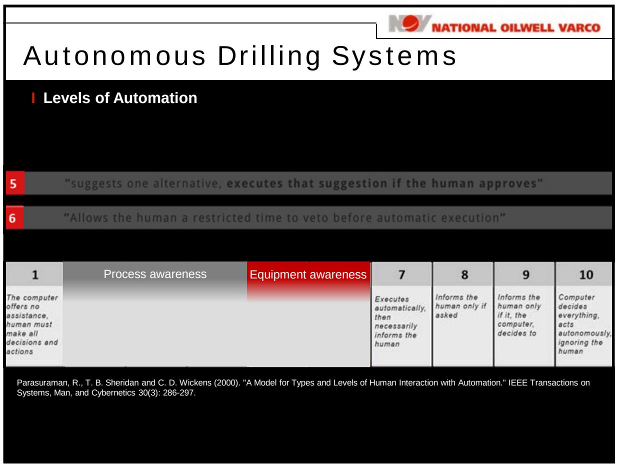
Outline
Autonomous Drilling system
- Levels of Automation
- The Dataset
- New Roles
Human on the Loop
- Human Factors Engineering
- Levels of interaction
- Tailored humans interaction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Autonomous Drilling Systems
Levels of Automation
5 "suggests one alternative, executes that suggestion if the human approves"
6 "Allows the human a restricted time to veto before automatic execution"
1
The computer offers no assistance, human must make all decisions and actions
Process awareness
Equipment awareness
7
Executes automatically, then necessarily informs the human
8
Informs the human only if asked
9
Informs the human only if it, the computer, decides to
10
Computer decides everything, acts autonomously, ignoring the human
Parasuraman, R., T. B. Sheridan and C. D. Wickens (2000). "A Model for Types and Levels of Human Interaction with Automation." IEEE Transactions on Systems, Man, and Cybernetics 30(3): 286-297.

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# Autonomous Drilling Systems

**Levels of Automation**

Process awareness | Equipment awareness

- Process Context
- Well Plan
- Procedural Plan
- Observe and Re-plan

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# Autonomous Drilling Systems

**Levels of Automation**

Process awareness | Equipment awareness

- Process Context
- Well Plan
- Procedural Plan
- Observe and Re-plan

- Equipment Context
- Map process domain to equipment domain

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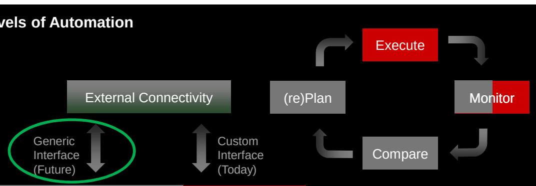
# Autonomous Drilling Systems

**Levels of Automation**




Process awareness | Equipment awareness

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- Well Plan
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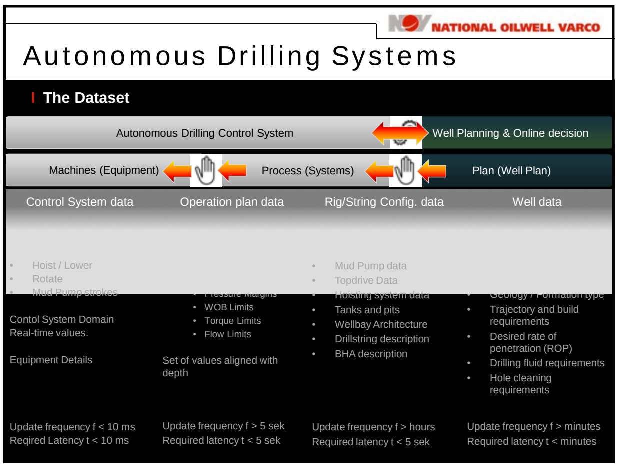
- Map process domain to equipment domain



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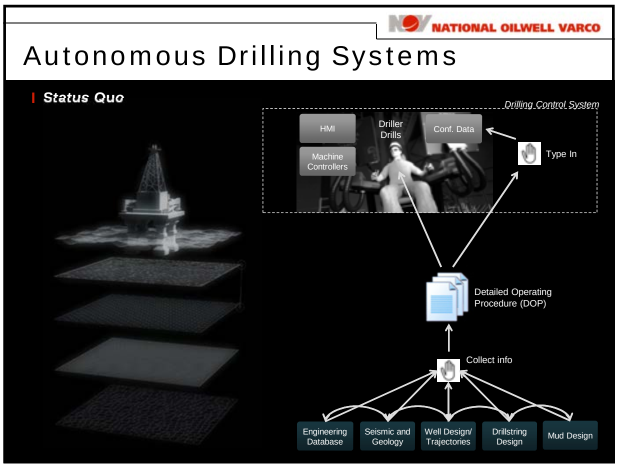
Autonomous Drilling Systems
The Dataset
Autonomous Drilling Control System
Well Planning & Online decision
Machines (Equipment)
Process (Systems)
Plan (Well Plan)
Control System data
Operation plan data
Rig/String Config. data
Well data
Hoist / Lower
Rotate
Mud Pump strokes
Contol System Domain Real-time values.
Equipment Details
WOB Limits
Torque Limits
Flow Limits
Set of values aligned with depth
Mud Pump data
Topdrive Data
Hoisting system data
Tanks and pits
Wellbay Architecture
Drillstring description
BHA description
Geology / Formation type
Trajectory and build requirements
Desired rate of penetration (ROP)
Drilling fluid requirements
Hole cleaning requirements
Update frequency f < 10 ms
Reqired Latency t < 10 ms
Update frequency f > 5 sek
Required latency t < 5 sek
Update frequency f > hours
Required latency t < 5 sek
Update frequency f > minutes
Required latency t < minutes

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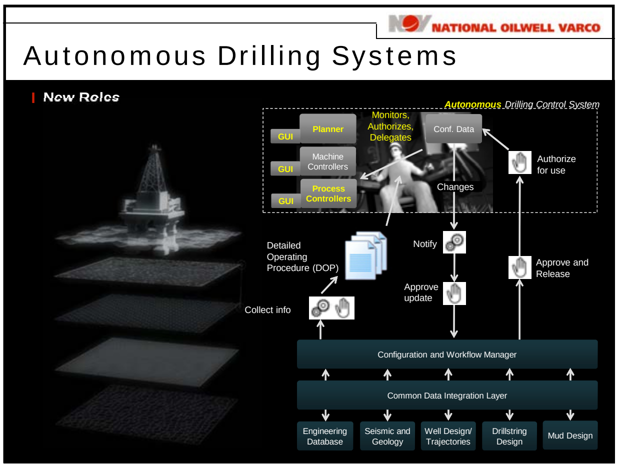
Autonomous Drilling Systems
Status Quo
Drilling Control System
HMI
Driller Drills
Conf. Data
Machine Controllers
Type In
Detailed Operating Procedure (DOP)
Collect info
Engineering Database
Seismic and Geology
Well Design/ Trajectories
Drillstring Design
Mud Design

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Autonomous Drilling Systems
New Roles
Autonomous Drilling Control System
GUI
Planner
Monitors, Authorizes, Delegates
Conf. Data
GUI
Machine Controllers
GUI
Process Controllers
Changes
Authorize for use
Detailed Operating Procedure (DOP)
Notify
Approve update
Approve and Release
Collect info
Configuration and Workflow Manager
Common Data Integration Layer
Engineering Database
Seismic and Geology
Well Design/ Trajectories
Drillstring Design
Mud Design

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## Human on the Loop

**Human Factors Engineering**

- Focus design decisions on the explicit allocation of cognitive functions and responsibilities between the human and computer to achieve specific capabilities.
- Recognizes that these allocations may vary by mission phase (operational context) as well as echelon (level of management)
- Makes the high-level system trades inherent in the design of autonomous capabilities visible.

Source: Einar Landre – Department Leader IT Drilling and Well Solutions - Statoil

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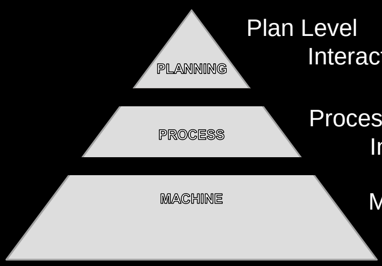
## Human on the Loop

**Human Interaction level**




Plan Level Interaction

Process Level Interaction

Machine Level Interaction

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## Human on the loop

**The Cycle**

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## Human on the Loop

- **Tailored levels of automation**

**Definitions:**

**Manual:** Tasks that can not be performed by a control system. Must be done manually by a human — M

**Approve:** Tasks can be done automatically by a control system – but human must approve first — ?

**Veto:** Task will be done automatically by a control system – unless human rejects — !

**Auto:** Task will be done automatically by a control system – no human intervention. — A

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## Human on the Loop

- **Tailored levels of automation**

**Configuration (Conceptual):**

Drilling | Tripping | Reaming | Cementing

| | | |
|---|---|---|
| Machine | PH: Get new pipe from Fingerboard | ! |
| Machine | PH: Move Pipe to Well Center | ! |
| Machine | TD: Spin inn | ? |
| Machine | RN: Make Up | M |
| Process | Land Bit (Pump, rotate, lower) | ? |
| Process | Drill Stand | ! |
| Plan | WOB Safety Limits | ? |
| Process | WOB actual Setpoint | A |
| Plan | Drilling Torque Safety Limits | A |

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## Sum Up

- Autonomous Drilling system
  - Levels of Automation
  - The Dataset
  - New Roles
- Human on the Loop
  - Human Factors Engineering
  - Levels of interaction
  - Tailored humans interaction


Who Has the first Question ?

HFC

# Minimizing human factors mishaps in unmanned aircraft systems

**R.Waraich, PhD George Washington University.**

**Mer informasjon:**

"*Heterogeneous Design Approach for Ground Control Stations to Marginalize Human Factors Mishaps in Unmanned Aircraft Systems*" Qaisar Raza Waraich; Dissertation submitted to The School of Engineering and Applied Science of The George Washington University – made available at www.hfc.sintef.no

"*Minimizing Human Factors Mishaps in Unmanned Aircraft Systems*" Qaisar R. "Raza" Waraich, Thomas A. Mazzuchi, Shahram Sarkani, & David F. Rico January 2013 ergonomics in design.

Waraich, Q. R., Mazzuchi, T. A., Sarkani, S., & Rico, D. F. (Jan 2013). *Heterogeneous Design Approach for GCS, to Marginalize Human Factors Mishaps in UAS. Ergonomics in Design*.

DoD. (2009). *FY2009-2034 Unmanned Systems Integrated Roadmap*. Washington, DC: Department of Defense.

Meshkati, N. (1997). *Human performance, organizational factors DoD*. (2011). Unmanned Systems Integrated Roadmap FY2011-2036. Retrieved from http://www.defenseinnovationmarketplace.mil/resources/UnmannedSystemsIntegratedRoadmapFY2011.pdf.

FAA/NASA. (2011). Human Factors Research Coordination Plan. Retrieved from http://www.jpdo.gov/library/20110224_FAA_NASA_HFRCP.pdf.

Forester, J., Bley, D., Cooper, S., Lois, E., Siu, N., Kolaczkowski, A., et al. (2004). Expert elicitation approach for performing ATHEANA quantification. Reliability Engineering & System Safety, 83(2), 207-220.

Hoffman, M., Tilghman, A., LaGrone, S., & Iannotta, B. (2008, Dec 21). Are enlisted airmen next to pilot UAVs? Air Force Times. Retrieved from http://www.airforcetimes.com/news/2008/12/airforce_enlisted_uas3_122108/

Hollnagel, E. (2003). Handbook of cognitive task design. Mahwah, NJ US: Lawrence Erlbaum Associates Publishers.

Manning, S. D., Rash, C. E., LeDuc, P. A., Noback, R. K., & McKeon, J. (2004). The role of human causal factors in U.S. Army unmanned aerial vehicle accidents. Ft. Rucker, AL: U.S. Army Aeromedical Research Laboratory.

Meshkati, N. (1997). Human performance, organizational factors and safety culture. Paper presented at the Human performance, organizational factors and safety culture.

http://www.wired.com/gadgetlab/2010/11/tonights-release-xbox-kinect-how-does-it-work/
http://www.yankodesign.com/2009/11/19/pilotless-airplane-control-station/
https://encrypted-tbn3.gstatic.com/images?q=tbn:ANd9GcT2fkqyMBfyfOOE5hT9yJYCLGNXDf4w0yzK_XpVQtWMBr__fwIm-g

Sheridan, T. B. (1992). Telerobotics, automation, and human supervisory control. Cambridge, MA US: The MIT Press.

Rogers, B., Palmer, B., Chitwood, J., & Hover, G. (2004). Human-systems issues in UAV design and operation. Wright-Patterson AFB, OH: Human Systems Information Analysis Center.

Senders, J. W., & Moray, N. P. (1991). Human error: Cause, prediction, and reduction. Hillsdale, NJ England: Lawrence Erlbaum Associates, Inc.

Stewart, M. G. (1992). Modelling human error rates for human reliability analysis of a structural design task. Reliability Engineering & System Safety, 36(2), 171-180.

Thompson, W. T., & Tvaryanas, A. P. (2008). Unmanned Aircraft System (UAS) Operator Error Mishaps: An Evidence-based Prioritization of Human Factors Issues. Brooks City, TX: North American Treaty Organization (NATO).

Thompson, W. T., & Tvaryanas, A. P. (2005). U.S. military unmanned aerial vehicle mishaps: assessment of the role of human factors using HFACS. Retrieved from http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA435063.

Tvaryanas, A. P. (2006). Human Systems Integration in Remotely Piloted Aircraft Operations. Aviation, Space, and Environmental Medicine, 77(12), 1278-1282.

Williams, K. W. (2004). A Summary of Unmanned Aircraft Accident/Incident Data: Human Factors Implications (No. DOT/FAA/AM-04/24). Oklahoma City, OK: Civil Aerospace Medical Institute, Federal Aviation Administration.

Andersen, H., Bove, T., Isaac, A., Kennedy, R., Kirwan, B., & Shorrock., T. (2002). Short Report on Human Performance Models and Taxonomies and Human Error in ATM (HERA): European Organization for the Safety of Air Navigation.

# Minimizing Human Factors Mishaps in Unmanned Aircraft Systems

Forum for Human Factors in Control
Trondheim, Norway

Raza Waraich, Ph.D.
Human Factors Engineering
October 16, 2013

## Introduction

- 10 Years @ Smartronix
  - Payload
  - Payload GCS
  - UAS GCS
- Research
  - HF in GCSs
  - Technology and HF
- Grad School
  - M.Sc., S.E, JHU, Sep 2007
  - Ph.D., HFE, GWU, Jan 2013

# Introduction – Smartronix, Inc.

- Founded in 1995
- 650+ Employees
- Innovative solutions provider
- US DoD, Federal Agency, and Commercial
- Labs (HW/SW, Fabrication, Light Manufacturing, and RF Design)


Minimizing HF Mishaps in UAS October 16, 2013 3

# Agenda

- Study
- Findings
- Framework
- Research
- Summary

Minimizing HF Mishaps in UAS October 16, 2013 4

# Study

## Basis

- UAS Mishap studies
  - Mishaps 100 to 200 times than manned aviation
  - 69% of all UAS mishaps are due to Human Factors
  - Up to 43% of these mishaps are associated to Ergonomics Human Factors (EHF) in Ground Control Stations (GCS)
- UAS
  - 45+ countries
  - 300+ manufacturers
  - 600+ types
- UAS demand increasing exponentially
  - Civilian
  - Military

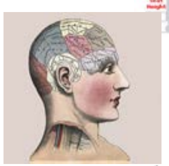
# Basis (cont.)

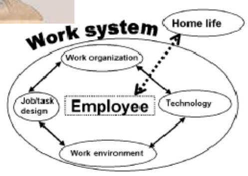
- UAS Studies
  - Mishaps cost millions of dollars each year
  - GCS designs do not account for human abilities, characteristics, and limitations
  - Lack of Ergonomic Human Factors (EHF) Standards



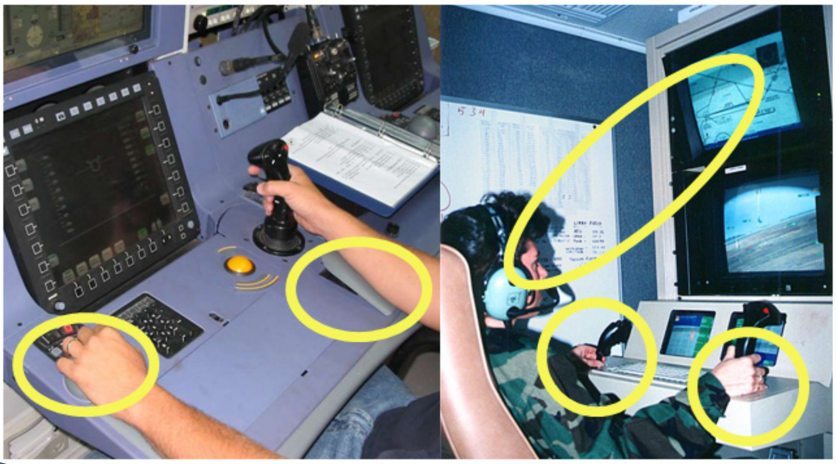
# Ergonomic Human Factors

- Physical Ergonomics
- Cognitive Ergonomics
- Organizational Ergonomics





# Common EHFs





# EHF Related Mishaps

| Mishap Year | Cause | Mishap Cost |
|---|---|---|
| 2001 | Visual display mounting and GCS lightning | $1.50 Million |
| 2005 | Visual display mounting and GCS lightning | $4.35 Million |
| 2006 | Improper control placement | $1.50 Million |
| 2010 | Improper seating | $2.75 Million |
| N/A | Display Arrangement | N/A |

Cognitive Ergonomics

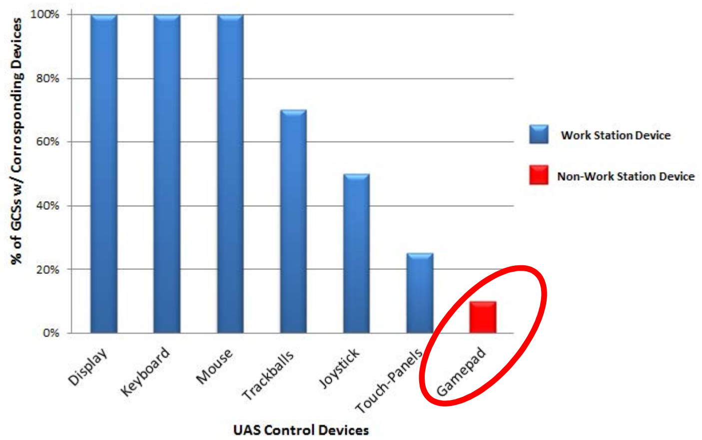
# What's Included?

- Ergonomic Human Factors (EHF)
- Total 20 UASs (Group 2 – 5) encompass
- UAS GCS Control Mechanism
  - Semi-Autonomous
  - Autonomous
- UAS/GCS operators 6.5 to 15 years of experience
- Human Factors Engineering of Computer Workstations (ANSI/HFES-100)
- Questions
  - IO devices usage GCS Vs. Workstation
  - Usability of IO devices GCS Vs. Workstation



# Findings

# GCS IO Devices






# Control Vs. IO Devices

| IO Devices | Semi-autonomous | Autonomous |
|---|---|---|
| Display | 100% | 100% |
| Keyboard | 100% | 100% |
| Mouse | 100% | 100% |
| Trackball | 90% | 50% |
| Joystick | 100% | 0% |
| Touch-Panel | 10% | 40% |
| Gamepad | 0% | 20% |

# Usability GCS Vs. Workstation

- Questionnaire (seven point Likert-scale)
  - Non-Emergency
  - Emergency
- Resulting Data
  - Same sized
  - Non-parametric statistical analysis
- Virtually the same

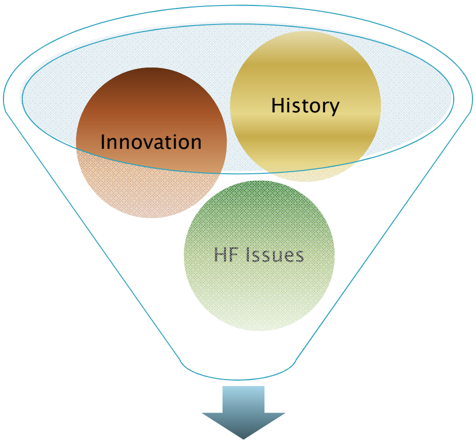


# Case Study

| Mishap Year | Cause | Mishap Cost | ANSI/HFES-100 |
|---|---|---|---|
| 2001 | Visual display mounting and GCS lightning | $1.50 Million | Yes |
| 2005 | Visual display mounting and GCS lightning | $4.35 Million | Yes |
| 2006 | Improper control placement | $1.50 Million | Yes |
| 2010 | Improper seating | $2.75 Million | Yes |
| N/A | Display location | N/A | Yes |

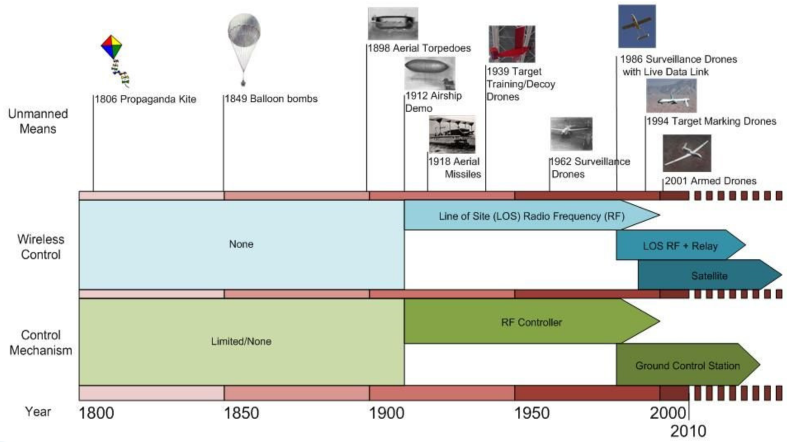
# Framework

## Solving EHF




Solution to EHF

# History – GCS






# GCS HF Issues – IO

- Display Arrangement
  - Vertical Vs. Horizontal
- Screen Focus Areas
  - Top Vs. Bottom
- Situational Awareness
  - Sign Vs. Text
- Alertness
  - Interactive
- Task Sequence
  - Control Layout Sequence
- Input Methods
  - Touchscreens Vs. Ancillary Device

# Innovation – Gamepad

- >60% of 16-21 years old own a gaming system
- >40% are expert in operating Gamepads
- Existing experience

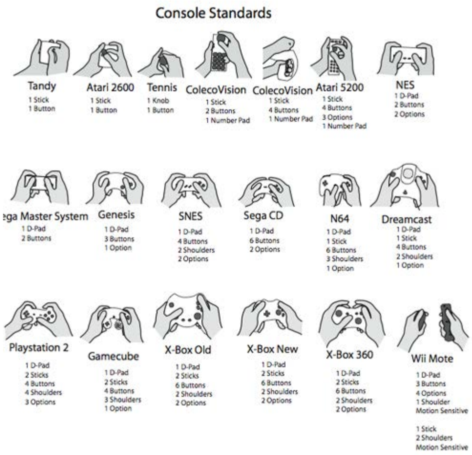


# Solution

- Used to surf through menus
- Utilized existing experience
- Learning curve
- Results were impressive

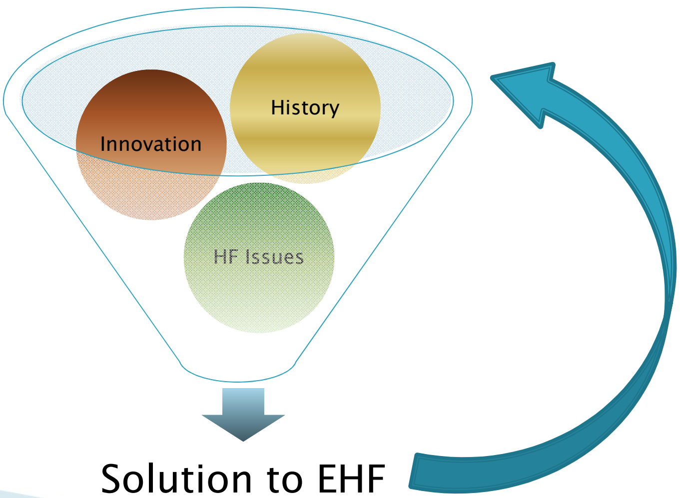
# REVISE

- **R**eassess
- **E**volution
- **V**ersatile
- **I**nterchangeable
- **S**ustain
- **E**ffective



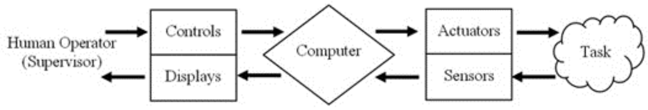



# EHF Solution Cycle



# Supervisory Controls

- Telerobotics, Automation, and Human Supervisory Control by Thomas B. Sheridan

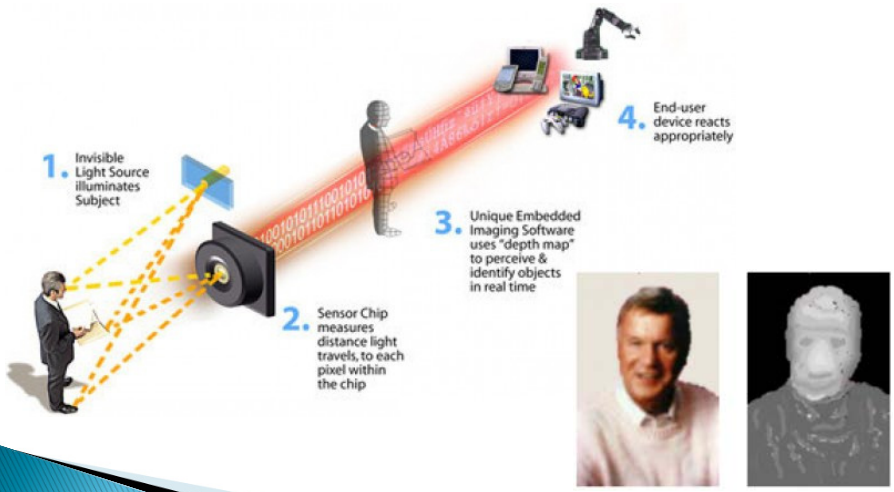



- Simplified approach to understanding the human machine interface
- Accurate diagram
- Updated IO Methods



# Research

# Microsoft Kinect for CCTV






# Summary

# Summary

- Study history of the system/issue at hand
- Study comparable systems
- Study comparable standards
- Understand your clients/workers
- Understand available IO technology
- Apply relevant available technology for EHF
- Design modular control stations



Questions?

Email: qwaraich@gmail.com

# EHF Standard

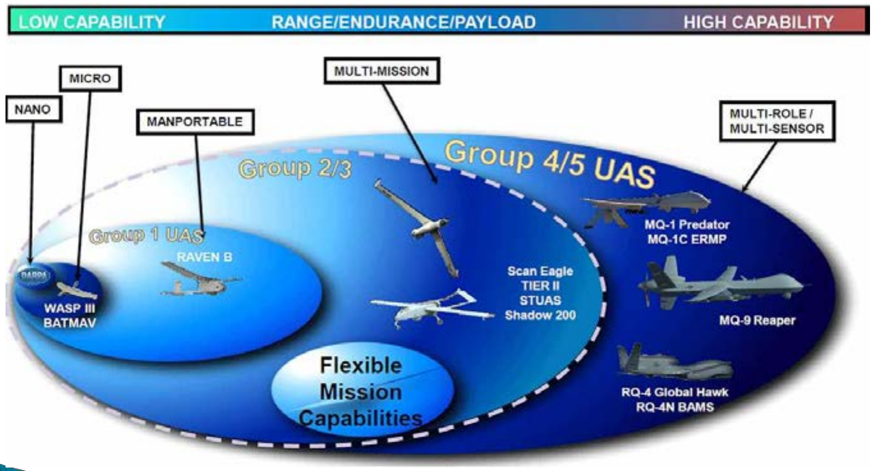
- ISO 10075-1:1991, Ergonomic principles related to mental workload — Part 1: General terms and definitions
- ISO 10075-2:1996, Ergonomic principles related to mental workload — Part 2: Design principles
- ISO 10075-3:2004, Ergonomic principles related to mental workload — Part 3: Principles and requirements concerning methods for measuring and assessing mental workload

# Study: Selection of UAS

| UAS Group | Weight (lbs) | Altitude (ft AGL) | Airspeed (knots) |
|---|---|---|---|
| Group 1 | Greater than 20 | Less than 1,200 | Less than 250 |
| Group 2 | Between 21 – 55 | Less than 3,500 | Less than 250 |
| Group 3 | Between 55 – 1,320 | Less than 18,000 | Less than 250 |
| Group 4 | Greater than 1,320 | Greater than 18,000 | Any |
| Group 5 | Greater than 1,320 | Greater than 18,000 | Any |

- UAS Control Mechanisms
  - Ground Control
    - Directly controlled from takeoff to landing; Group 1 – 5; like cockpit
  - Semi-autonomous
    - Supervisory tasks and some direct control; Group 2 – 5; like CWS
  - Autonomous
    - Supervisory tasks and mission modification; Group 2 – 5; like CWS

# Background: UAS Groups






# References


- Waraich, Q. R., Mazzuchi, T. A., Sarkani, S., & Rico, D. F. (Jan 2013). *Heterogeneous Design Approach for GCS, to Marginalize Human Factors Mishaps in UAS. Ergonomics in Design*.
- DoD. (2009). *FY2009-2034 Unmanned Systems Integrated Roadmap*. Washington, DC: Department of Defense.
- Meshkati, N. (1997). *Human performance, organizational factors* DoD. (2011). *Unmanned Systems Integrated Roadmap FY2011-2036*. Retrieved from http://www.defenseinnovationmarketplace.mil/resources/UnmannedSystemsIntegratedRoadmapFY2011.pdf.
- FAA/NASA. (2011). *Human Factors Research Coordination Plan. Retrieved from http://www.jpdo.gov/library/20110224_FAA_NASA_HFRCP.pdf.*
- Forester, J., Bley, D., Cooper, S., Lois, E., Siu, N., Kolaczkowski, A., et al. (2004). Expert elicitation approach for performing ATHEANA quantification. *Reliability Engineering & System Safety, 83*(2), 207-220.
- Hoffman, M., Tilghman, A., LaGrone, S., & Iannotta, B. (2008, Dec 21). Are enlisted airmen next to pilot UAVs? *Air Force Times*. Retrieved from http://www.airforcetimes.com/news/2008/12/airforce_enlisted_uas3_122108/
- Hollnagel, E. (2003). *Handbook of cognitive task design*. Mahwah, NJ US: Lawrence Erlbaum Associates Publishers.
- Manning, S. D., Rash, C. E., LeDuc, P. A., Noback, R. K., & McKeon, J. (2004). *The role of human causal factors in U.S. Army unmanned aerial vehicle accidents*. Ft. Rucker, AL: U.S. Army Aeromedical Research Laboratory.
- Meshkati, N. (1997). *Human performance, organizational factors and safety culture*. Paper presented at the Human performance, organizational factors and safety culture.
- http://www.wired.com/gadgetlab/2010/11/tonights-release-xbox-kinect-how-does-it-work/
- http://www.yankodesign.com/2009/11/19/pilotless-airplane-control-station/
- https://encrypted-tbn3.gstatic.com/images?q=tbn:ANd9GcT2fkqyMBfyfOOE5hT9yJYCLGNXDf4w0yzK_XpVQtWMBr__fwlm-g
- Sheridan, T. B. (1992). *Telerobotics, automation, and human supervisory control*. Cambridge, MA US: The MIT Press.
- Rogers, B., Palmer, B., Chitwood, J., & Hover, G. (2004). *Human-systems issues in UAV design and operation*. Wright-Patterson AFB, OH: Human Systems Information Analysis Center.

# References


- Senders, J. W., & Moray, N. P. (1991). *Human error: Cause, prediction, and reduction*. Hillsdale, NJ England: Lawrence Erlbaum Associates, Inc.
- Stewart, M. G. (1992). Modelling human error rates for human reliability analysis of a structural design task. *Reliability Engineering & System Safety, 36*(2), 171-180.
- Thompson, W. T., & Tvaryanas, A. P. (2008). *Unmanned Aircraft System (UAS) Operator Error Mishaps: An Evidence-based Prioritization of Human Factors Issues. Brooks City, TX: North American Treaty Organization (NATO).*
- Thompson, W. T., & Tvaryanas, A. P. (2005). *U.S. military unmanned aerial vehicle mishaps: assessment of the role of human factors using HFACS*. Retrieved from http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA435063.
- Tvaryanas, A. P. (2006). Human Systems Integration in Remotely Piloted Aircraft Operations. *Aviation, Space, and Environmental Medicine, 77*(12), 1278-1282.
- Williams, K. W. (2004). *A Summary of Unmanned Aircraft Accident/Incident Data: Human Factors Implications* (No. DOT/FAA/AM-04/24). Oklahoma City, OK: Civil Aerospace Medical Institute, Federal Aviation Administration.
- Andersen, H., Bove, T., Isaac, A., Kennedy, R., Kirwan, B., & Shorrock., T. (2002). *Short Report on Human Performance Models and Taxonomies and Human Error in ATM (HERA)*: European Organization for the Safety of Air Navigation.

HFC

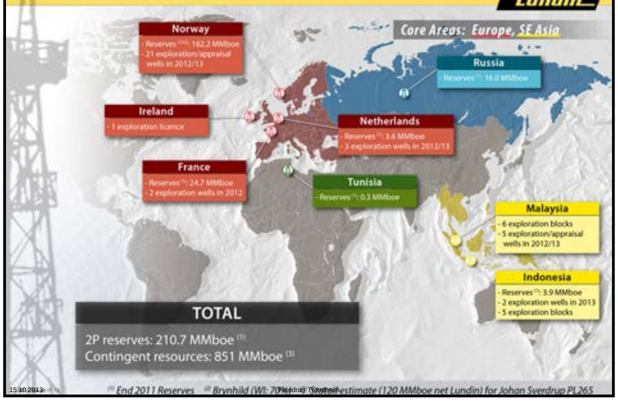
# Emergency preparedness and response (Beredskap)

**R.H.Grønning, Lundin**

**Mer informasjon:**

http://www.acona.com/services/safety-and-emergency-preparedness/emergency-preparedness

## Lundin Petroleum - Asset Overview




(1) End 2011 Reserves (2) Brynhild (WI: 70 ... estimate (120 MMboe net Lundin) for Johan Sverdrup PL265



## Lundin Norway AS

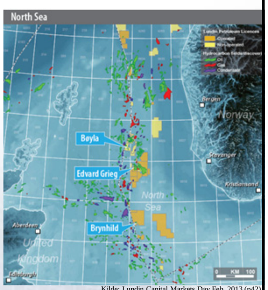
- Lundin Petroleum established in 2001
- Lundin Norway AS established in 2004
- 62 licenses at the NCS
- Ca. 180 emloyees which encreases with about 100 during 2013
- 10 exploration wells in 2013
- We focus on a few core areas at the NCS.


Kilde: Lundin Capital Markets Day Feb. 2013 (p32)



## Three ongoing development projects

- **Brynhild** (Lundin 90%, operatør)
  - Subsea field, tie in to Haewene Brim FPSO, on the Pierce field in UK
- **Bøyla (Lundin 15%)**
  - Subsea field tied to Alvheim FPSO
  - Operated by Marathon Oil Norge AS
- **Edvard Grieg** (Lundin 50%, operatør)
  - Productionplatform on a steal frame (Jacket)
  - First oil 2015.

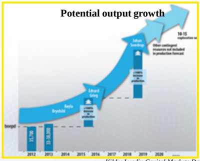



Kilde: Lundin Capital Markets Day Feb. 2013 (p42)

## A fantastic business development in a few years

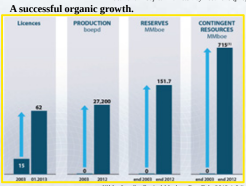
**Drilling of 25 wells at 5 year with 8 different drliling rigs.**


**Potential output growth**




*Kilde: Lundin Capital Markets Day Feb. 2013 (p40)*

**A successful organic growth.**




*Kilde: Lundin Capital Markets Day Feb. 2013 (p34)*





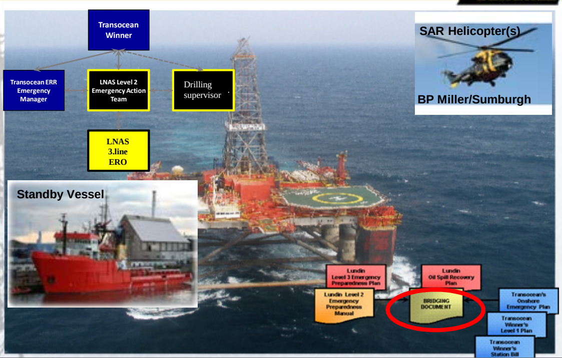

## Lundin operation center – Lysaker Norway.

## Operating Principles

- **Leadership based on large personal responsibility and trust**
- **Culture characterized by openness, respect, mutual trust, cooperation and a practical approach**
- **Working as an integrated team - across place, disciplines, roles, organizations and subcontractors**
- **Good decisions**
  - -based on shared situational awareness
  - -Using the vendors 'smart'
- **Anything that can be done on land to be made on land**
- **Good at planning.**
- **We are a learning organization**
  - continuous focus on improvement
  - knowledge sharing and harvesting of expertise
  - adopt new technologies and methods

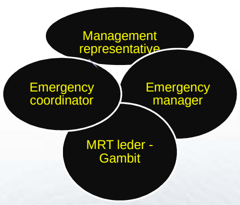



## Emergency preparedness – Drilling operation 1-3 line.

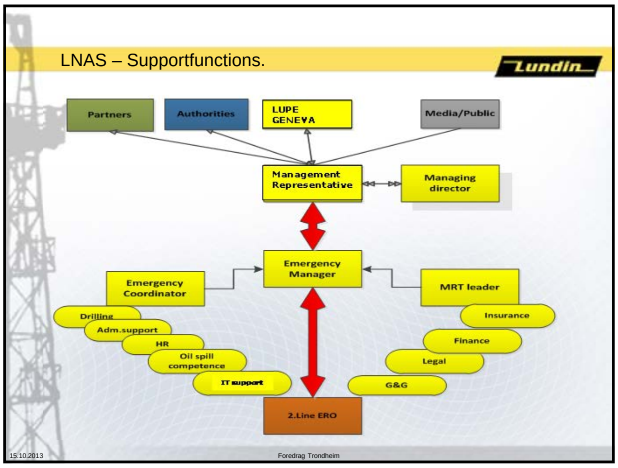


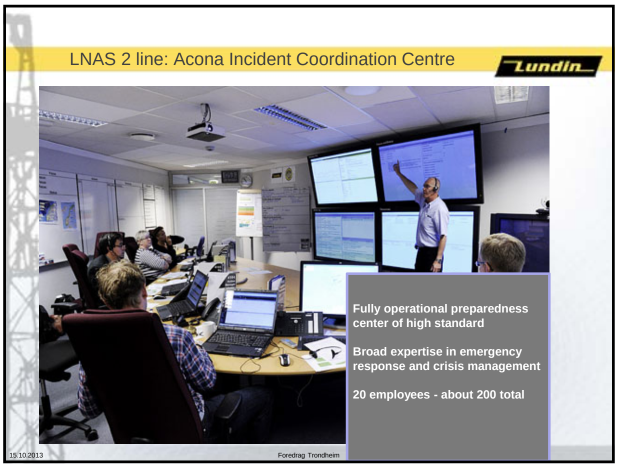


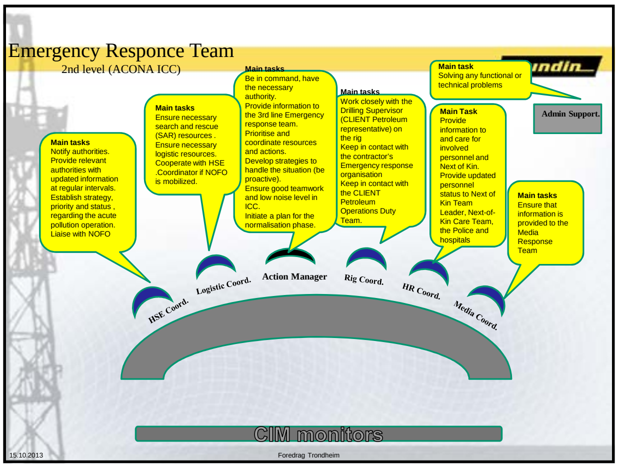

## 3. line LNAS

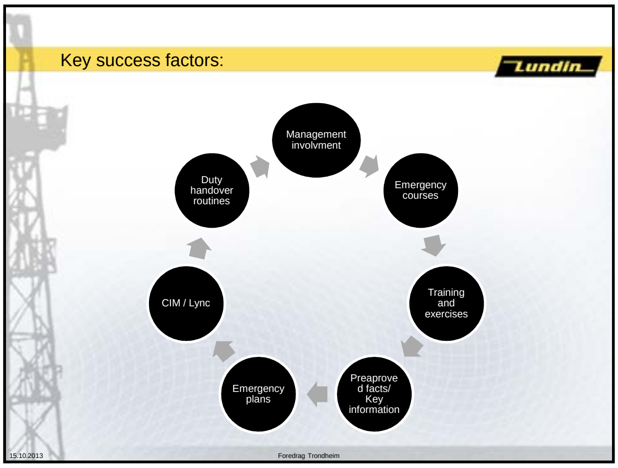


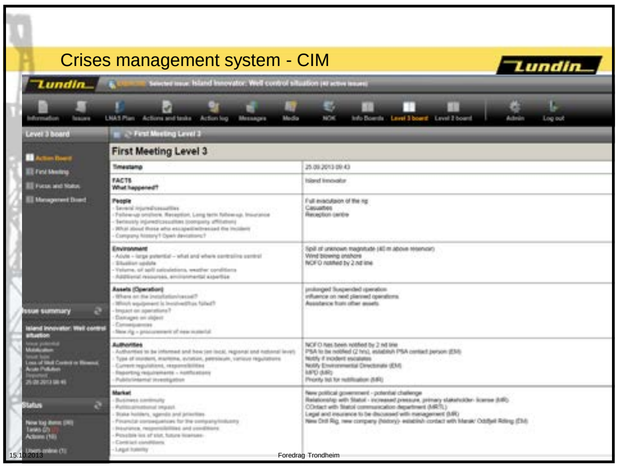

- **Based on the survey of Emergency preparedness skills in LNAS**
- **18 people from across the organization with solid experience in emergency preparedness. - 6 teamsv 24/7 – 365.**
- **Solid participation and grounding in the LNAS management.**
- **Expanded training plan.**
- **Expandend portifolio of courses**


LNAS – Supportfunctions.
Lundin
Partners
Authorities
LUPE GENEVA
Media/Public
Management Representative
Managing director
Emergency Manager
Emergency Coordinator
MRT leader
Drilling
Adm.support
HR
Oil spill competence
IT support
Insurance
Finance
Legal
G&G
2.Line ERO
15.10.2013
Foredrag Trondheim


LNAS 2 line: Acona Incident Coordination Centre
Lundin
Fully operational preparedness center of high standard
Broad expertise in emergency response and crisis management
20 employees - about 200 total
15.10.2013
Foredrag Trondheim


Emergency Responce Team
2nd level (ACONA ICC)
Main tasks Notify authorities. Provide relevant authorities with updated information at regular intervals. Establish strategy, priority and status , regarding the acute pollution operation. Liaise with NOFO
Main tasks Ensure necessary search and rescue (SAR) resources . Ensure necessary logistic resources. Cooperate with HSE .Coordinator if NOFO is mobilized.
Main tasks Be in command, have the necessary authority. Provide information to the 3rd line Emergency response team. Prioritise and coordinate resources and actions. Develop strategies to handle the situation (be proactive). Ensure good teamwork and low noise level in ICC. Initiate a plan for the normalisation phase.
Main tasks Work closely with the Drilling Supervisor (CLIENT Petroleum representative) on the rig Keep in contact with the contractor's Emergency response organisation Keep in contact with the CLIENT Petroleum Operations Duty Team.
Main task Solving any functional or technical problems
Main Task Provide information to and care for involved personnel and Next of Kin. Provide updated personnel status to Next of Kin Team Leader, Next-of-Kin Care Team, the Police and hospitals
Main tasks Ensure that information is provided to the Media Response Team
Admin Support.
HSE Coord.
Logistic Coord.
Action Manager
Rig Coord.
HR Coord.
Media Coord.
CIM monitors
15.10.2013
Foredrag Trondheim


Key success factors:
Lundin
Management involvment
Emergency courses
Training and exercises
Preaprove d facts/ Key information
Emergency plans
CIM / Lync
Duty handover routines
15.10.2013
Foredrag Trondheim


Crises management system - CIM
Lundin
First Meeting Level 3
15.10.2013
Foredrag Trondheim


Extensive use of Lync from all meeting rooms and workstations
Lundin
Lync kobler personer sammen hvor som helst
Saksliste
Bilde av arbeidstasjon med Lync.
15.10.2013
Foredrag Trondheim

## Key information and duty routines.

Lundin

15.10.2013 Foredrag Trondheim

## Be careful when using different systems….

Lundin

15.10.2013 Foredrag Trondheim

Lundin

## Thank you for your attention !

15.10.2013 Foredrag Trondheim

HFC

# Telemedisin som integrerte operasjoner – støtte fra land

**A. Evensen, Statoil**

**Mer informasjon:**

Todnem K., Evensen A., et al "The implementation of telemedicine as an integrated part of the health services on the Statoil operated installations on the Norwegian continental shelf (NCS)" SPE 2012

"Medical Evacuations from Oil Fields in the North Sea, Norway" (Jakarta 1994). Arne M.C. Evensen and Dag Andreassen, Statoil ASA, SPE 27220

"Review and Follow up of Search and Rescue (SAR) Missions and Medical Evacuation from Oil Fields in the Tampen Area, North Sea, Norway" Author: Arne M.C. Evensen, Advisor E&P Norway, HSE Dept, Statoil ASA. Co-author: Guttorm Brattebø MD, Medical, Director Prehospital Emergency Services, Haukeland University Hospital, Norway; SPE 2006.

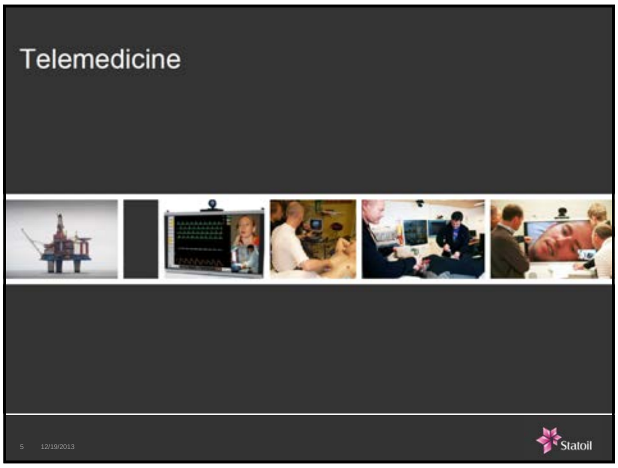
"The use of Integrated Operations in order to improve quality of health care and medical evacuations from offshore installations" Arne M.C. Evensen, Adviser, Exploration & Production Norway, HSE Dept; StatoilHydro; Inger Fjærtoft, Project Coordinator Integrated Operations, StatoilHydro. 2008, Society of Petroleum Engineers, SPE 112520

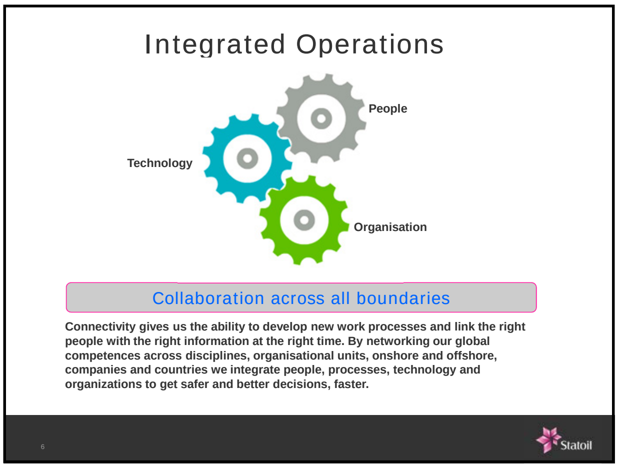

Statoil
Telemedisin som integrerte operasjoner i Statoil
Støtte fra land ved sykdom offshore


Integrerte operasjoner
Operasjons- og beslutningsstøtte på land
Statoil


Centres
of expertise
Statoil


Emergency
preparedness
4
12/19/2013
Statoil

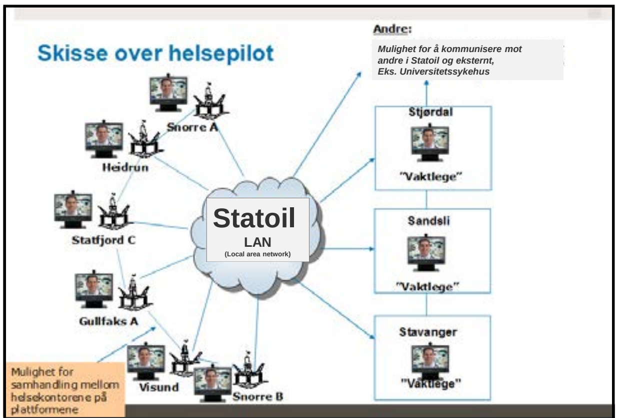

Telemedicine
5
12/19/2013
Statoil


Integrated Operations
People
Technology
Organisation
Collaboration across all boundaries
Connectivity gives us the ability to develop new work processes and link the right people with the right information at the right time. By networking our global competences across disciplines, organisational units, onshore and offshore, companies and countries we integrate people, processes, technology and organizations to get safer and better decisions, faster.
6
Statoil

## Integrated Operations
### Work processes

| Before | After |
|---|---|
| Serial | Parallel |
| Single discipline | Multidiscipline teams |
| Dependent of physical location | Independent of location |
| Decisions based on experience data | Decisions based on Real-time data |
| Reactive | Proactive |

Statoil




8 12/19/2013 Statoil

IO contributing to improved HSE
## Statoil`s Telemedicine Concept

- Initial pilot 2007, all Statoil installations, NCS operational 2009
- Real time data and image transfer to shore
  - ECG and monitored patient data
  - Image- and video transfer of skin diseases, ear, eye, wounds/cuts etc.
  - Video assisted Ultrasound examination and diagnostics (pilot)
- Real time onshore medical examination, assitance and diagnostics from
  - Haukeland University Hospital, Bergen
  - St.Olav`s Hospital, Trondheim
  - Stavanger University Hospital, Stavanger
  - University Hospital Northern Norway, Tromsø (soon startup)

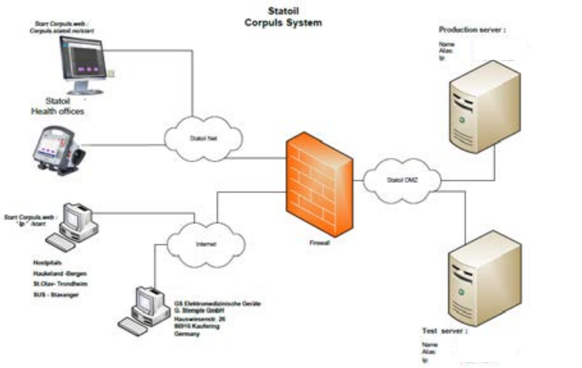
9 12/19/2013 Statoil

## Corpuls³
## New advanced ECG equipment

Assembled

Devided in 3 functional parts.
Wireless connections.








## Telemedicine equipment in use today

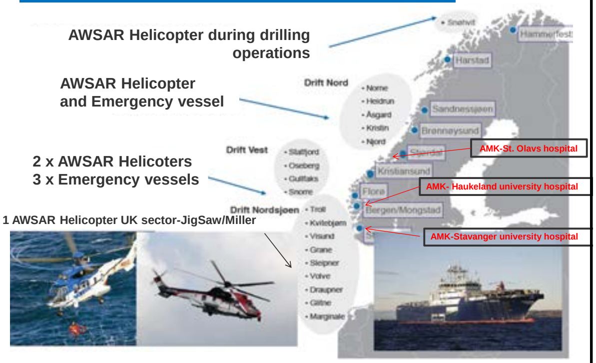
## Medical Unit – Crestron print function


13 12/19/2013 Statoil

## Medical Unit – Electromedical equipment

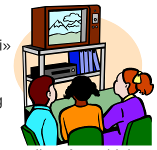
14 12/19/2013 Statoil

## Medical emergency resourses




15 12/19/2013 Statoil

## Videoassistert opplæring og sertifisering

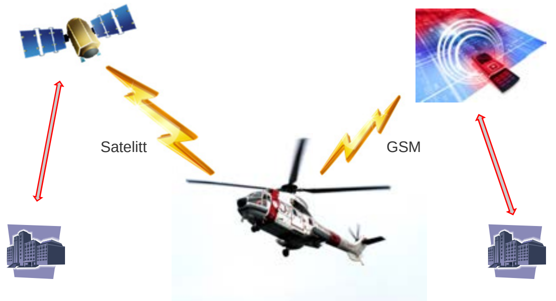


På plass i dag:
- Undervisning i bruk av elektronisk otoskop → «Otoskopi»
- Undervisning i medisinsk problem → «Rødt øye»
- Elektronisk stetoskop (kommer)
- Oversendelse og tolkning av EKG – Sanntids overføring

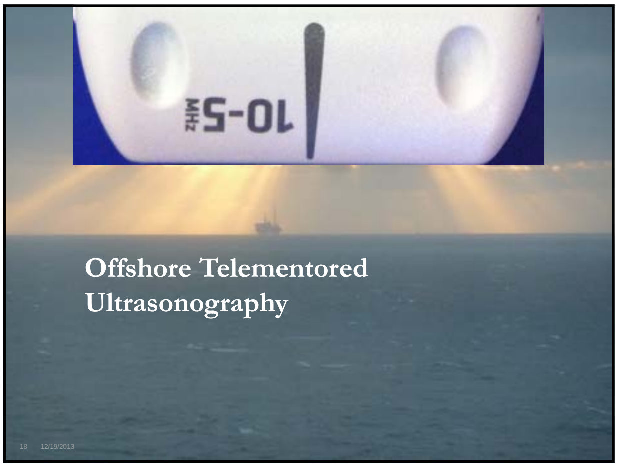
Framtidige muligheter:
- Videoassistert sertifisering og resertifisering av helsepersonell og førstehjelpere i AHLR og DHLR (vurderes gjennomført med fasilitatorer på land. Avanserte dukker som fjernstyres).
- Videoassistert ultralyd undersøkelse (benytte 4 faste protokoller). Eksperter på land/vaktleger som kan veilede og tolke
- Etablere flere opplæringstiltak med basis i allmennhelsetjeneste så som:
  - Hudproblematikk
  - Kjemikalie-/etseskader
  - Flere?



## In-flight video transfer of data and image





Slide 19

## Point-of-care ultrasonography

- Focused examinations performed at the patient's bedside.
- Development of small hand-held ultrasound machines.
- An important adjunct to the clinical examination in some settings
- Potentially life-saving

Statoil

Slide 20

## Project Telementored Ultrasonography

- ~30 volunteering workers at Statfjord C
- Expert located on shore with standard 46'' monitor
- FATE and E-FAST
- Storage of video of about 6 seconds for every position (14)
- Scoring by independent experts in ultrasonography
- Scoring system: 1-5; clinically useful: 3-5

Statoil

Slide 21

## Conclusions

- Full scale telemedicine implemented on Statoil-operated installations on the NCS in 2009
- Integrated with defibrillator/monitoring unit, othoscope
- User satisfaction is high (including MD on-call)
- Improvement of the communication
- Better and safer primary diagnosis
  - Avoid unnecessary use of SAR-helicopter
- Telementored ultrasonography is a feasible option
- Important: The receiver must have the appropriate competence
- Equipment; how far do we go and where?

Statoil

## An integrated future



There's never been a better time for good ideas


Telemedisin som integrerte operasjoner i Statoil

Arne M.C. Evensen
Rådgiver
amce@statoil.com
Tel: +47414 76 054

www.statoil.com

HFC

# NTNU Course: An Introduction to Human Factors - 2014

**A. Balfour, HFS**

**Mer informasjon:**

Kursbeskrivelse - Se videre.ntnu.no/link/nv13444

Pensum:

1. Stanton, N. A., Salmon P. M., Walker G.H., Baber C. & Jenkins D.P. (2013). Human factors methods: A practical guide for engineering and design. Second Edition. Asgate publishing.
2. Wickens, J. E., Lee. J., Lui & Gorden-Becker, S. (2004). Introduction to human factors engineering. Prentice Hall.
3. Kirwan, B. (1992). A Guide to task analysis. Taylor and Francis
4. Woods, D., Dekker S., Cook R., Johannesen L., Sarter N. (2010). Behind Human Error. Ashgate.
5. Bower, C., Salas, E., Jentsch, F. & Bowers C. A. (2006). Creating high-tech teams: Practical guidance on work performance and technology. American psychology association.
6. Salas, E. & Fiore, S. M.(2002). Team cognition: Understanding the factors that drive process and performance. American Psychology Association.
7. Johnsen S.O., Bjørkli C., Steiro T., Fartum H., Haukenes H., Ramberg J., Skriver J.. (2011): "CRIOP – A scenario method for Crisis Intervention and Operability analysis". SINTEF (2008) ISBN 9788214042962. See www.criop.sintef.no
8. Johnsen, S. O.; Lundteigen, M. A. "Sikrere fjerndrift med CRIOP". In: Robust arbeidspraksis - Hvorfor skjer det ikke flere ulykker på sokkelen. Tapir Akademisk Forlag 2008 ISBN 978-82-519-2208-1. s. 57-74, NTNU
9. Kompendium av utvalgte artikler og bokkapitel – f.eks.
   a. Antonsen S., Ramstad L., kongsvik T., "Unlocking the organization: Action research as a means of improving organisational safety. " Safety Science Monitor.;
   b. Boring, Ron 2007. Meeting human reliability requirements through human factors design, testing, and modelling. Proceeding of the European Safety and Reliability Conference ESREL 2007 – Risk, Reliability and Societal Safety. 1, pp. 3-8.
   c. Ø. Dahl "Safety compliance in a highly regulated environment: A case study of workers' knowledge of rules and procedures within the petroleum industry" Safety Science, Volume 60, December 2013, Pages 185–195
10. ISO 11064: Principles for the design of control centres, International Organization for Standardization. Kan bestilles via http://www.pronorm.no/

Valgfritt

1. Salvendy, G. (2012). Handbook of human factors and ergonomics. John Wiley and Sons.
2. Greenwood, D. and Levin, M. (2007). "Introduction to action research: Social re-search for social change", Sage.
3. Endsley, M.R., Bolte, B., & Jones, D.G. (2012). Designing for situation awareness; An approach to user centered design. (2 ed)Taylor & Francis.

4. Henderson J., Wright K., Brazier A., (2002). Human factors aspects of remote operations in process plants. Health and Safety Executive (HSE).
5. Redmill F. and Rajan, J. (1996). Human factors in safety-critical systems. Butterworth Heinemann.
6. Hollnagel E., Woods D., Leveson N. (2006) "Resilience Engineering". Ashgate.
7. Reason, J. (1990). Human error. Cambridge University Press.
8. Kongsvik, T. (2013) Sikkerhet i Organisasjoner, Akademika

*Risk reduction by design*

# NTNU Course:

## ”An Introduction to Human Factors in the Oil & Gas Industry”

Developed for the HFC Forum

October 2013

## Agenda

- Goals / Scope
- Syllabus
- Theory and practice
- Course assignment
- Challenges
- Reading material
- Practical





## Course Goal: What we want to avoid…

## Course Goals and Learning Outcomes

**Course Goal**

- The aim of the course is to provide ***an introduction and overview*** of human factors approaches, methods and techniques that can be applied in the Norwegian oil and gas industry for the control room/systems design. Greenfield and Brownfield. The framework for the course is the ISO 11064 standard.

**Scope**

- Norwegian oil and gas industry for ***control room/systems*** design. Includes cabins, systems and Integrated Operations.
- Norwegian ***PSA regulations*** and ***NORSOK*** standards apply.
- The framework for the course is the ***ISO 11064*** standard.



## Goals/learning outcome

**Target group**

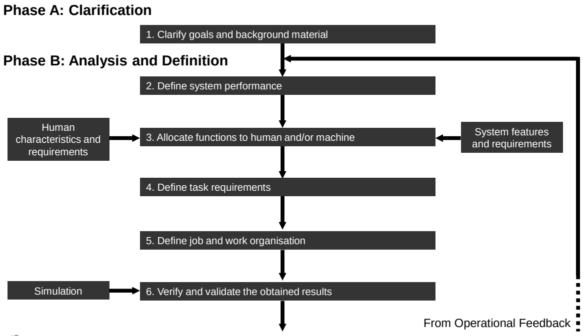
- Professionals in the oil and gas industry in Norway - engineers, equipment/systems designers, interface designers, psychologists, social scientists, ergonomists.
- "***Open minded***" to new disciplines, approaches, methods and techniques.
- Attend all lectures (50/60 lectures) + complete assignment (ca 10 days)

**Learning Outcomes**

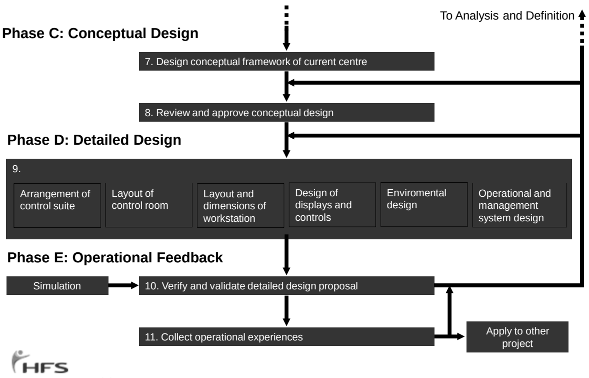
- Working knowledge of what human factors is and the challenges when applying HF to control room/system design in the Norwegian oil and gas industry.
- An overview of the different human factors approaches, methods and techniques and where these can be applied in the ISO 11064 design process (CCR).



## Framework: Design Process: ISO 11064 (1 of 2)



## Framework: Design process: ISO 11064 (2 of 2)







## HF Approach – Typical Syllabus

- **Day One** Introduction to Human Factors, PSA Regs, ISO 11064
- **Day Two** Clarify Goals and Overview of Analyses
- **Day Three** Overview of Analyses, Preparation and Assignment

- **Day Four** Perception and Information Processing
- **Day Five** Workstation and Control Room Design
- **Day Six** Interaction Design and Display Design
- **Day Seven** Organisation, Training and Procedures

- **Day Eight** Team work / Visit to site
- **Day Nine** Verification and Validation incl CRIOP
- **Day Ten** Human Error and Summary




## Theory and Practice

- Classroom exercises
- Practical exercises
- Visit to Control Room / IO

## Course Assignment

- Demonstrate ability to *apply* HF approach to Norwegian offshore oil and gas industry challenges. Use of methods, literature and knowledge
- Can relate to own work
- Wide range of assignments
- Support from lecturer
- 10 days work
- Formalities described




## Challenges

- Different background / interests
- ”I want more info on IO”
- ”I want less info on IO”
- More theory vs. less theory
- I know all about HMI, do I need to attend the HMI module?
- Written course assignment – first time in 25 years…
- I just wanted to know the character size on the screen
- No time is a good time for everyone




## Course Advantages

- Formal part of Masters / PhD at NTNU
- 15 Study points, NTNU
- Networking
- Understanding of human factors impact on individuals, companies and the industry
- Less than 5% drop out
- Positive written feedback

## How can you contribute?

- Spread infomation about course
- Propose project assignments
- Provide facilities for demonstration

HFS





## HF Approach – Reading Material

**Reading list: Obligatory**

- Wickens, Lee, Lui and Gorden-Becker, 2003. Introduction to Human Factors Engineering, Prentice Hall
- Kirwan : A Guide to task analysis
- Ivergård, 1989. Handbook of Control Room Design and Ergonomics, Taylor and Francis.
- Johnsen, S.O., Lundteigen, M.A., Fartum, H., Monsen, J., 2005. Identification and reduction of risks in remote operations of offshore oil and gas installations, SINTEF.
- ISO 11064: Principles for the design of control centres, International Organization for Standardization.

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## HF Approach – Reading Material

**Reading list: Optional**

- Dix, Finlay, Abowd and Beale, 2004. *Human Computer Interaction, Prentice Hall.*
- Endsley, 2003, Designing for Situation Awareness, Taylor & Francis.
- Henderson J., Wright K., Brazier A, 2002. *Human factors aspects of remote operations in process plants, Health and Safety Executive (HSE).*
- Reason, 1990. *Human Error, Cambridge University Press.*
- Redmill and Rajan, 1997. *Human Factors in Safety-Critical Systems, Butterworth Heinemann.*
- Sandom C. and Harvey R., 2004. *Human Factors for Engineers, Institution of Engineering and Technology*
- Wilson and Corlett, 1990. *Evaluation of Human Work, Taylor & Francis.*
- Weick, C. *"Sensemaking"*
- Luff.. *London Underground*

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## Practical

- Location: NTNU Videre Trondheim & HFS, Ski or other
- 2014 course – weeks 6,11,14
- Book by 10 January
- 10 days lecturing
- 10 days assignment
- Course material English
- Assignment English/Nordic
- Fee NOK 25.000
- 15 Study points, NTNU
- Feedback throughout course

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http://videre.ntnu.no/shop/courses/displayitem.do?dn=uid=nv13119,ou=ntnuvproducts,dc=ntnu,dc=org

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# Nye driftsformer i kjernekraft: "Small Modular Reactors

**Ø. Berg, IFE**

**Mer informasjon:**

# Nye driftsformer i kjernekraft:

# Small Modular Reactors, Generation III+ and IV

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HFC 2013

# The future of nuclear power?

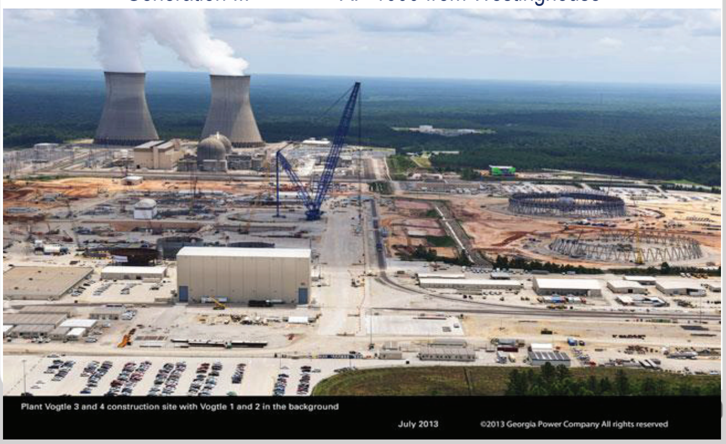
**Worldwide:**

- 434 Nuclear Power Reactors in operation
- 11,3 % World electricity production
- 70 Reactors under construction
- 150 Reactors in planning stage

# Georgia Power - Southern Company, USA

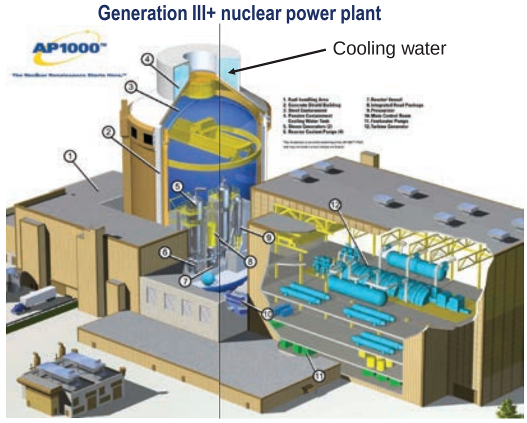
Vogtle1,2 in operation, 2 under construction, Vogtle 3,4 (2017)

Generation III+ AP-1000 from Westinghouse




# Emergency core cooling based on passive safety systems (Gravitation)–

**Generation III+ nuclear power plant**



## Traditional nuclear plants

- May have multiple nuclear power plant units collocated at one site
- Units are operated independently from separate control rooms
- Most existing and planned plants are operated this way

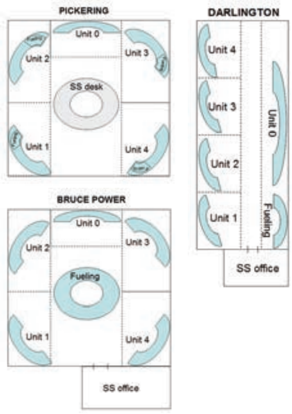
## Modular plants

- Multiple reactor units are operated from a central control room
- A few existing and planned plants are operated this way
  - CANDU multi-unit reactors
  - Small Modular Reactors (SMRs)

## CANDU multi-unit reactors

## Industry visit to Canada, 2008

| Plant | Design |
|---|---|
| Darlington plant & control room<br>Ontario Power Generation | 4 units operated from one control room |
| Pickering A plant & control room<br>Ontario Power Generation | 4 units operated from one control room |
| Pickering B plant & control room<br>Ontario Power Generation | 4 units operated from one control room |
| Bruce Power A plant & control room<br>Bruce Power | 4 units operated from one control room |
| Bruce Power B control room<br>Bruce Power | 4 units operated from one control room |




## Canadian multi-unit stations

- Constructed between 1960s and 1980s
- Traditional analog control panels with some retrofitted digital indicators and computerized displays
- Most computerized displays were two-color CRTs in typical 1980s style - rather conventional
- Control room layout and staffing solutions were extremely different from what we find elsewhere in the world

## Operational characteristics #1

- Four plant units operated from one main control room
- Electrical functions were common for all units and assigned to “unit zero”
- The control area for each plant unit was originally designed to be handled by a single operator
- One shift supervisor manages the operation of all four units
- Additional people may be available in the control room to administer and manage work

## Operational characteristics #2

- The staffing level in the control room has gradually increased over time
  - Pressure from the international nuclear community
- Typical staffing solutions are currently
  - 2 operators per unit during normal operation
  - 3-4 operators available per unit in upset situations
  - 2 or more additional licensed operators present to support plant units when needed

## Operational characteristics #3

- When operators handle disturbances on a unit, they are not given specific roles with pre-defined functions; tasks are distributed dynamically depending on the needs
- In the case of a multi-unit disturbance (e.g. loss of grid on all units), the staffing level may be reduced to 1-3 operators per unit depending on where the resources are needed

## Main experiences

- Initial staffing benefits of multi-unit operation was gradually lost due to
  - International safety requirements and conventions
  - Risk related to multi-unit disturbances
- Increased staffing has introduced “traffic” problems in the control environment
  - Up to 37 people in control area designed for 6-10 people

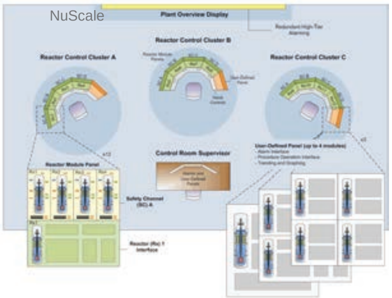
## Small Modular Reactors (SMRs)

## SMRs

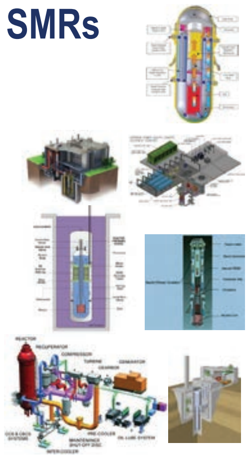
- Advanced modular plants are under development in the US
- Initiated pre-licensing process for several reactor designs
  - NuScale
  - B&W mPower
  - Westinghouse and NexStart SMR Alliance
  - CAREM, Argentina

## Operational concept

- Multiple reactor units operated from a central control room




## Claimed advantages of SMRs

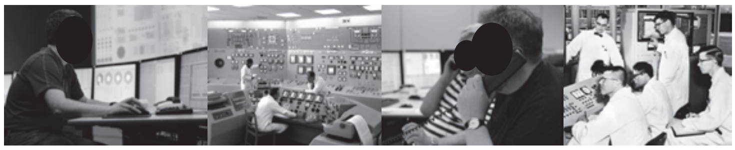


- Simple reactor design
- Natural circulation
- Highly automated
- Each module produces significantly less power than current plants
- Multiple modules can be stacked together and operated by a single crew
- Safe and easy to operate

## Issues under investigation

- How can operators transition smoothly between roles and tasks when they work on several units?
- Is it possible to maintain an overview of multiple units that are in different process states?
- May operators confuse plant units under high pressure?
- Can a small crew handle multi-unit disturbances (e.g., loss of grid on all units)?
- Collaboration between operators and automation

# HWR-938: Staffing Strategies in Highly Automated Future Plants



Presented by Øivind Berg

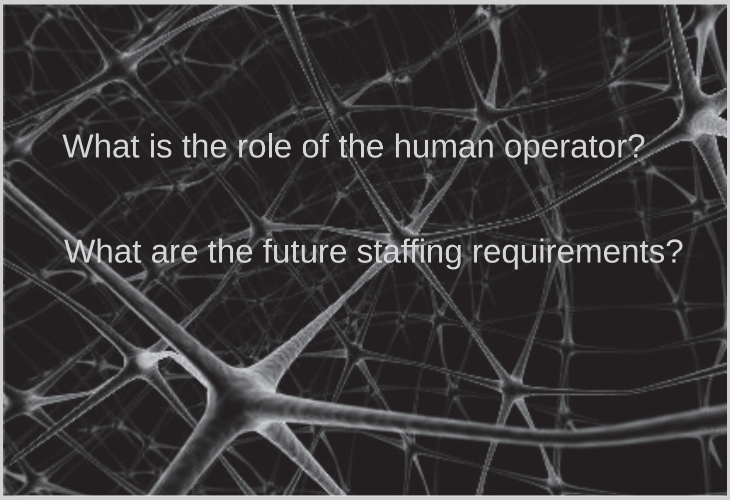
Maren H. Rø Eitrheim, Gyrd Skraaning Jr., Nathan Lau, Tommy Karlsson, Christer Nihlwing, Mario Hoffmann, Jan Erik Farbrot

**OECD Halden Reactor Project**

## Staffing needs

- When computers do more of the work, the staffing needs should go down
- True impact of higher levels of automation on staffing requirements is uncertain







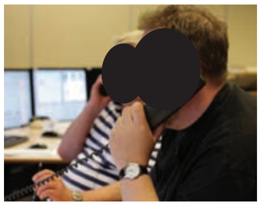

## Staffing needs in future NPP

- Introducing advanced reactor designs and high levels of automation may change the roles, responsibilities, composition, and size of the crews
- Possible changes:
  - Smaller CR crews
  - Crews responsible for a number of reactors
  - Off-site operations of one or more reactors
  - New staff positions requiring different qualifications



## Research goal

- Explore staffing strategies that can support future operational concepts

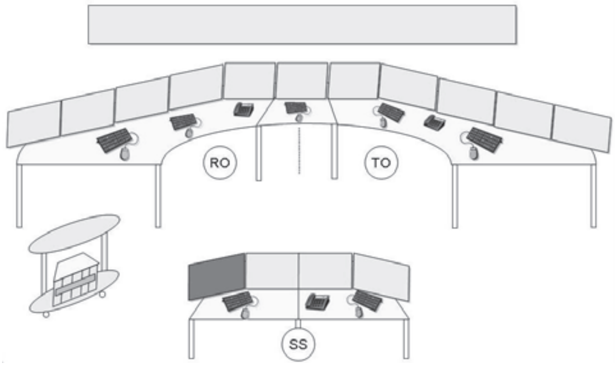


The 2009 HAMMLAB experiment:

**How will three operators manage to control two nuclear processes?**

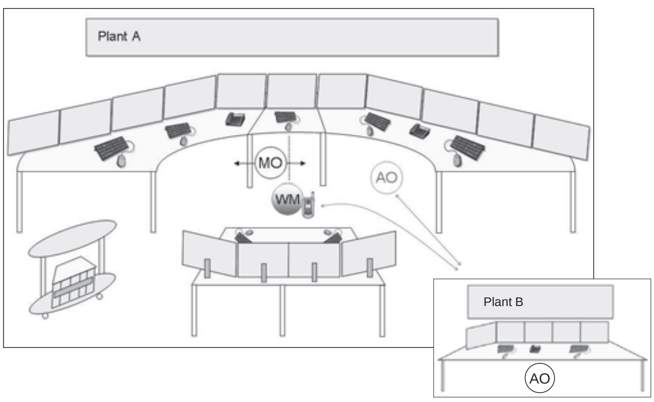


## Traditional staffing solution






## Untraditional staffing solution

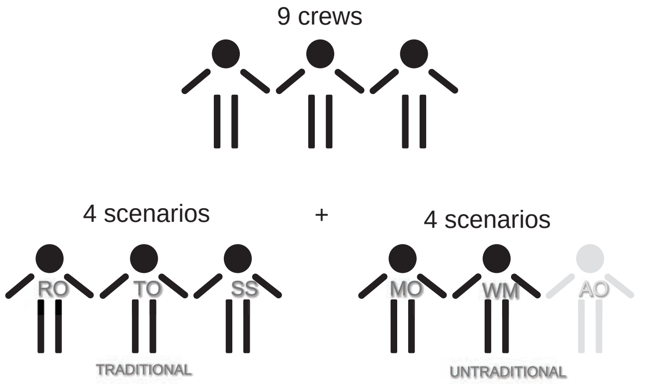





## Untraditional operator roles

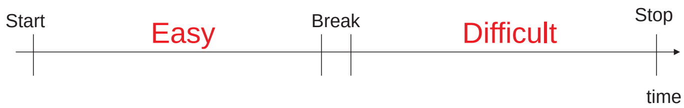
- Main Operator (MO)
  - responsible for reactor and turbine side of Plant A
  - monitors the automatic system
- Assistant Operator (AO)
  - controls the turbine side of Plant B
  - supports turbine side of Plant A when needed (as judged by the WM)
- Work Manager (WM)
  - responsible for Plant A and Plant B
  - makes decisions of operator allocation between plants
  - administrative tasks

# Data collection






# Scenarios



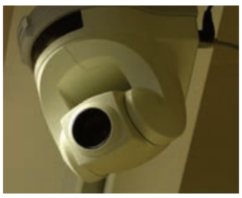

- Simple failures
- independent failures
- symptoms are causes
- low time pressure
- Automation always reliable

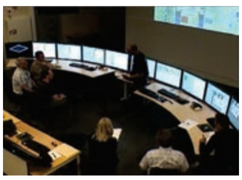
- Complex failures
- dependent failures
- masking of root causes
- high time pressure
- Automation may be unreliable
- Accumulated effect of failures



# Human performance data

- Before first scenario run
  - Demographic questionnaire
- During scenario runs
  - Operator task performance
  - Situation awareness
  - Self-rated performance
  - Workload
- After last scenario run
  - Debriefing (semi-structured interview with the crew)

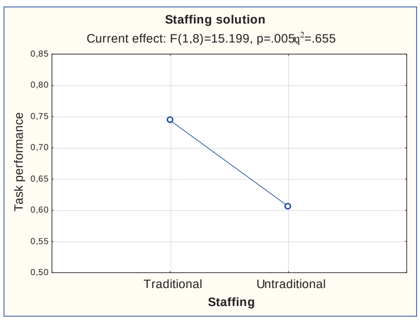






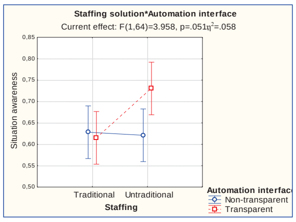
# Task performance

- The untraditional staffing solution degraded operator task performance



# Situation awareness (SA)

- Higher SA in the untraditional staffing solution with the transparent automation interface

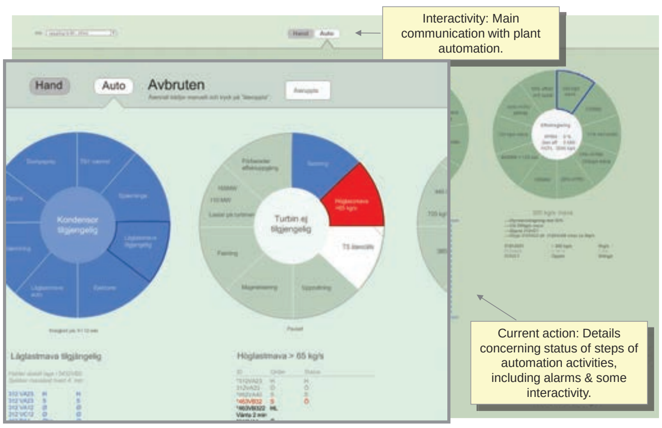





# Automation interface

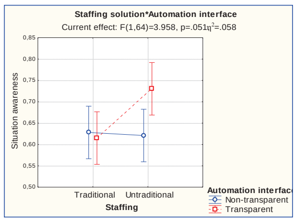
How information about the automation is shown to the operators

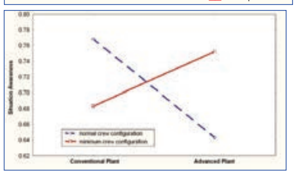
# Transparent Automation Overview Screen




# Situation awareness (SA)

- Higher SA in the untraditional staffing solution with the transparent automation interface
- A similar finding in a previous staffing study (HAMMLAB 1995)
- Innovative staffing strategies may improve situation awareness with new tools

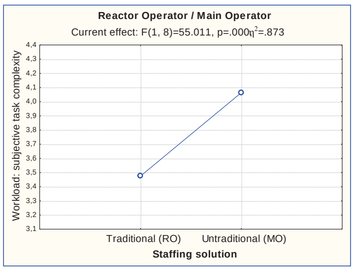


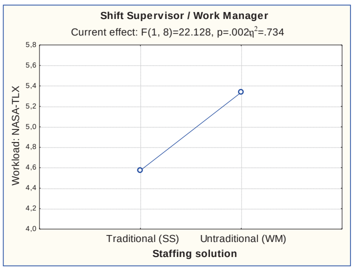




Hallbert, Sebok & Morisseau, 2000 (NUREG/IA-0137)

# Workload

- Main Operators and Work Managers reported higher workload in the untraditional staffing solution



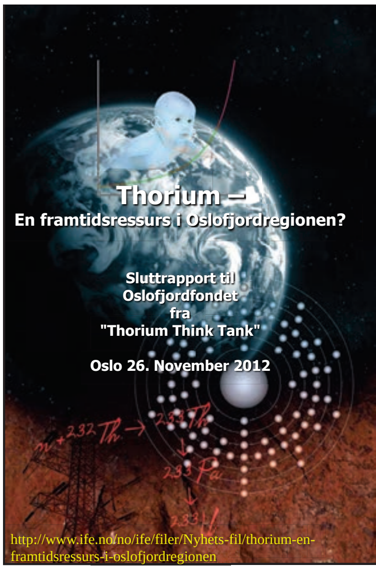



# Conclusion

- How well did three operators manage to control two nuclear processes?
  - Though with degraded task performance, operators managed a considerable number of prescribed tasks
  - The new operator roles are beneficial for
    - Utilising new tools
    - Simplifying communication between the operators in the control room
- Controlling more than one nuclear process may be feasible, but more operators may be needed during disturbances



# Extra slides - if time allows…..




# Thorium –

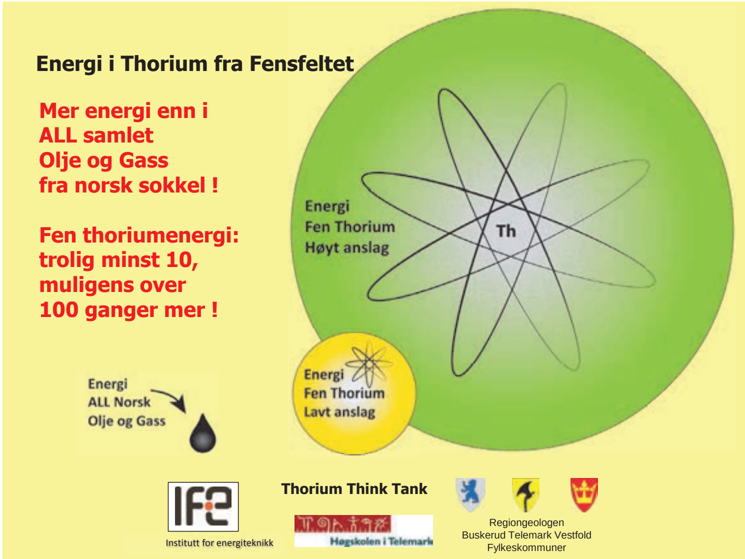
**Thorium - en stor miljøvennlig energikilde for framtida.**

**Øivind Berg**
**Institutt for energiteknikk, Halden**

Institutt for energiteknikk
Høgskolen i Telemark

Regiongeologen
Buskerud Telemark Vestfold
Fylkeskommuner


Energi
ALL Norsk
Olje og Gass
Hva om vi sammenlikner denne energien
med energien i Thorium fra Fensfeltet?
IFE
Institutt for energiteknikk
Thorium Think Tank
Høgskolen i Telemark
Regiongeologen
Buskerud Telemark Vestfold
Fylkeskommuner


Energi i Thorium fra Fensfeltet
Mer energi enn i
ALL samlet
Olje og Gass
fra norsk sokkel !
Fen thoriumenergi:
trolig minst 10,
muligens over
100 ganger mer !
Energi
Fen Thorium
Høyt anslag
Th
Energi
ALL Norsk
Olje og Gass
Energi
Fen Thorium
Lavt anslag
IFE
Institutt for energiteknikk
Thorium Think Tank
Høgskolen i Telemark
Regiongeologen
Buskerud Telemark Vestfold
Fylkeskommuner


DET EUROPEISKE PERSPEKTIV:
FENSFELTET
– EN STRATEGISK FRAMTIDSRESSURS
Norge er det eneste landet i Europa med betydelige kjente thoriumressurser
Andre kjente, store thoriumressurser er i BRIKS-landene og Nord-Amerika
IFE
Institutt for energiteknikk
Thorium Think Tank
Høgskolen i Telemark
Regiongeologen
Buskerud Telemark Vestfold
Fylkeskommuner

HFC

# Offshore robotics – Remote inspection and maintenance of oil platforms

**A. Transeth, NTNU**

**Mer informasjon:**

Linken under er til en rapport som nevner noen fundamentale utfordringer for robotikk generelt på side 62 (side 78 i selve pdf-fila):
www.wtec.org/robotics/report/screen-robotics-final-report-highres.pdf

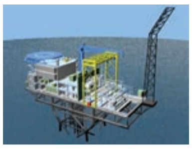
Autonomy in the Oil & Gas Industry – informasjon om autonome systemer og hvilke muligheter og løsninger dette gir olje- og gassindustrien. NFA har i samarbeid med Statoil, FMC Technologies, SINTEF, Computas og Alfatroll utarbeidet et dokument som omfatter definisjon av autonomi, løsninger som eksisterer samt autonome systemer for fremtiden.-
www.nfaplassen.no/2013/06/377/

A. Transeth et al. "Robotics for the Petroleum Industry – Challenges and Opportunities" SPE
Link til artikkel online er her:
http://www.onepetro.org/mslib/servlet/onepetropreview?id=SPE-167417-MS

Følgende rapport er også svært interessant når det gjelder autonomi. Den omhandler militære systemer, men innholdet kan også brukes generelt:
http://www.fas.org/irp/agency/dod/dsb/autonomy.pdf

# Offshore robotics – Remote inspection and maintenance of oil platforms



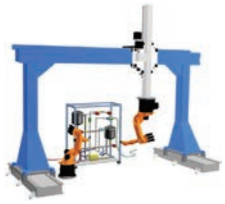




17 october 2013 Aksel A. Transeth, SINTEF ICT Applied Cybernetics



## Outline

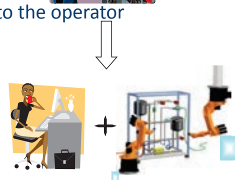
- **Future visions** for remote inspection and maintenance
- **Robotic lab facility** for both remotely controlled and automated operations



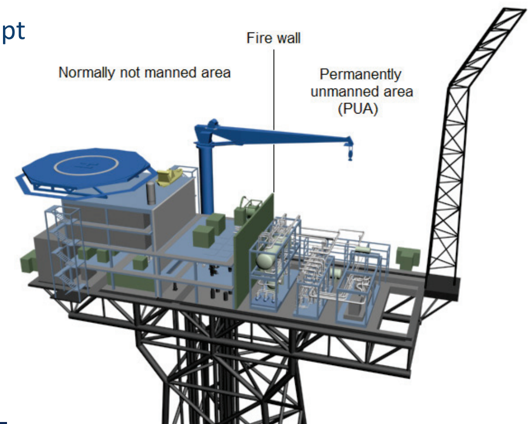
## Requirements for remote operations

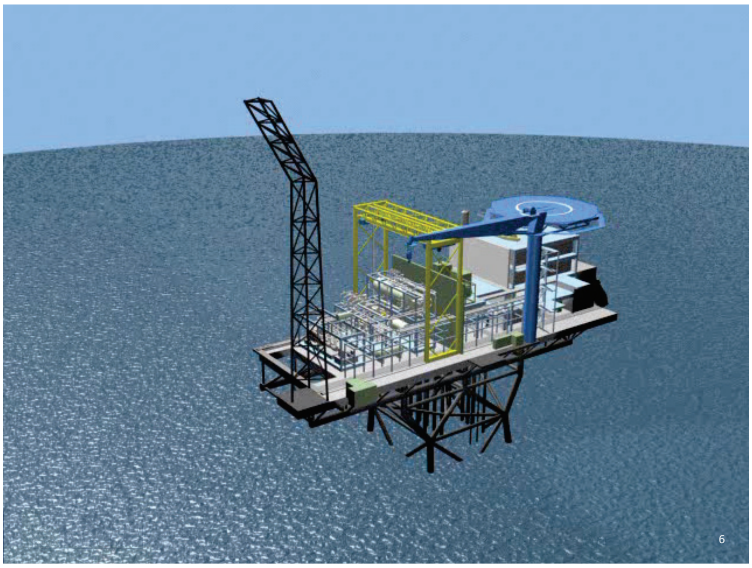
- The onshore operator must be able to monitor and remotely control all operations – also inspection and maintenance
- Remote operation of all critical operations
  - Operator should be "virtually" present off-shore
  - Operator should be able to remotely control the inspection and maintenance operations in real-time
- Operator interface must provide enough information to the operator
  - Audio, stereovision, tactile, temperature
  - Process views, virtual environments, control interfaces
- Ensure the quality of data
  - External inspection of process equipment
  - Automatic detection of deviations
- Goal:
  - A (semi-)autonomous system that replaces manual inspection tasks



## Platform concept





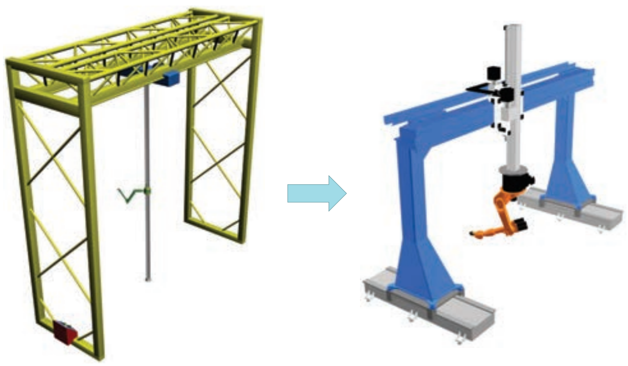


## Development of a robotic lab facility

Statoil → ROBOTNOR.no Centre for Advanced Robotics (SINTEF, NTNU) ← KUKA

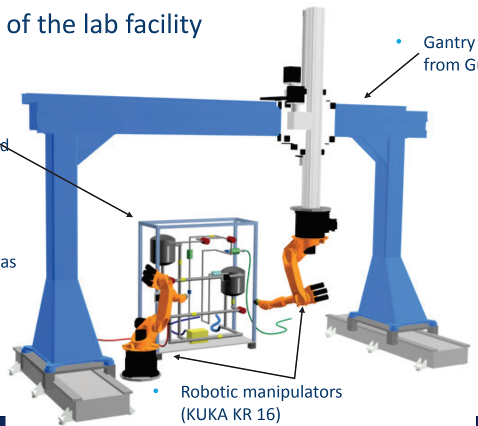


## Development of a robotic lab facility

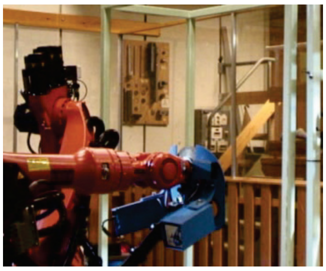




## Development of the lab facility

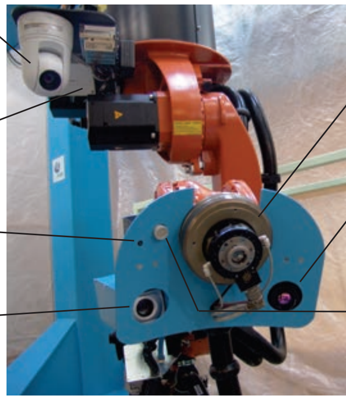


## The robotic system





## Permanent sensors on the robot



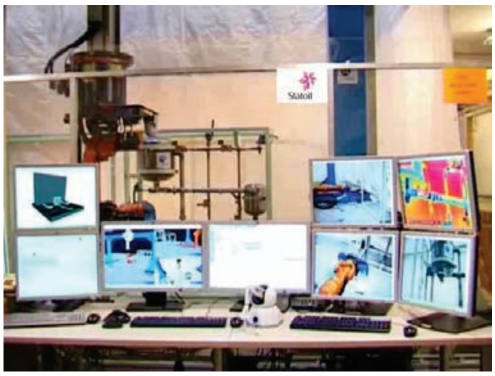
- Pan/tilt camera
- Data acquisition unit
- Microphone
- Macro focus camera
- Force/torque sensor
- Temperature camera (IR)
- Gas detector (CO2)



## Automatically exchangeable sensors and tools




## Control room



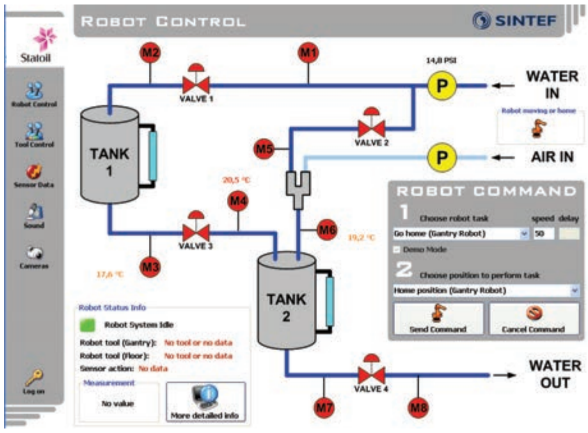
## Three modes of operation

- High-level control

- Model-based planning

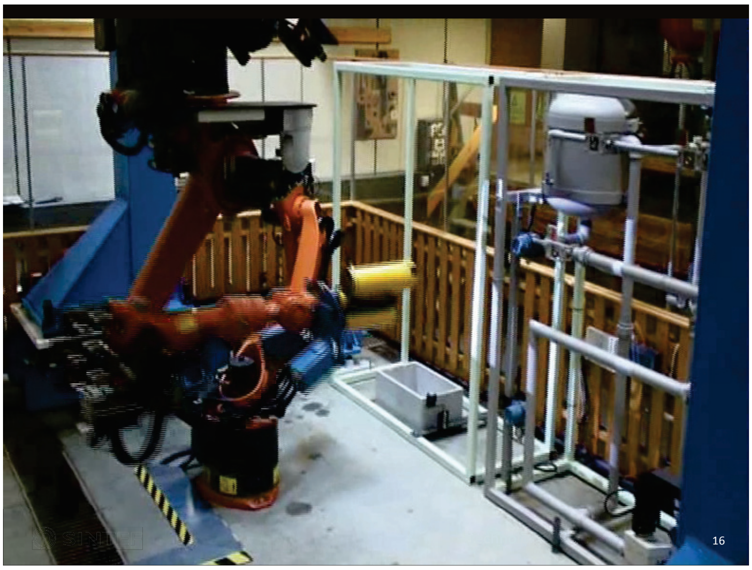
- Manual control



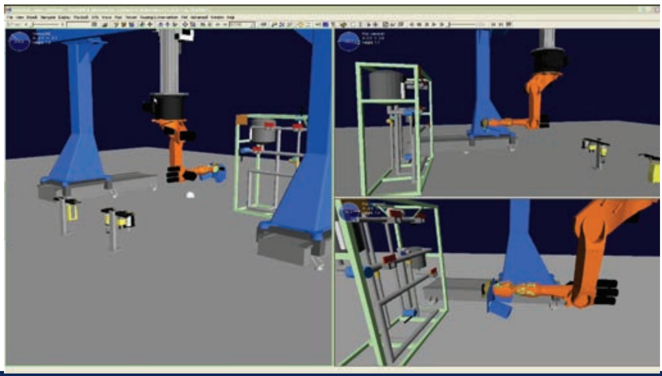



High-level control of operations



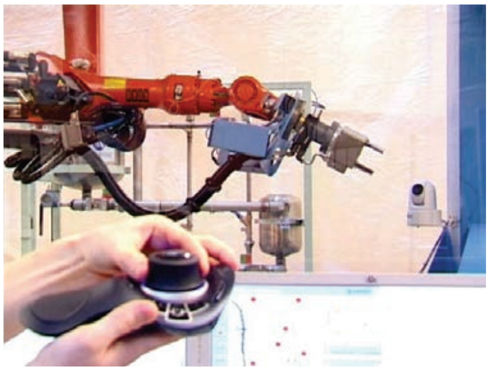


## Virtual planning of operations





## Manual control





## Human-machine collaboration – issues to consider


- Mental workload of operator
  - 🟢 Automation may *decrease* the workload of operators
  - 🔴 Automation may *increase* the workload of operators
- Situational awareness
  - 🟢 Irrelevant information may be filtered out automatically
  - 🔴 Humans tend to be less aware when not in control
  - Operator must have access to "raw data"
- Trust in the system
  - 🔴 Failure of a "near-perfect" automation system may not be tackled by operator
- Operator skills
  - 🟢 Autonomy enables operator to achieve complex tasks
  - 🔴 Autonomy may degrade operator sub-system skills

*Parasuraman, Sheridan, and Wickens (2000), A model for types and levels of human interaction with automation*



## Human-machine collaboration – issues to consider

- Human performance
  - workload, situation awareness, trust, skill
- Automation reliability
  - Low reliability reduces potential performance due to mistrust
  - Over-trust may lead to bad operator choices
- Cost of action outcomes
  - Particularly important for *decision* and *action*

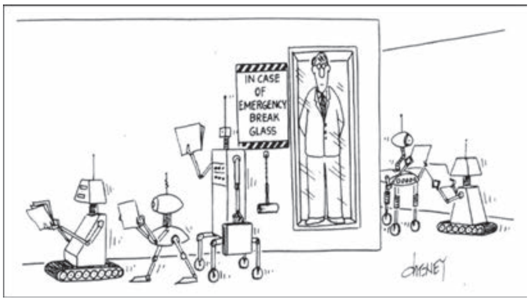
> The question is no longer whether one or another function can be automated, but, rather, whether it should be. Wiener & Curry (1980)

## Summary

- Considerations for human-machine collaboration
  - Human performance
  - Automation reliability
  - Costs of actions/decisions
- Deterministic system behaviour provides trust
- Early involvement of all key segments of the industry is important in order to succeed (suppliers, end-users, legislators, …)



## Thank you!




Aksel.A.Transeth@sintef.no

HFC

# Distribuert kontroll av produksjon i olje og gass

**T. Wærhaug, SIEMENS**

**Mer informasjon:**

SIEMENS

# Distribuert kontroll av produksjon i olje og gass

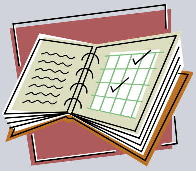
Trondheim 16.-17. oktober 2013



SIEMENS

## Agenda

- Forutsetninger
  - Endringer i kontroll/støtte
  - Hva er kontroll og hvem har kontroll
  - Målsetninger og utfordringer
  - Kontrollrom
- Konsept
  - Indikasjon i prosessbildet
  - Objekter kontrollert av andre
  - Oversikt over kontrolldistribusjon
  - Dialogboks
  - Endre kontrolldistribusjon
  - Meldinger/alarmer
  - Aktivere/deaktiver distribuert kontroll
- Fra konsept til produkt
  - Kundepresentasjon
  - Internbruk i testrom
  - Brukerpresentasjon/workshop
  - Brukertest

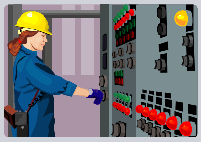


SIEMENS

## Endringer i kontroll/støtte

- Sentralisering av kontroll
  - Flere kontrollrom til ett
  - Flere plattformer til styres fra ett kontrollrom på én plattform

- Kontroll fra land
  - Enkelte operasjoner kan utføres fra land
- Støtte fra land
  - Støtte fra spesialister kan utføres fra kontrollrom på land







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## Hva er kontroll og hvem har kontroll?

- Tilstand
  - Ventilen er åpen
- Kommando
  - Stenge ventilen
- Meldinger/alarmer
  - Melding/alarm om feil på ventilen
  - Kvittere en melding eller alarm
- Horn
  - Varsel om feil på ventilen

Skal påvirkes av distribuert kontroll

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## Målsetning og utfordringer

- Målsetning
  - Kunne isolere kontrollen over hele eller deler av et anlegg til en operatør eller gruppe av operatører
  - Kunne flytte hele eller deler av kontrollen for anlegg mellom ulike operatører

- Utfordringer
  - Motforestillinger mot å flytte kontroll til land
  - Motforestillinger mot å ikke kunne kontrollere hele anlegget til enhver tid
  - ”Frykt” for å ikke kunne kontrollere anlegget i en kritisk situasjon
  - Intuitiv informasjon om kontroll/ikke kontroll til operatør
  - Intuitivt og brukervennlig å endre kontrollfordelingen

- Sikkerhet
  - Distribuert kontroll skal ikke svekke sikkerheten på anlegget




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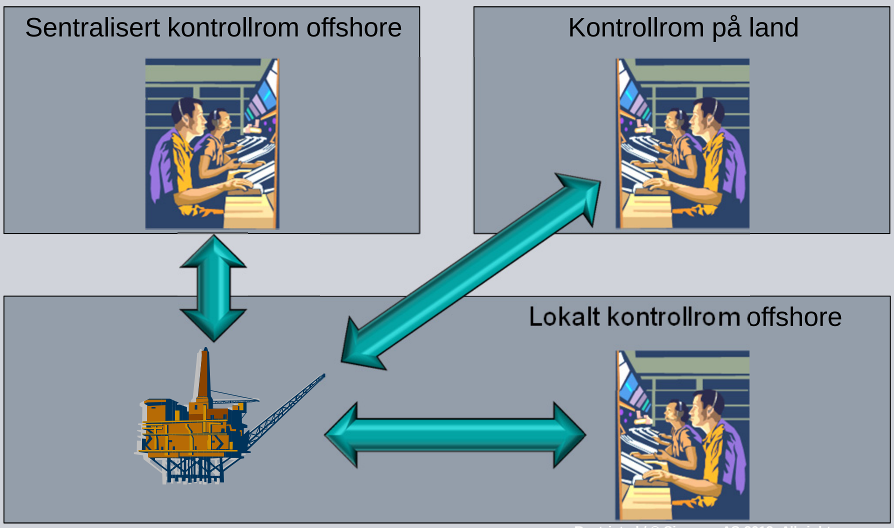
## Kontrollrom



## Konsept
## - Indikasjon i prosessbildet

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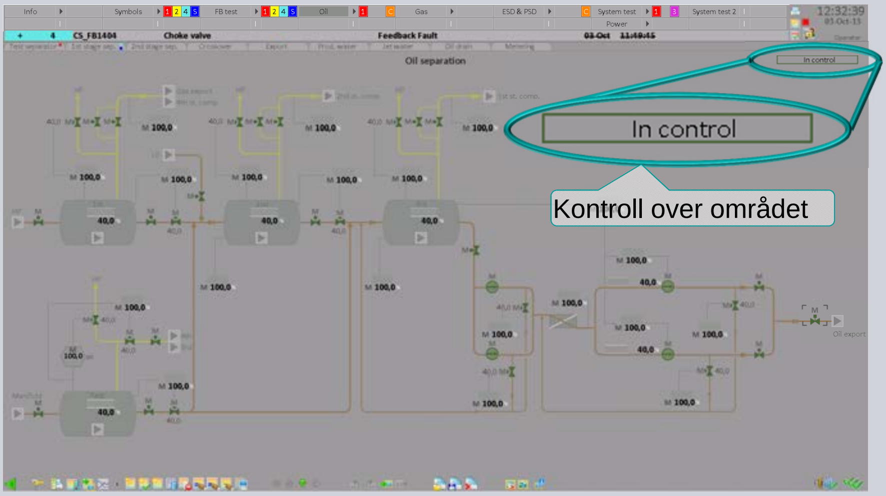






## Konsept
## - Objekter kontrollert av annen klientgruppe

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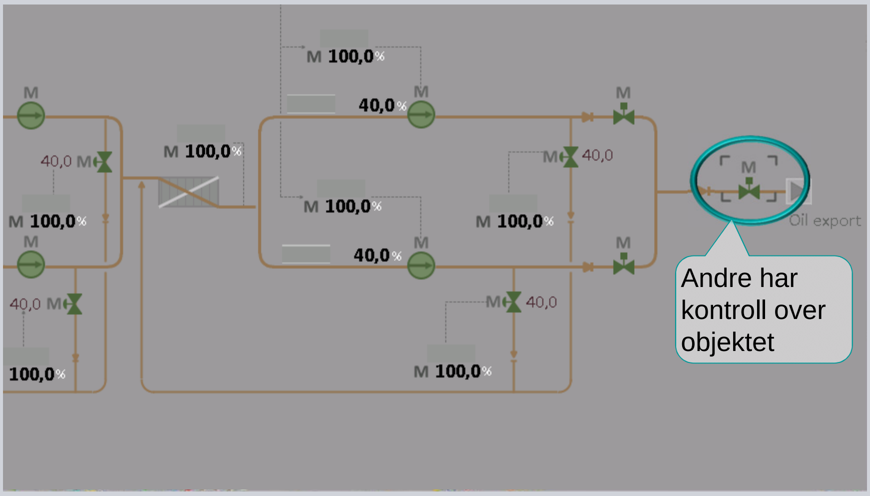

## Konsept
### - Område kontrollert fra annen klientgruppe

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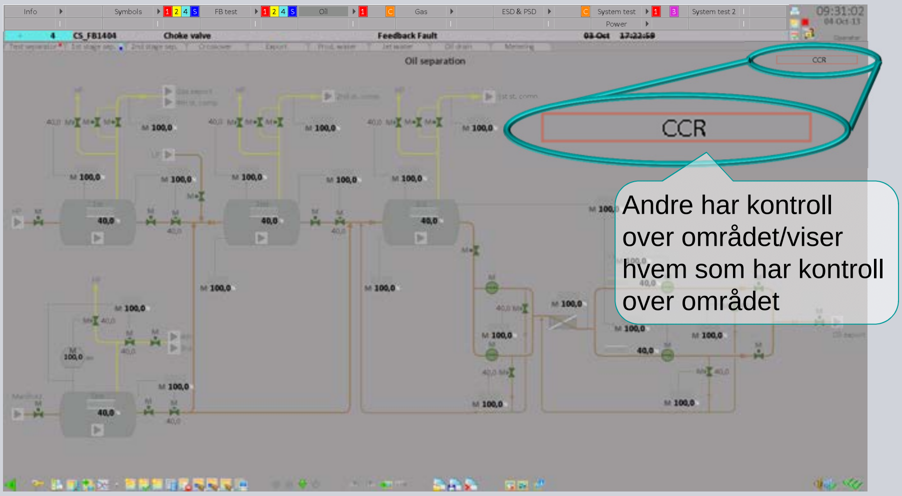


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## Konsept
### - Hopp til oversiktbilde kontrolldistribusjon

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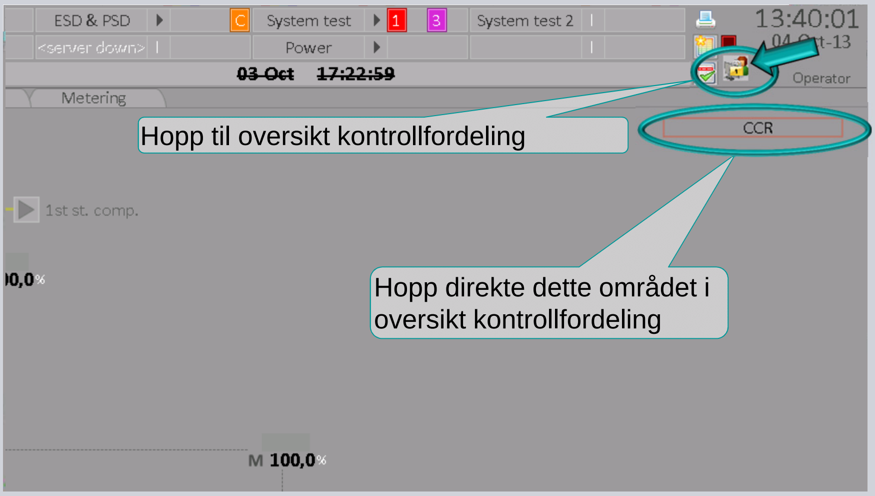


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## Konsept
## - Oversiktbilde kontrolldistribusjon

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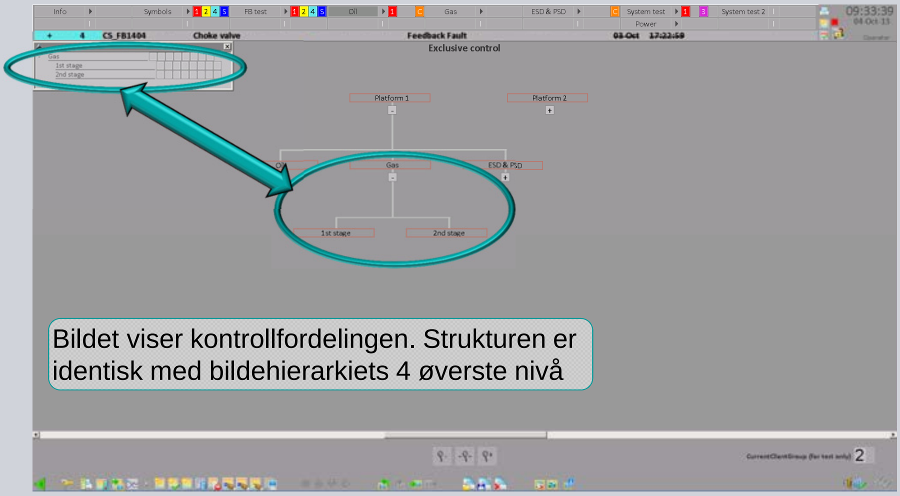





## Konsept
## - Forespørre kontroll

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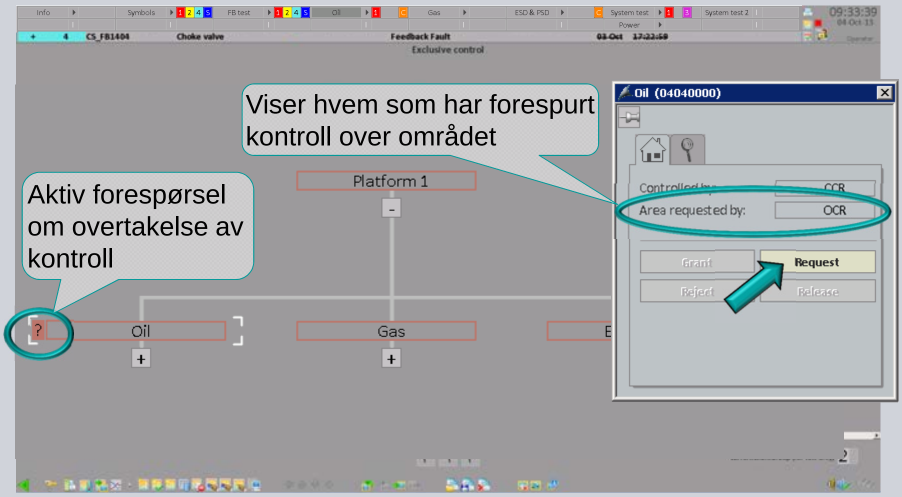

## Konsept
### - Varsel om forespørsel

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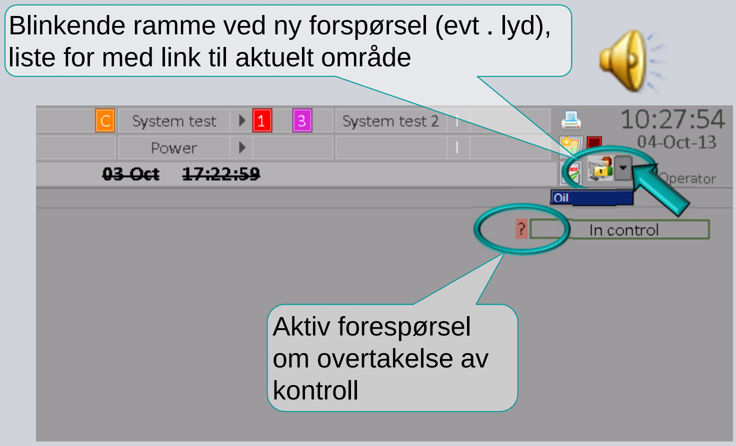





## Konsept
### - Gi kontroll

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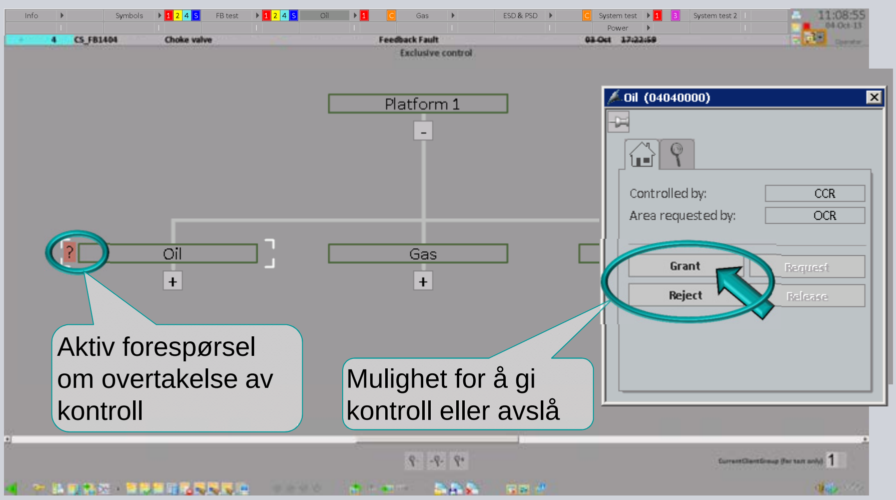

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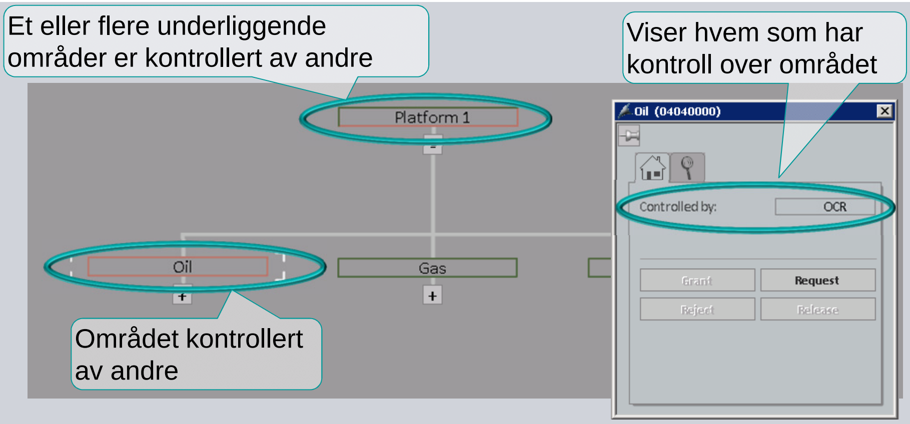
## Konsept
## - Avgitt kontroll på underliggende nivå

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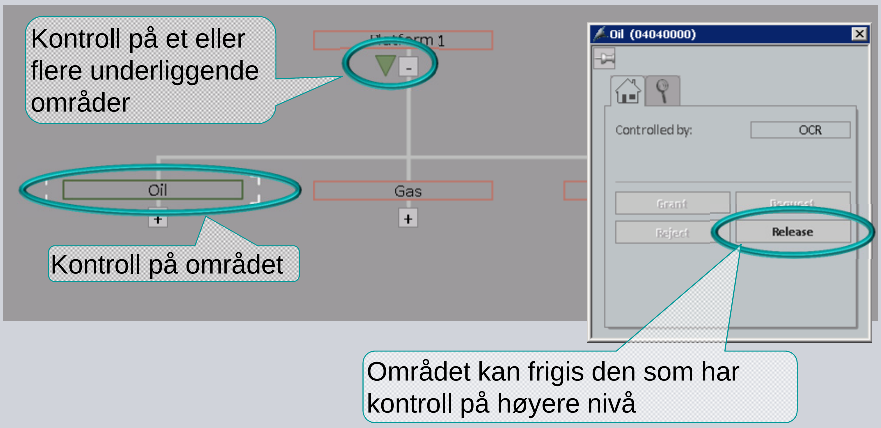
## Konsept
## - Kontroll på underliggende område

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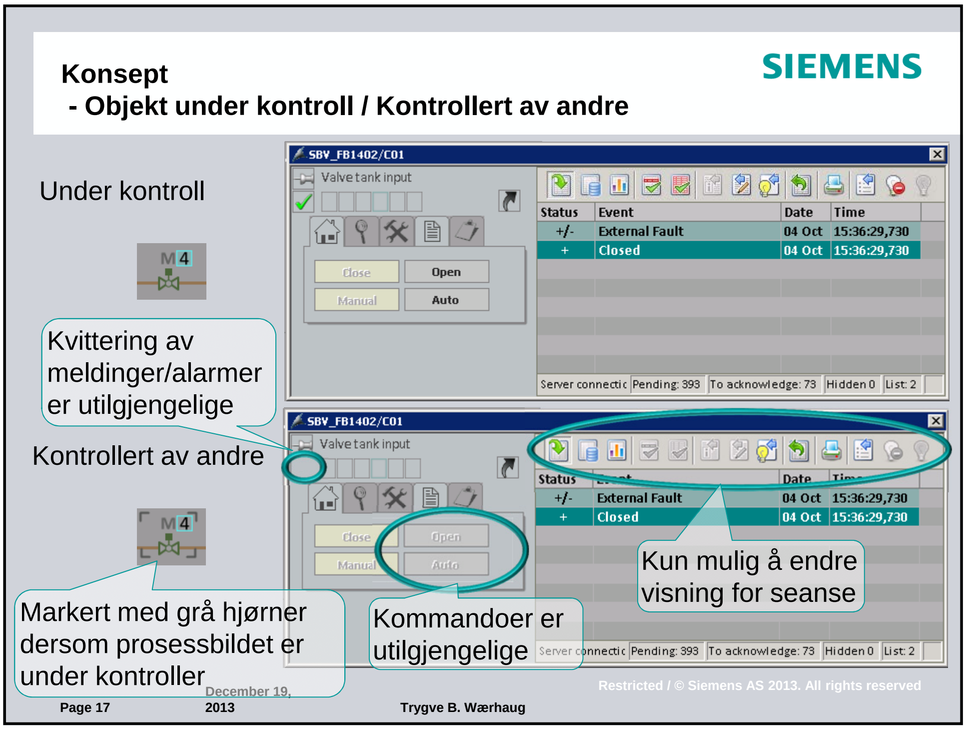
Konsept
- Objekt under kontroll / Kontrollert av andre
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Under kontroll
Kvittering av meldinger/alarmer er utilgjengelige
Kontrollert av andre
Markert med grå hjørner dersom prosessbildet er under kontroller
Kommandoer er utilgjengelige
Kun mulig å endre visning for seanse
SBV_FB1402/C01
Valve tank input
Close
Open
Manual
Auto
Status
Event
Date
Time
External Fault
Closed
04 Oct
15:36:29,730
Pending: 393
To acknowledge: 73
Hidden 0
List: 2
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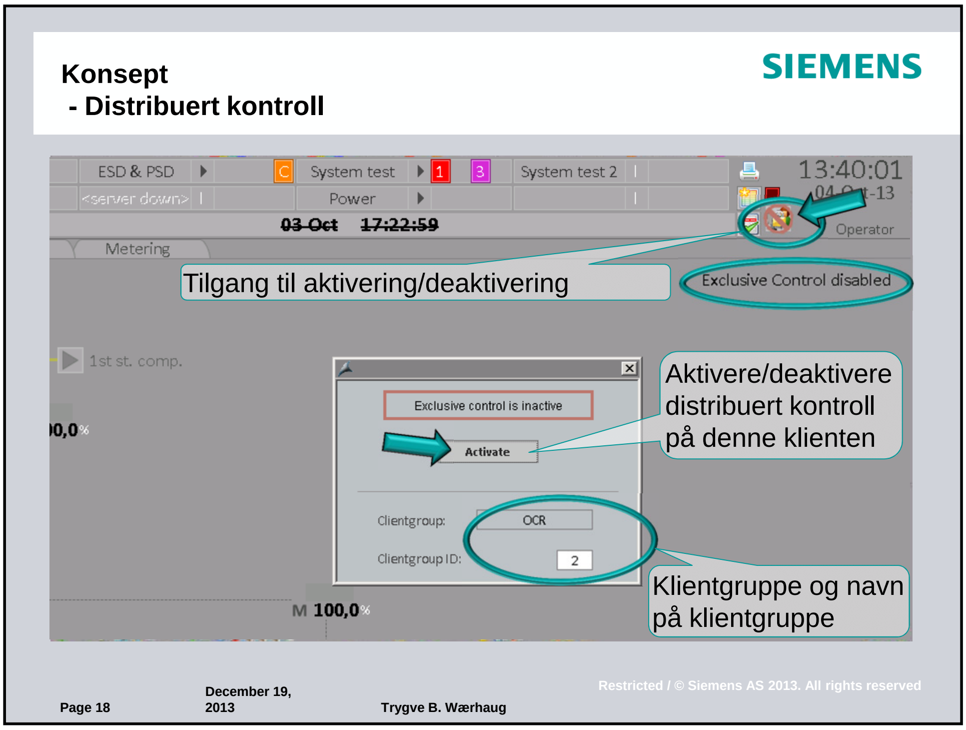
Page 17
December 19, 2013
Trygve B. Wærhaug


Konsept
- Distribuert kontroll
SIEMENS
ESD & PSD
System test
System test 2
Power
Metering
13:40:01
Operator
03 Oct 17:22:59
Tilgang til aktivering/deaktivering
Exclusive Control disabled
1st st. comp.
Exclusive control is inactive
Activate
Clientgroup:
OCR
Clientgroup ID:
2
Aktivere/deaktivere distribuert kontroll på denne klienten
Klientgruppe og navn på klientgruppe
M 100,0 %
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## Konsept
## - Meldinger/Alarmer

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## Fra konsept til produkt

- Kundepresentasjon
  - Konseptet presenteres for kunder som først vil ta i bruk produktet
  - Tilbakemeldinger som gjelder funksjonalitet
- Internbruk i testrom
  - Ingeniører som ikke er involvert i konseptet bruker distribuert kontroll over tid i forbindelse med andre tester
  - Erfaringer og tilbakemeldinger
- Brukerpresentasjon/workshop
  - Operatører fra de kundene som først kommer til å ta i bruk produktet
  - HF team
  - Tilbakemeldinger utforming

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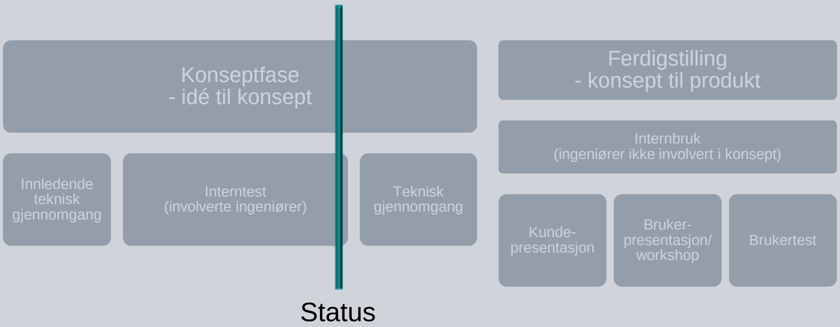
## Fra konsept til produkt

- Brukertest med operatører og HF team
  - Presentasjon/Innføring i bruk
  - Brukeroppgaver
  - Tilbakemeldinger utforming og bruk





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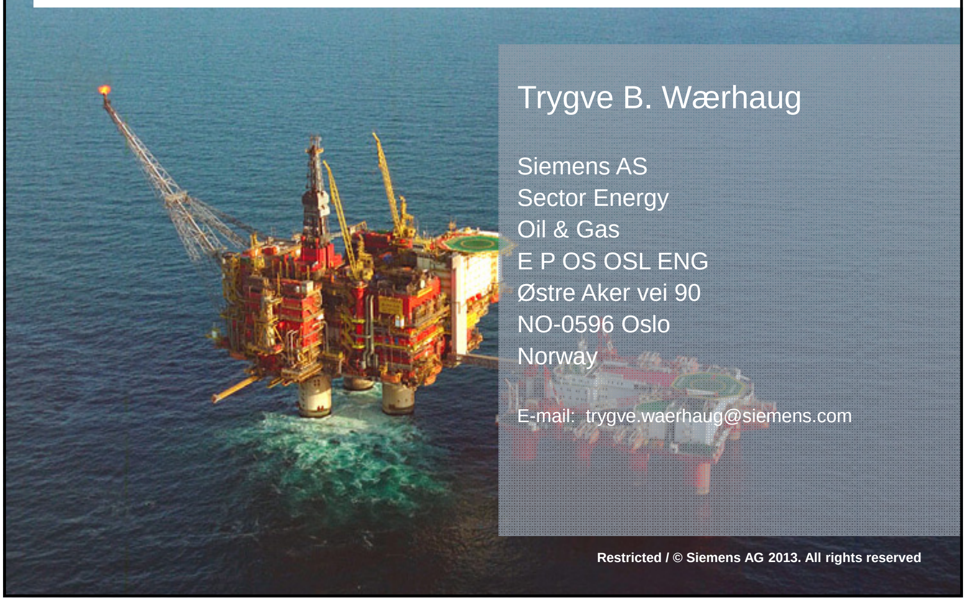
## Takk for oppmerksomheten



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HFC

# The need for guidelines using Closed Circuit Television (CCTV)

- **Research Proposal and presentation**
- **Workshop - HF Guidelines for off-shore CCTV systems**
- **Result from Workshop**

**R. Pikaar**

**Mer informasjon:**

Aldridge, J. & Gilbert, C.; Performance testing of CCTV. Perimeter surveillance systems. Using the Rotakin Standard Test Target. Version 1.0. Police Scientific Development Branch. Publication 14/95. Home Office - Police policy directorate (1996).

Damjanovski, V.; CCTV Networking and digital technology, Burlington, Elsevier Butterworth - Heinemann (2005).

ISO11064 Ergonomic Design of Control Centres - Multi part standard.

Wood, J. (2007); CCTV Ergonomics: Case Studies and practical guidance. In: Pikaar, R.N., Koningsveld, E., Settels, P. (Eds): Meeting diversity in ergonomics; Elsevier, Amsterdam.

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Ergonomics

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# Work Packages CCTV-Research Part II.

last version: 11 October 2013
reference: P337-O-CCTV phase 2.pdf
author: ir. R.N. Pikaar Eur.Erg.

This Annex describes the Work Packages (WP) for the research project Human Factors Guidelines for CCTV-supervision in control centres (Part II). The results achieved during Part I of this research project (2012 - 2013), are the starting point for the Part II research WPs. The results can be found in 3 reports:

- Schreibers, K.B.J., R.B. Landman, R.N. Pikaar (2012); *Human Factors of CCTV - Part 1 Technology and Literature review*.
- Pikaar, R.N. (editor) (2013); *Draft HF Guidelines for the design of CCTV-systems.*
- Bennis, A., R.B. Landman, T.M.J. Lenior (2013); *Experienced CCTV-image quality, pilot experiments investigating the usability of instruments for the measurement of perceived image quality.*

During the Part I research, several blank spots have been uncovered.

- There is a contradiction between case studies and literature. For example, in several case studies, the number of CCTV images presented to one operator is considerably larger than the “12 to 16 images guideline” found in literature. Users don’t seem to have a problem with this.
- Experiments are needed to better understand factors influencing image quality. Also of interest would be to verify the validity and practical use (instructions) of published test charts.
- Related to the previous item, image complexity is not clearly defined. For example: does movement within images contribute to the level of complexity? How does image complexity relate to operator mental workload?
- To describe the content of CCTV-images, a new concept has been introduced. A **scene** is a logical and meaningful **set of visual information**, to be monitored with a specific aim. It is expected, that the concept of **scenes** will be useful to address CCTV task complexity. This concept might replace the traditional task complexity variables “camera-operator ratio” and “camera-monitor ratio”. The operator task determines the composition of a scene.
- Task complexity is related to operator education, training, and experience. The case studies showed large differences; an impact on guidelines for task complexity, information structuring, and so on, should be expected.
- It should be considered to address HF aspects related to automated video content analytics (VCA), post-event analysis of CCTV footage, special Infra Red and/or very high resolution cameras.

**Work Package 1.**
**The concept of Scenes - theory development and practical validation.**

- ***Aim***
  - Develop a theory for the concept of a scene, as a tool to analyse task complexity. A preliminary definition: a scene is a logical and meaningful set of connected and coherent visual information, to be monitored with a specific aim. A scene does not necessarily contain CCTV-image only.
  - Develop guidelines on how to compose scenes.
  - Develop guidelines on the number of scenes an operator can handle.

- ***How***
  - Review literature on factors determining image and task complexity, in search of experimental evidence of statements regarding complexity factors. Thus far, image complexity is not yet clearly defined.
  - Review relevant cases/ case studies of project phase I, regarding:
    - factors determining task complexity and image complexity
    - any workload indicators
    - case review includes additional visits on site to get more detailed data on the images on display (for specific tasks).
    - suggested cases include: traffic control and/or tunnel supervision, remote control, train station surveillance, and building security.
  - Develop a theory on how to identify a scene
    - check in practice: what did we find in case studies
    - develop a guideline and find evidence regarding the number of scenes per job by performing field experiments as well as controlled laboratory experiments.
  - Develop guidance on how to design scenes: i.e. the arrangement of images, need for stitching technology, etc.

- ***Product***
  Report on the concept of scenes, summarizing the research findings. In addition Guidelines regarding scenes will be formulated, such as for
  - number of scenes an operator can handle;
  - structuring of images within a scene
  - the design of reference graphics (graphics to support scene selection).

- ***Who***
  Leading contractor/research partner: Intergo
  Overall project management: ErgoS Engineering & Ergonomics.

- ***Cost - Amount work***
  A first estimate for this proposal would be 50 days of work, requiring a project budget of approximately € 40.000.

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- ***Who***

  Leading contractor/research partner: Intergo
  Overall project management: ErgoS Engineering & Ergonomics.

- ***Cost - Amount work***

  A first estimate for this proposal would be 50 days of work, requiring a project budget of approximately € 40.000.

**Work Package 2.**
**Experienced image quality - laboratory and simulation research**

- ***Aim***
  - Get a better understanding of the variables that influence the operator experienced quality of CCTV mediated images.
    - what happens at pixel level during transmission and processing from camera to monitor.
    - compare mediated images and direct view (what are performance differences between direct view and mediated images).
    - investigate the degrading influence of the camera environment, particular of light and lighting conditions (day/night, reflection hindrance, maritime situations).
  - Publish an evidenced test procedure on experienced image quality of CCTV mediated images related to typical operator tasks.

- ***How***
  Laboratory experiments & experiments in controlled (simulator) settings. Experiments will follow-up on reported pilot experiments (Bennis etal.).
  - Study existing task typologies (literature) and indicate expected relationships between types of tasks and experienced image quality.
  - Validate Vidilabs, Rotakin and Landolt C methods / test charts.
    - A pilot experiment indicated that the Rotakin method is not valid for facial recognition. Further proof for this statement in practical contexts will be provided, because at this moment the method is widely used.
    - The Vidilabs chart and Landolt C approach could be integrated in one test tool and/or test procedure; to be validated for use in one or several CCTV application areas.
  - Test in a controlled setting (i.e. simulator of tunnel traffic management system)
  - Verification of controlled setting outcomes by laboratory experiments (usability laboratory at HAN).

- ***Product***
  - Report on the image quality experiments, summarizing the research findings.
  - Method & procedure for experienced image quality assessment in different areas of application. Choice of application areas to be based on situations which are relevant to the funding project partners. Suggested: surveillance/security, traffic control, and maritime situations.
  - Text proposals for including findings of the experiments in the (Draft) Guidelines document.

- ***Who***
  - Leading contractor: HAN University of Applied Sciences.
  - Overall project management: ErgoS Engineering & Ergonomics.

- ***Cost***

  Estimated total costs for a full set of experiments and simulator studies.
  - scientific staff € 40.000 (50 days)
  - student contributions / costs € 16.000

  In case of a lack of sufficient funding for WP 2, research activities will be carried out at a low pace.

**Work Package 3.**
**Guidelines - development of a full set of HF guidelines**

- ***General aim***
  Development of the current Draft Guidelines for CCTV system design into a a full or final guideline.

- ***More specific aims***
  - To get feed back on the use of the Draft Guidelines document, as well as on the scientific quality of the Draft Guidelines.
  - Follow up on recently published literature, and research.
  - Integrate outcomes of other work packages into the main document.
  - Develop Additional Guidance for the application of CCTV in specific application areas (depending on the interests of project partners). Possible areas of specific application are 1. remote control in the off-shore environment and 2. health care.

- ***How***
  - During Part I we have come across several (international) studies, though with a few published results. At the start of Part II, we propose to actively seek contact with other research institutes in order to exchange knowledge and experiences. Emphasis will be on research in the UK.
  - Project partners and research partners are involved in a diversity of real world projects of CCTV control centre (re)design. Within WP 3 a systematic feed back on the use of the guidelines will be organized.
  - Scientific feed back by experienced researchers.
  - Include outcomes of Work packages 1 and 2 in the Guideline document.
  - The Guidelines aim for all types of CCTV systems and therefor are general by nature. A differentiation towards application areas could be useful and has been asked for by several organizations. The following approach is envisaged:
    1. Establish a general part of the CCTV systems guideline
    2. Include an updated version of the literature survey and HF related aspects of CCTV technology.
    3. Develop supplemental guidance for specific application areas.
  - Development of a standard contribution (text) on HF requirements for CCTV related systems, that can be offered to third parties for including in their standards/guidelines (such as ISO11064, or the CRIOP V&V).

- ***Product***
  The final product of WP 3 will be an improved/updated final Guideline Document.

- ***Who***
  Leading contractor and overall project management: ErgoS Engineering & Ergonomics. ErgoS will seek cooperation with Sintef (Norway), presumably on a 50-50% basis.

- ***Costs***
  The amount of work may vary depending on the available funding.
  - To effectively integrate the output of the other Work Packages in the Guidelines, a minimum effort of 20 days (€ 16.000) is estimated.
  - It is assumed and hoped for that a more substantial contribution by industries will enable us to double the efforts in WP3.

## Introduction to Workshop

HF Guidelines for CCTV-supervision in control centres

Ruud Pikaar, ErgoS (NL)

## Content

- Project outline
  - pooled funded research
- Part I – research (May ‘12-‘13)
  - Literature & field studies
  - Laboratory experiments
  - Guidelines - interactive sessions
- Part II – research proposal (‘14)
  - visit afternoon Workshop !

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## CCTV Project goal

- Goal
  develop HF Guidelines for CCTV work systems
- Why ?
  - no evidence based guidelines available
  - no guidelines for remote control, off-shore
  - practice contradicts “theory”
- Nowadays
  - bad image quality
    do you see what you need to see?

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## Project outline

- Phase 1: orientation - literature
- Phase 2: 8 field case studies
  - report *Technology and literature review*
- Phase 3 – Pilot experiments
- Phase 4 – Develop *Draft HF Guidelines*
  - 160 days effort + 4 Interactive workshops
  - Budget: € 104.000 (11 partners x € 8.000)

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## Project limitations

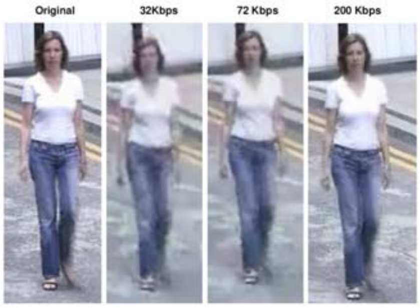
- technology — digital/software, IP-based
- not about — legal & privacy aspects
- tasks — relevant to our project partners
  industry, traffic control, security

- system
  recording – transmission – display – cognitive processing


## Active input – Workshops

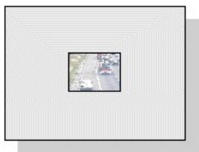

## Literature (until 2012)

- 40 references
- Keval – image recognition
  - surveillance
- Wood et al. (2007)
  - field experiments
  - object detection




## Typical engineering questions

- # screens / operator ?
- # camera views / operator ?
- # camera's / operator ?
- answers:
  - literature: max. 16 cameras
  - # screens limited by visual field (70° horizontal, 60° vertical)
- much unknown!



## Conclusions – literature

- HF literature: limited to traffic and surveillance
- Guidelines are often “open” doors
  - things you should think of
  - or already known control centre guidelines
- Tasks typology:
  - detect, monitor (observe), recognize, identify
  - needed: metric for image & task complexity
- Do less with video, more with sensor data

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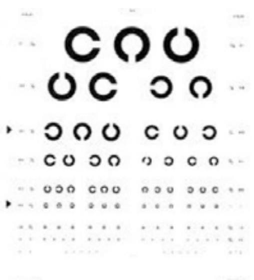
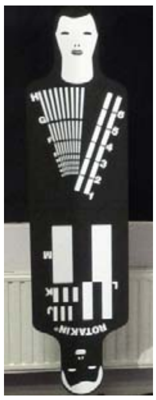
## Pilot experiments

- experienced image quality
- compare 3 test charts / methods
- Rotakin: not a valid test procedure.



Landolt – eye sight test


Vidilabs test chart



Rotakin

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## Draft Guidelines

- Goal: HF guidelines
  - for the project/engineering environment
  - system approach (MMI)
  - in line with ISO-standards
- Literature: less than expected.....
  .....we did not finish/finalize guidelines

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## Content Draft Guideline

- Chapters
  1. Project Ergonomics (= HF engineering process)
     finished
  2. System characteristics (= define system)
     finished
  3. Tasks and jobs
     available, except task allocation/workload indicators
  4. Control centre layout & workplace design
     available, except details of cctv hardware
  5. Image presentation and interaction design
     available, mostly not evidenced & concept of scenes to be worked out

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## CCTV-Research Part II

- 3 Work Packages (WP)
  - 1. Concept of Scene
  - 2. Experienced Image Quality
  - 3. Final Guidelines
- Start WP 1 & WP 2 – start November 2013
  - funded by Dutch partners
- WP 3 – Norwegian contribution ?
  - develop guidance for off-shore CCTV use

ERGOS
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## Closing

- After lunsj
  - CCTV Workshop
- Aim
  - Show the need for guidelines (cases)
  - Off shore (+ other industries):
    define CCTV requirements needed
  - Need to establish standards
  - … become project partner

# Workshop

## HF Guidelines for off-shore CCTV systems

Ruud Pikaar Eur.Erg.

## Content

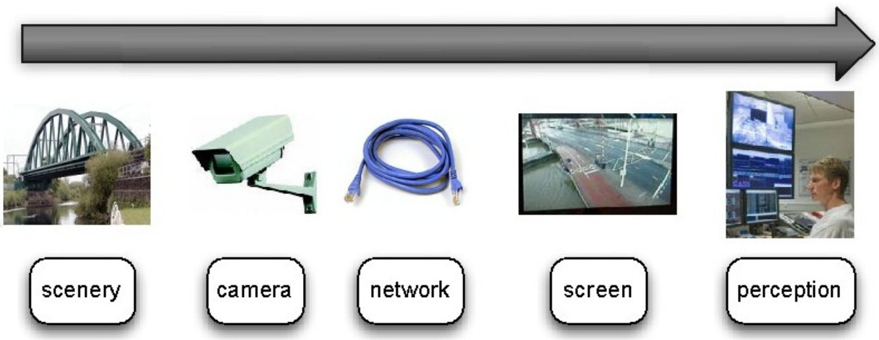
- Short project outline – what do we know ?
  - Part I – research (May '12-'13)
- Cases: remote control
  - comment & do you recognize ?
- Do we need to establish standards ?
  - Part II – research proposal ('14)
- Become a stakeholder ?
  - proposal to collaborate

## Goal

- Develop HF Guidelines for CCTV work systems
  - to fill in blank spots (off shore, remote control)
  - fitted to engineering needs
  - CRIOP: add CCTV requirements
- Our basis of today
  - 8 case studies & literature search
  - report *Technology and literature review*
  - Pilot experiments: perceived image quality
  - *Draft HF Guidelines*

## Definition of CCTV-system

- scene (& environment) → camera/recording → transmission → display → cognitive processing

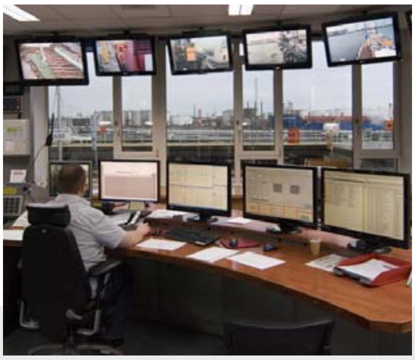


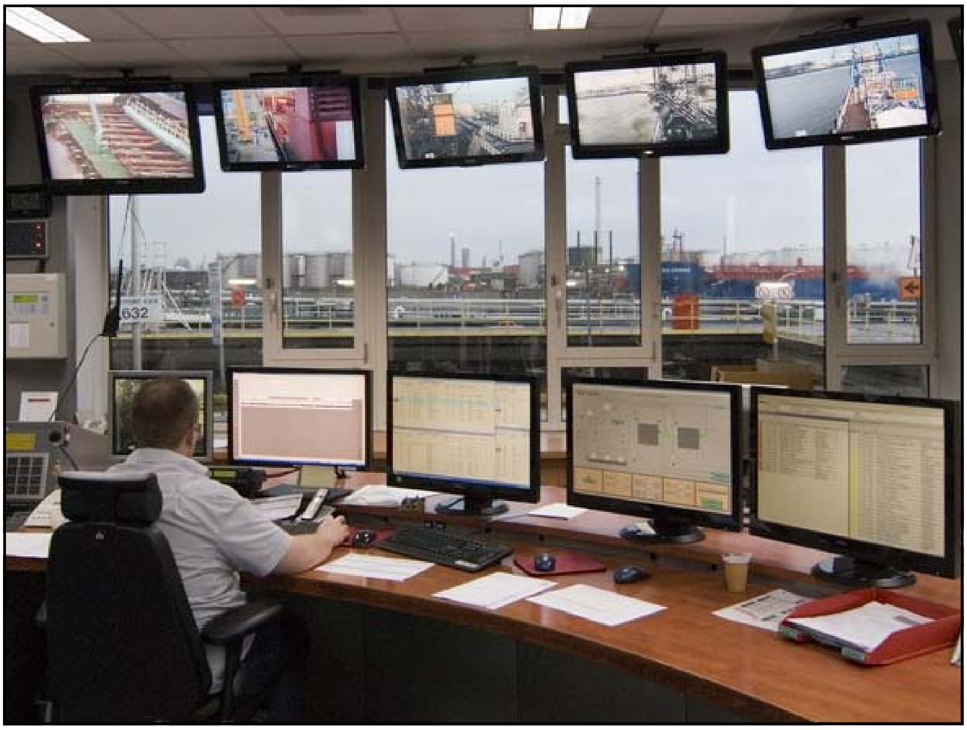

- Tasks typology (in literature):
  - detect, monitor (observe), recognize, identify

## Challenge ……

- tanker terminal
- remote supervision (safety)

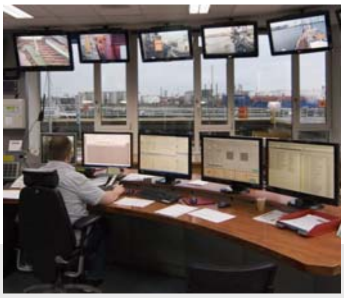
- your comments
- can same situations be found in your own organisation?





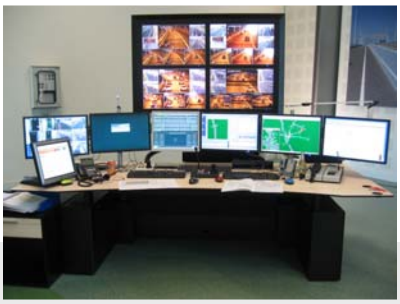
## this is not good HF ......

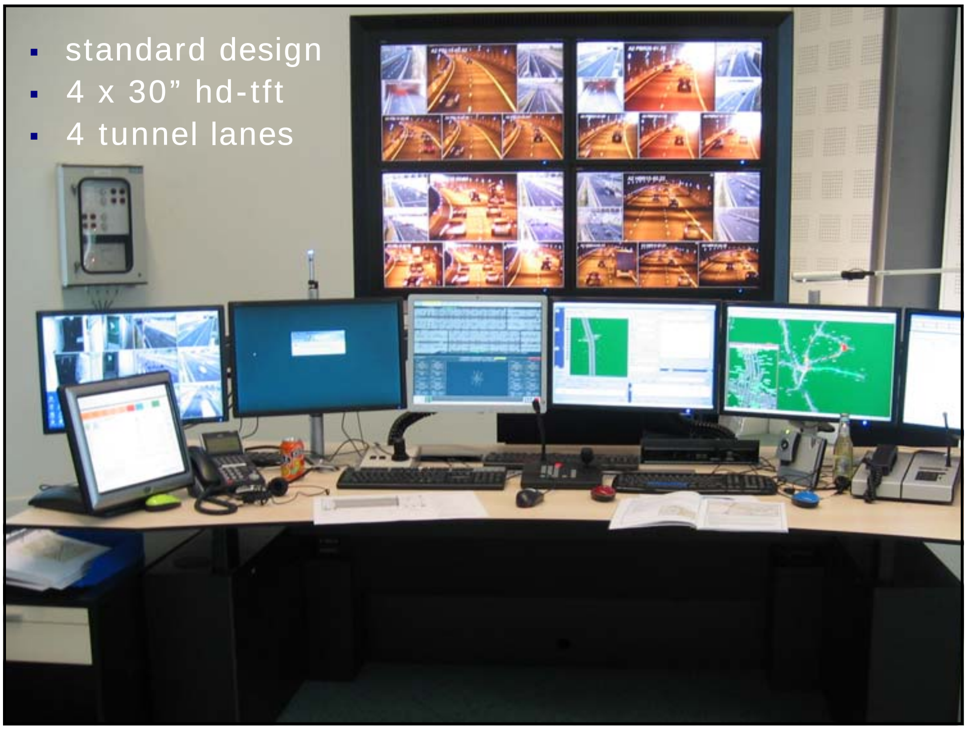
- workplace layout
  - large viewing distance & angle
  - large screens: scaling
  - wide screens: distortion
- images
  - low picture resolution
  - maritime situation, reflections via water
- did you do better ?



## Case – Videowall technology

- workstation with videowall
  - left – governmental standard
  - right – new (test)
  - what do you think operators like best ?
  - and why ?





standard design
4 x 30" hd-tft
4 tunnel lanes


RWS

## Case – Videowall technology

- left – standard: best CCTV resolution
- right – new: larger, reduced resolution
  - operators like ...........
- experienced image quality

## Need for better guidelines

- Goal: HF guidelines
  - for the project/engineering environment
  - system approach (MMI)
  - in line with ISO-standards
- Literature: less than expected.....
  .....we did not finish/finalize our guidelines
- Case studies
  - do we understand user preferences ?
  - what is best for task performance ?

## CCTV-Research Part II

- 3 Work Packages
  - 1. Concept of Scene
  - 2. Experienced Image Quality
  - 3. Final Guidelines

    including off shore / remote control
- Start WP 1 & WP 2 – November 2013
  - funded by Dutch project partners
- WP 3 – Norwegian contribution ?
- Work packages in line with your needs ?

## WP1 – Concept of Scenes

- Scene
  - logical and meaningful set of visual information, to be monitored with a specific aim.
  - closely linked to operator task (i.e. better than the # of cameras rules)
  - possibly better relationship with complexity parameters.
- Example: tunnel safety
  - overview condition
  - incident condition

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## WP1 – Concept of Scenes

- Aim:
  - develop theory
  - guidelines operator workload
  - define task complexity
- How: review of literature & re-visit cases
  - how to identify a scene, check in practice
  - how to design scenes (image arrangements)
- Product: guidelines (& background)
- Cost: 40 days (rough estimate)



## WP2 – Image quality

- Aim:
  - to understand variables influencing experienced image quality
  - develop evidenced test procedure
- How:
  - laboratory / simulator experiments
- Product: method & procedure
  - on going research (at University Arnhem-Nijmegen, NL)

## WP3 – Final Guidelines

- Aim: Final guidelines
  - check feedback & recent literature
  - integrate results of WP 1 and WP 2
- How:
  - testing / feed back project partners
  - scientific review by Sintef, possibly others
  - generic, plus supplemental annexes
- Product: document
- Estimated cost: 40 days (rough estimate)

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## Research funding

- Low investment, high output !
- Output: guidelines, including for CCTV in off-shore and industrial environments
- Investment: each project partners @ € 8.000
- Role Human Factors in Control members
  - do you want to establish CCTV standards ?
  - transfer of current knowledge
  - > 50% of research to be done in Norway

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## Research continues !

- I was your guest in Bergen, and now I actively use CRIOP. I see potential to extend CRIOP with CCTV guidance.
- HFC is a unique forum to establish the need for guidelines. The project needs your support
- Become a stakeholder
  - contact ruud.pikaar@ergos.nl
  - or stig.o.johnsen@sintef.no

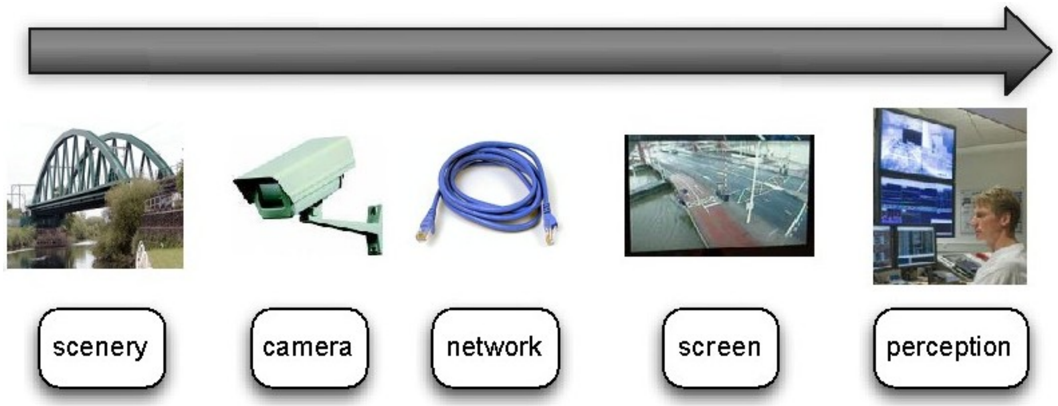
**Workshop – HF requirements related to CCTV standards.**

**Summary**

The Workshop consisted of a short presentation on current research in the Netherlands regarding the development of Human Factors Guidelines for CCTV work systems. The current basis for guideline development has been: a literature search (which resulted in 40 useful publications), 8 case studies in traffic surveillance, remote control and security, and several pilot experiments regarding perceived image quality. Draft guidelines could be developed. However, several blank spots remain, due to a lack of evidence based material world wide. The goal of a follow-up on this research is to fill in the blank spots and to develop additional guidelines for specific applications, such as the use of CCTV in the off shore industries.

**CCTV System evaluation**

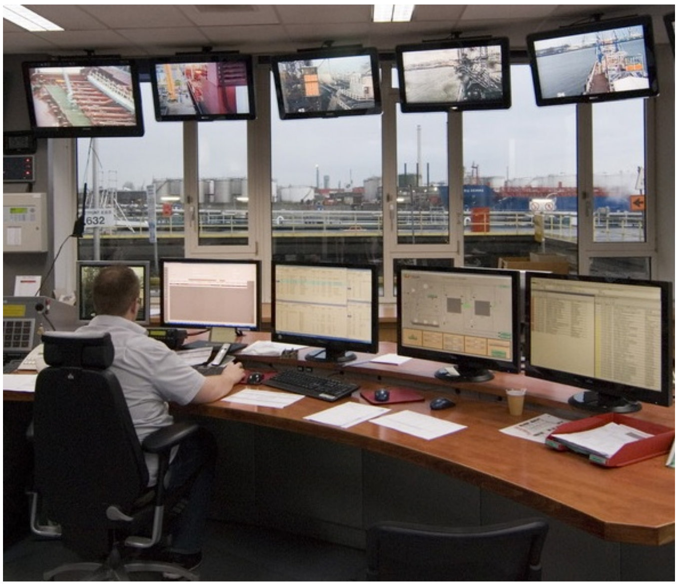
The components of a CCTV system can be seen in the figure below.




Two examples of CCTV work situations were shown to the participants of the workshop by means of a picture of the control centre. Within small groups, possible HF issues of the cases were discussed. Besides comments on the situation at hand, the participants were asked whether they could recognize the situation in their own organization.

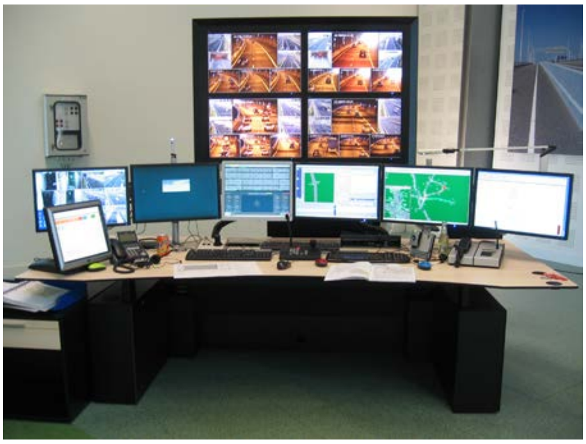
The situation shown in the picture below led to the following observations:

- What will be the viewing distance and angle to the CCTV screens (at the ceiling)
- Are the outside windows needed for the job; what about reflections?
- Workplace design: number of screens, keyboards and mouses (does it work with so many input devices?)



Equally important, but not mentioned by the workshop participants, is the mis- match between CCTV-camera output resolution and the screen resolution. In this case the camera output resolution and format (3:4) is not in line with the wide-screen resolution and format (9:16). Usually the camera image will be scaled and distorted if presented full size on a wide-screen monitor. It can be argued that a 1:1 display of camera pixel on screen pixel gives the best (sharpest) picture.

The second case was related to traffic supervision in a tunnel. Two different types of videowalls could be compared for the same task and same group of users. One videowall consisted of 4 x 30” high resolution screens, will the other was enlarged by two screens (2 rows of 3 screens (42”). Operators used the additional area to put some more image on the screens, though the overall resolution of each image was significantly less than for the original videowall.



Theoretically the left situation is the better one, regarding image quality. The workshop participants were asked what the user preference would be. There was no clear decision on this. Actually, the users preferred the right one and did not experience a reduced image quality. This led to the question: how come?
For now, we assume that contrast en brightness play a role in the user preference, as well as the possibility to see more pictures.

At the end of the workshop a proposal for the continuation of the research project was presented. In particular Work Package 3 is of interest for the HFC members. The aim of Work Package 3 is to establish (final) HF guidelines for CCTV systems in the off shore industries (and remote control).
During the workshop it was suggested to consider the level of formality needed for the guidelines: should it become a formal standard, an industrial standard, an engineering practice document, or merely a description of CCTV design issues. The researchers will take this suggestion in consideration.

Finally, members of HFC with an interest in supporting CCTV research were encouraged to contact Stig. O. Johnsen at Sintef / HFC. A full research proposal and description of all Work Packages is available upon request.

Contact: ruud.pikaar@ergos.nl or stig.o.johnsen@sintef.no

HFC

# Inblick i framtidens kontrollrum

**P. Schäring**

**Mer informasjon:**

P&ID viewer
http://www.youtube.com/watch?v=NI-lh77Xxng

P&ID Viewer
http://www.cgm.se/?q=d3-collaboration-desk-pid-viewer

KPI Software - Video
https://www.youtube.com/watch?feature=player_embedded&v=CXCdkyrAido

# CGM's shorter presentation

**This is a shorter presentation where we highlight a few topics we believe are important regarding a modern control room design**

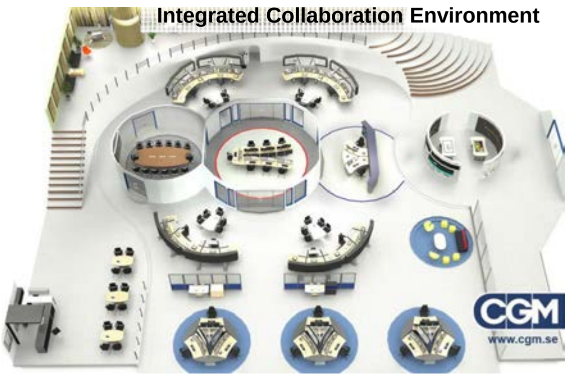


- Please also visit our website www.cgm.se

CGM

## The Environment holds the key to real control

- For many years now owners and engineers of Automation Systems have been focused on protocols, boxes and instruments.
- CGM has under some years observed and understood a change in the market. We are focused on the Ergonometric Collaborative Environment where we use our knowledge and experience from a Human Factor perspective to improve the 24 / 7 environment.

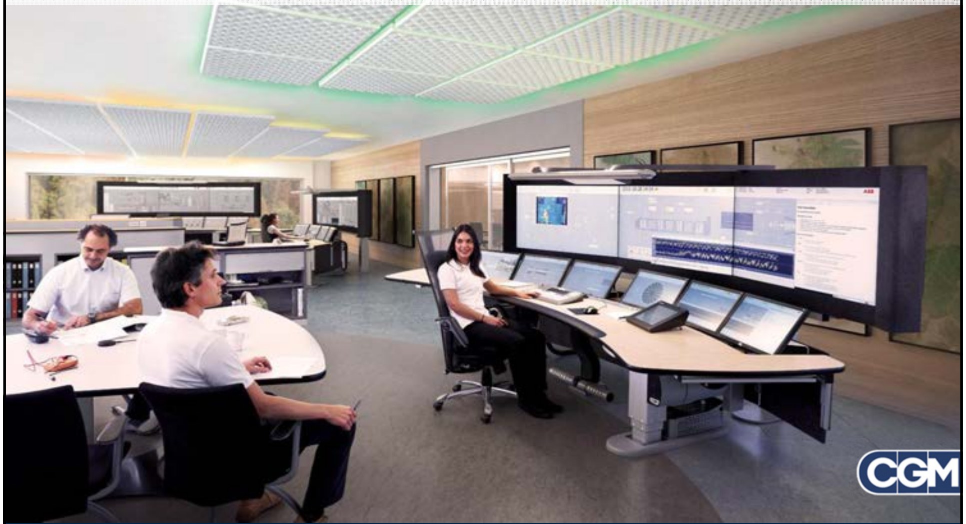



A real time intelligence centre to support your control room and field units with the right information and instructions.

- Empowering operator alertness
- Improved response times
- Attract the new generation of operators
- Efficient interaction between previously disparate groups
- Increase the operators efficiency
- Create attractive 24/7 environments and prevent operator boredom and fatigue

## Alert and focused operators make fast and correct decisions

**The highly collaborative environment in a modern control room or operations center is not only the heart of the operation, but also the brain.**




**By using this link http://www.cgm.se/FOC/Virtual_Control_Room/WebPlayerOrginal/ you can explore our Future Operation Centre in Borås, Sweden.**

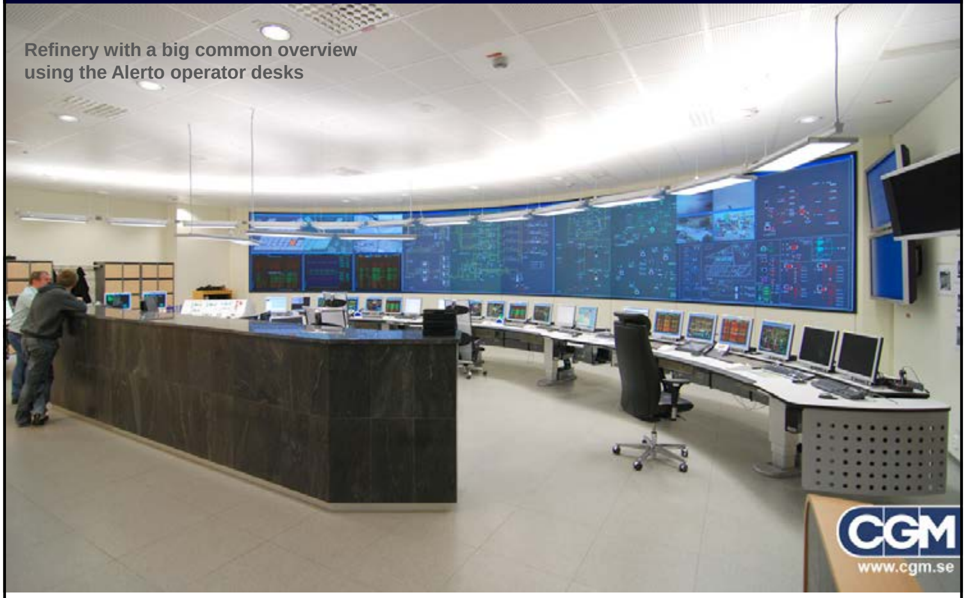
## Higher level of integration allows expansion in existing environments

**Newly built Control center for a Oil Refinery**


**This link http://www.cgm.se/pdf-filer/CGM_150_layout_proposals.pdf shows examples of several good 24 / 7 environments (layouts) we have made in different projects.**

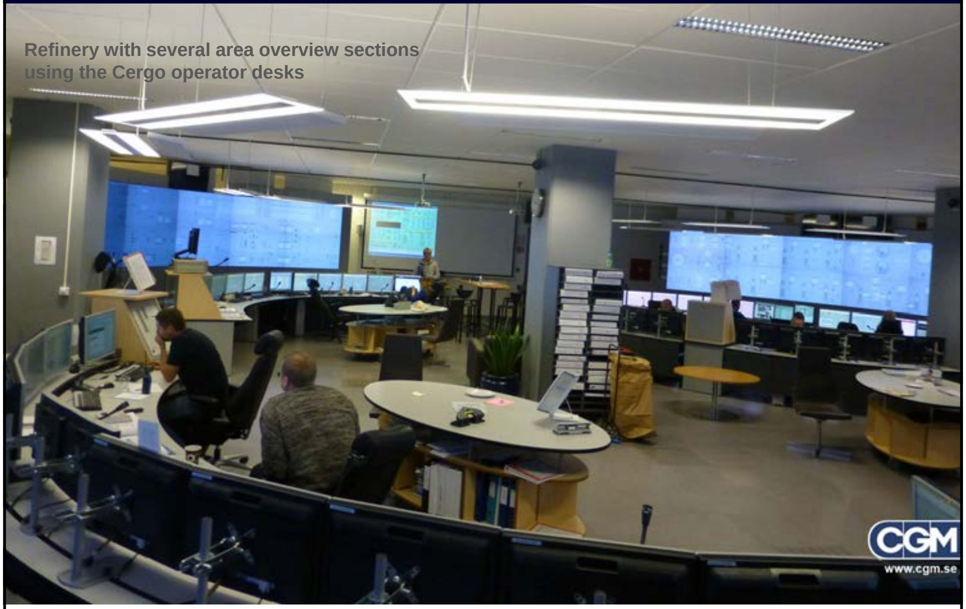
- **The higher level of integrated organization often requires fewer active inside and outside operators due to more efficient process overview and the ability to easily interpret the situation as a whole.**

## It is not obvious all the time that the operators must sit far away from a big display wall



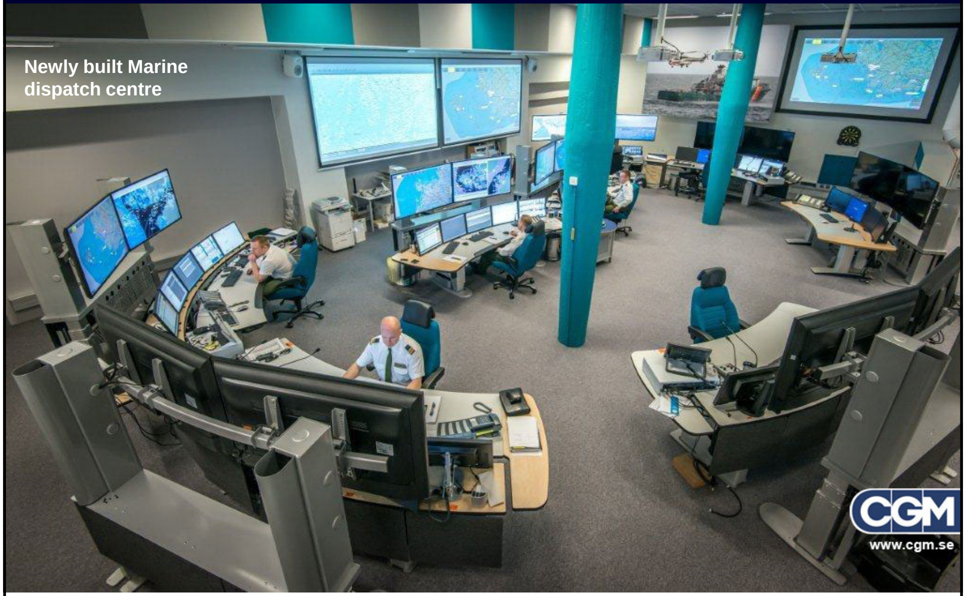

- This is an example of a control room using our state of the art ergonomic operator desk system named Alerto that are supporting a traditional big wall screen arrangement.

## Consolidating of different operator areas in one common control room




- This is an example of a control room using our most common operator desk system named Cergo that are used with amore a more close large over view area

## Higher level of integration allows expansion in existing environments




- **Improved ergonomics and collaboration is so important to take in consideration when planning a modern control room because of the higher level of integration that needs to be achieved.**

## Early collaboration with control room design from CGM improves the end result

- The traditional control room will transform into a collaboration environment

## Early collaboration with control room design from CGM improves the end result

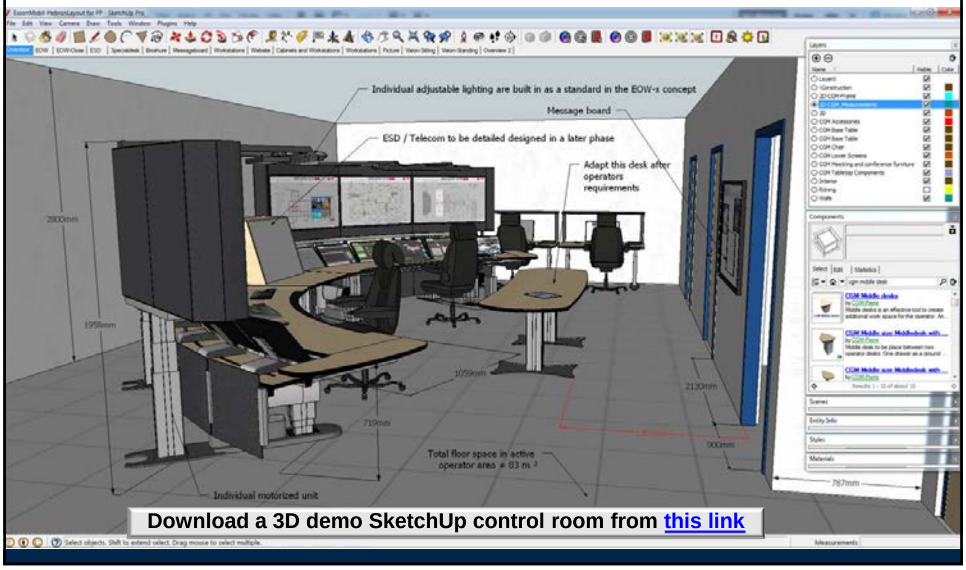
- Former divided control rooms will be consolidated into a collaboration environment


## Early collaboration with control room design from CGM improves the end result

- The presentation of early conceptual design can be visualized in a new interactive way that improves the early understanding of an design and are easy to comment.

## To work with the free of charge Google SketchUp saves valuable time in projects

- Easy import and export to all types of program and very fun to work with
- Increases the overall understanding for complete control room with adjacent areas
- CGM have made special tutorial movies that make it easy and fast to be productive




**Download a 3D demo SketchUp control room from this link**

## CGM has developed our own flexible Human Factor manikins for analyzing purposes

- Adjustable sight cones which also follow head movements and built in reach cones.
- Measurement tools used for reviewing layouts are also available.
- Visualize viewing angles and readability distances are a few of several useful functions.


**See a short movie showing manikins in different percentiles and positions via this link**

## What is Human Factors?

*"A structured process to be able to understand and map the operators needs so the whole process and control room design is minimized for failure actions in critical situations"*

Knowledge
Competence

How to

Improve
Analyze

Collaboration between

Man
Technology
Organisation

*"We shall use the operator's creativity to enhance competitiveness"*

## CGM has developed an ergonomic collaboration desk and also a P&ID viewer

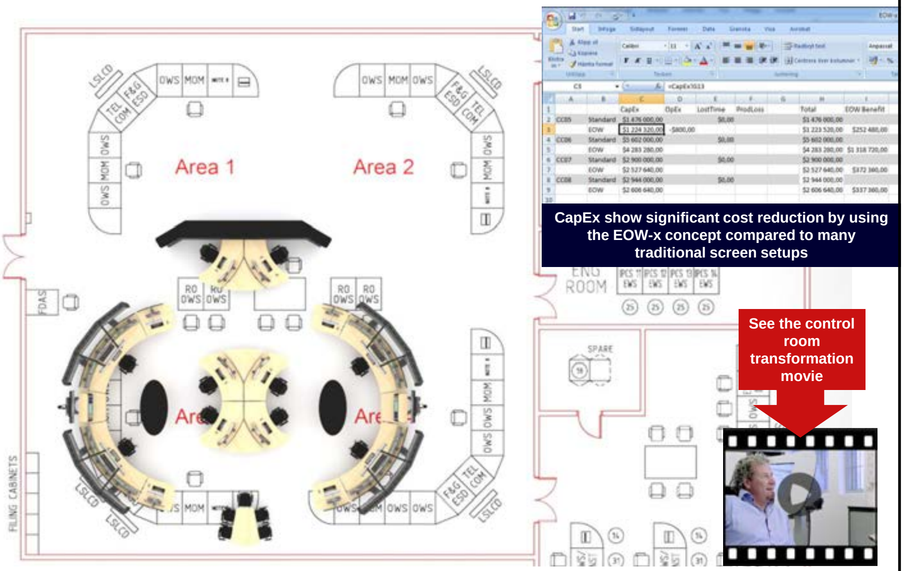
- The CGM **D3** Collaboration desk with many new touch interaction options for operators
- D3 stands for Design – Discussion – Decision

- Save time and reduce risk by finding the right information at the right time.
- Friendly user interface software providing operators a new interactive way to browse P&ID drawings and allow them to access available information faster
- Increase the productivity and reduced risk by ensuring everyone is working with the most up-to-date information.
- **The new P&ID viewer software we developed can be seen from this link http://www.cgm.se/?q=d3-pid-viewer.**

**The KPI 3D plant / P&ID viewer are typical examples of new developed products that simplify daily tasks for the operators.**

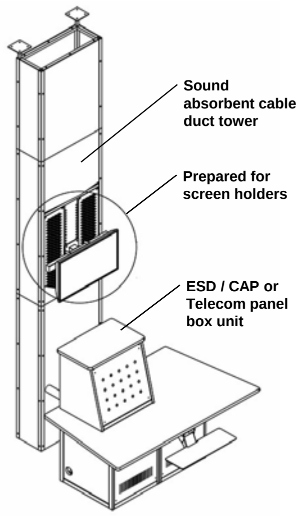
## Space reduction = cost reduction compared to traditional solutions

- Improved ergonomics and collaboration with the Close Large OverView concept is possible because its make the higher level of integration possible

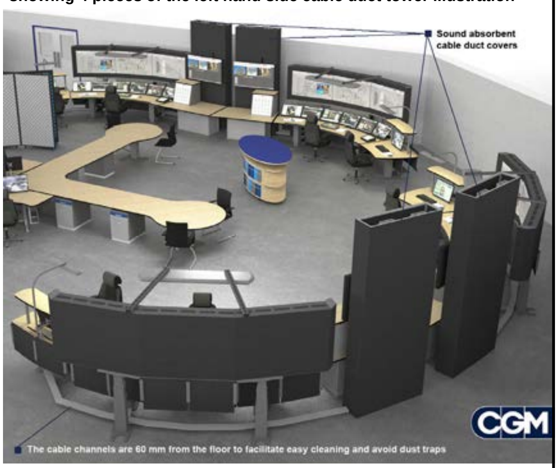



## Cost reduction when all the cables come from the ceiling instead of raised floor

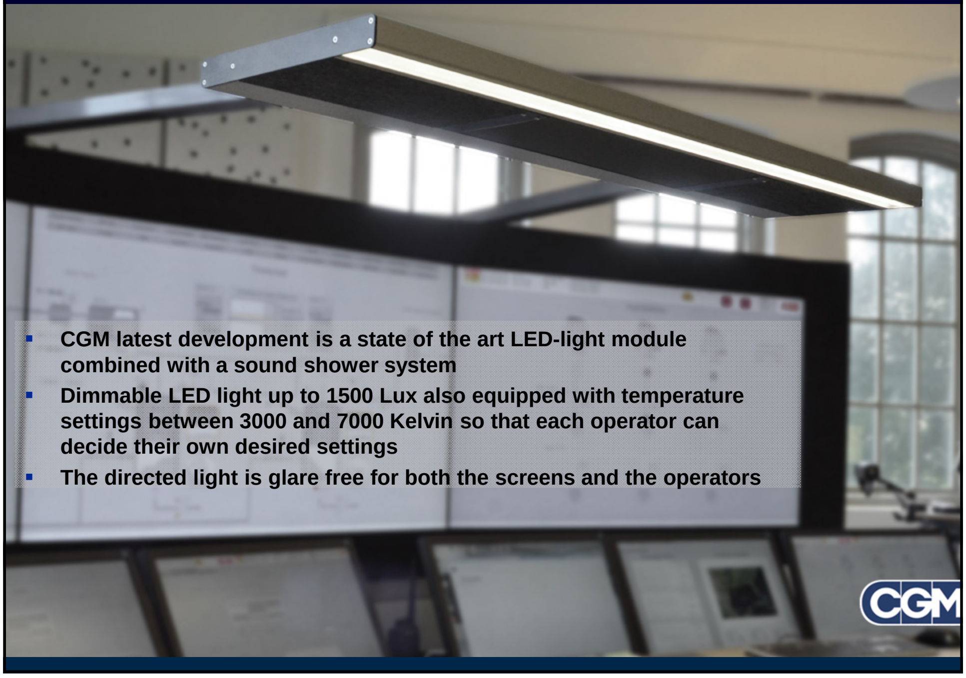
- The CGM standard operator desk does not require expensive computer flooring systems as all cabling can be simply and safely run from the ceiling with our cable duct tower.
- Easy movement of our flexible consoles means that hot cut over in modernization project is easy to perform and it also allow late changes in the control room.




**Below is a rendered picture from an operator area configuration showing 4 pieces of the left hand side cable duct tower illustration**



## New developed high frequency dimmable lighting module



- CGM latest development is a state of the art LED-light module combined with a sound shower system
- Dimmable LED light up to 1500 Lux also equipped with temperature settings between 3000 and 7000 Kelvin so that each operator can decide their own desired settings
- The directed light is glare free for both the screens and the operators

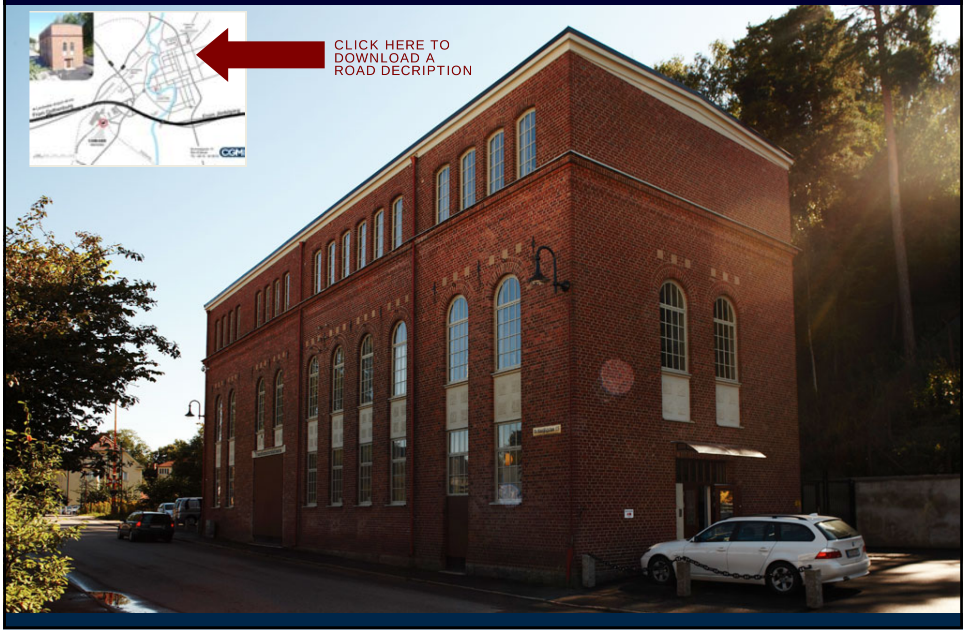
**CGM offers, in addition to the ABB unique EOW-x concept, three different series of operator desk systems and other furnishings for adjacent areas outside the control room.**

|  |  |  |
| --- | --- | --- |
| Alerto Operator Desk System | Cergo Operator Desk System | Comfortio Operator Desk System |
| CGM Class I SUPER-PREMIUM™ 24/7 operator desk system | CGM Class II SUPERIOR™ 24/7 operator desk system | CGM Class III UNIVERSAL™ operator desk system |

**Designed to keep operators alert during monotony and calm in emergencies. Our operator desks and auxiliary products are bio-mechanically optimized, aesthetically pleasing and built to last.**


**Download the CGM-brochure to read more detailed about CGM and the wide range of operator desk systems and other loose interior products for 24/7 environments.**

**Welcome to visit us**



# INVITASJON

# Human Factors in Control

16.-17. oktober 2013

## Nye driftsformer i oljeindustrien – hva gjør andre industrier – utfordringer og erfaringer

Kjære deltaker
Vi vil med dette invitere til møte i HFC-forum (Human Factors in Control). Møtet holdes onsdag 16. og torsdag 17.oktober 2013 i Trondheim, hos Siemens, Bratsbergvegen 5. Vi starter kl 11.00 onsdag med lunsj og avslutter etter lunsj på torsdag, med en workshop/ diskusjon om human factors baserte retningslinjer for bruk av intern TV; Closed Circuit TeleVision (CCTV).

Tema for møtet er " *Nye driftsformer i oljeindustrien – hva gjør andre industrier – utfordringer og erfaringer"* hvor vi diskuterer erfaringer med menneskelige faktorer (human factors) i nye driftsformer som for eksempel lavbemannet eller ubemannet drift, fjernstyring, fjernstøtte og økt bruk av undervannsinstallasjoner. Hvem "eier" de nye driftsformene? Blir konsekvensene av nye driftsformer støttet av gode "human factors" analyser tidlig nok? Hvilken praksis tar form innen olje og gass, og hvilke erfaringer kan vi hente fra andre industrier?

Vi har reservert rom på Clarion Hotel, Brattørkaia 1, Tlf: 73 92 55 32, referanse 025745. Frist for rombestilling er den 2/10. Vi kan også bestille rom for dere – kryss da av på siste side.

### Programmet i grove trekk

Foredrag holdes bl.a. av eksperter fra romfart (European Space Agency/ESA) som vil presentere hvordan komplekse bemannede og ubemannede operasjoner utføres – av U. Muellerschkowski, vi får erfaring fra Norge hvor vi samarbeider med ESA både mht. drift og utvikling, vi får høre om fremtidens boresystemer, vi får erfaringer med menneskelige faktorer fra styring av ubemannede fly fra R. Waraich/ USA, hvordan beredskap håndteres, bruk av telemedisin for å gi støtte fra land, nye driftsformer i kjernekraft, bruk av roboter til vedlikehold offshore, hvordan designe framtidens kontrollrom, diskutere behov for CCTV retningslinjer for å underbygge sikkerhet og menneskelige faktorer, presentert løsninger for distribuert kontroll av produksjon, og vi får sett på undervanns strømforsyning (subsea power grid) fra SIEMENS. Vi avslutter med en workshop knyttet til retningslinjer for CCTV for å diskutere brukerbehov.

### Visjon og hovedoppgave for HFC forumet

HFC visjon: "Kompetanseforum for bruk av HF innen samhandling, styring og overvåkning i olje og gass-virksomheten." HFC hovedoppgave: "Å være et forum for erfaringsoverføring som bidrar til å videreutvikle HF metoder til bruk ved design og vurdering av driftskonsepter." (Om HFC, se: www.hfc.sintef.no). Vi vil også benytte anledningen til å minne om kurset "MTO-Human factors" ved UiS som går høsten 2013, og NTNU kurset "Introduksjon til Human Factors, CRM, metoder og teorier med eksempler fra nye driftsformer" som arrangeres 2014. Kurset kan inngå som del av mastergrad ved NTNU eller PhD studie.

Vennlig hilsen
Arne Jarl Ringstad /Statoil, Andreas Bye /IFE, Mark Green /HCD, Marius Fernander /DNV og Stig Ole Johnsen /SINTEF.

**Vær vennlig og returner registreringen innen 2.oktober 2013 til:**
Rigmor.Skjetne@sintef.no, SINTEF

# AGENDA

**16. til 17. oktober 2013**

# HFC Møte

## Nye driftsformer i oljeindustrien – hva gjør andre industrier – utfordringer og erfaringer

Siemens, Bratsbergvegen 5

| Dag 1 | Innlegg og diskusjon | Ansvar |
|---|---|---|
| 11.00-12.00 | Lunsj SIEMENS (og registrering) | P. Gundersen/ SIEMENS |
| 12.00-12.30 | Velkommen til seminaret og runde rundt bordet | |
| 12.30-13.00 | Complex operations on the International Space Station - training and execution in manned and unmanned situations | U. Muellerschkowski/ ESA |
| 13.00-13.30 | Diskusjon og pause | |
| 13.30-14.00 | "Human operated systems in space" – erfaringer og nye initiativer | /CIRIS,NTNU |
| 14.00-14.15 | Diskusjon og pause | |
| 14.15-14.45 | Hvilken rolle har mennesket i framtidens boreprosess, og hvordan påvirkes det tradisjonelle rollemønstret i bore-organisasjonene? | J. I. Ornæs/ NOV |
| 14.45-15.15 | Diskusjon og pause | |
| 15.15-15.45 | Minimizing human factors mishaps in unmanned aircraft systems | R.Waraich/ USA |
| 15.45-16.15 | Diskusjon og pause | |
| 16.15-16.45 | Emergency preparedness and response (Beredskap) - Lundin | R.H.Grønning/ Lundin |
| 16.45-17.00 | Diskusjon og pause | |
| 17.00-17.30 | Telemedisin som integrerte operasjoner – støtte fra land ved sykdom offshore | A. Evensen/ Statoil |
| 17.30-17.45 | HF kurs ved NTNU våren 2014 – Introduksjon til Human Factors teori & CRM (Del av mastergrad eller PhD) | NTNU/ A. Balfour |
| 18.00- | Middag (og Revy) | |

| Dag 2 | Innlegg og diskusjon | Ansvar |
|---|---|---|
| 08.00-08.30 | Kaffe og noe å bite i | SIEMENS |
| 08.30-09.00 | Nye driftsformer i kjernekraft: "Small Modular Reactors, Generation III+ and IV" | Ø. Berg/ IFE |
| 09.00-09.30 | Offshore robotics – Remote inspection and maintenance of oil platforms | A. Transeth/ SINTEF |
| 09.30-10.00 | Diskusjon – Hva er human factors utfordringene? | |
| 10.00-10.30 | Distribuert kontroll av produksjon i olje og gass | T. Wærhaug/ SIEMENS |
| 10.30-10.45 | Diskusjon og pause | |
| 10.45-11.00 | The need for guidelines and standards using Closed Circuit Television (CCTV) - introduction to workshop | R. Pikaar/ ERGOS |
| 11.00-13.00 | Omvisning SIEMENS - Subsea Power Grid (SPG) og Lunsj | E. Brekke/ SIEMENS |
| 13:00-14:00 | ”CCTV workshop, Organisational and human factors requirements related to standards – needs from the industry” | R. Pikaar/ ERGOS |
| 14.00-14.30 | Inblick i framtidens kontrollrum och designverktøy for Human Factors som underlättar den itterativa processen att nå bäst muligt resultat. | P. Schäring/ CGM |

# REGISTRERING

# Human Factors in Control

16. til 17. oktober
2 0 1 3

## Nye driftsformer i oljeindustrien – hva gjør andre industrier – utfordringer og erfaringer

Ja, jeg vil gjerne delta:

Navn: __ ________________________________

Tittel / stilling: ____ ______________________________

Organisasjon: ___ _______________________________

Adresse: __ ________________________________

Kryss av for:
__ Lunsj 16/10, __ Middag 16/10, __ HFC bestiller hotellrom for meg 16/10 __ Revy 16/10
__ Lunsj 17/10

Tlf. : _________
E-post: _____________

Hvem faktureres (PO-Nr/Bestillingsnr/Referansenr: )_________________

For å være med må man betale inn medlemsavgift eller møteavgift, som dekker lunsj, middag og kopi av presentasjonene som holdes samt annet relevant materiale.
Medlemsavgiften er pr år:
- 25.000 for bedrifter med mer enn 15 ansatte (dekker 3 deltakere på årets to møter)
- 12.500 for bedrifter med under 15 ansatte (dekker 2 deltakere på årets to møter)
Møteavgiften er pr møte:
- 6.500 kr pr møte for ikke-medlemmer (dekker 1 deltakere på ett møte)
- Studenter deltar gratis i møtet, men må betale for middag dersom de vil delta på den
Medlemsavtale, informasjon og publikasjoner om HFC kan finnes på WEB-siden:
http://www.hfc.sintef.no

Vær vennlig og returner registreringen innen 2.oktober 2013 til:
Rigmor.Skjetne@sintef.no, SINTEF