RAPPORT

HFC – forum for human factors in control

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TITTEL

Samhandling i distribuerte team
Resultater HFC Forum, 21. til 22.oktober 2009, møte #10.

FORFATTER/REDAKTØR

Johnsen S. O.

OPPDRAGSGIVER(E)

HFC forum

RAPPORTNR. SINTEF A13035	GRADERING Åpen	OPPDRAGSGIVERS REF. Throndsen, T.I. /Statoil	
GRADER. DENNE SIDE Åpen	ISBN 978-82-14-04847-6	PROSJEKTNR. 504144	ANTALL SIDER OG BILAG 184
ELEKTRONISK ARKIVKODE https://project.sintef.no/eRoom/civil/504017CRIOPUserGroup/		PROSJEKTLEDER (NAVN, SIGN.) Johnsen, Stig O.	VERIFISERT AV (NAVN, SIGN.) Bodsberg, L.
ARKIVKODE	DATO 30.10.2009	GODKJENT AV (NAVN, STILLING, SIGN.) Throndsen, T.I. /Statoil	

SAMMENDRAG

Denne rapporten dokumenterer presentasjoner/artikler, agenda og deltakerliste fra HFC forum møtet den 21.-22.oktober 2009 i Trondheim, HFC forum møte nr 10.

De vedlagte presentasjonene og artiklene er:

G. Hauland/DNV	Setter scenen – What is Situation Awareness?
M.Rosen/Univ. of C.F.	Team cognition - Principles & Strategies for Improving Team Effectiveness in Distributed Systems
N.Stanton/Univ. of South.	Distributed situational awareness
A.Ringstad/StatoilHydro	
P.Næsje Coldevin/DnV	Integrerte operasjoner og betydning for HMS nivået
T.A.N. Hernes	Besøk Fremtidens Operasjons Rom (FOR)
C. Tveiten/NTNU/	Challenges related to distributed collaboration
A.Arntzen/Weatherford	Distributed team communion - reusable fighter jock experiences
E.Nystad/ IFE	Collaboration Training in Distributed Virtual Reality Environments

STIKKORD	NORSK	ENGELSK
GRUPPE 1	HMS	HES
GRUPPE 2	Sikkerhet	Safety
EGENVALGTE	Menneskelige Faktorer	Human Factors
	ISO 11064	ISO 11064

INNHOLDSFORTEGNELSE

1 Evaluering av møtet og innspill

1.1 Innledning

I det følgende vil vi dokumentere deltakernes evaluering av HFC møtet, navneliste for de som deltok og kopi av presentasjonene og relevante rapporter eller artikler fra HFC forum møtet den 21.-22.oktober i Trondheim.

1.2 Evalueringer

Generelt synes det som om de fleste er godt fornøyd med HFC møtene og formen som benyttes. Kommentarene vi får er positive, med gode tilbakemeldinger på det faglige og sosiale utbytte. Forumet er bredt med mange forskjellige deltakere, og utfordringen er å gi alle noe, både forskere, konsulenter og industrideltakere. Vi får derfor et bredt sett av innspill.

Deltakerne satt stor pris på å kunne besøke FOR - Fremtidens Operasjons Rom, ved St. Olavs hospital.

Det var generelt små marginer mellom de forskjellige innleggene – generelt ble foredragsholderne godt mottatt.

1.3 Formen på HFC møtene

Tilbakemeldingene er generelt positive til formen på møtene, og det ble påpekt at gruppearbeid er en god mekanisme for å bli bedre kjent og få til gode refleksjoner. Det bør minimum settes av 30 minutter med 15 minutters diskusjon etter hvert innlegg.

Om det er tid, bør møtene innledes med en status om forumet, kort om aktuelle aktiviteter, litt om forumet for nye medlemmer. Gruppearbeid hvor alle kan bidra bør legges til første dag slik at deltakerne blir mer kjent med hverandre og det blir økt grad av trygghet og åpenhet i forumet.

1.4 Tema og forelesere til de neste HFC møtene

I nedenstående tabell-1 har vi listet tidligere innspill fra deltakerne på tema som bør presenteres og diskuteres i HFC forum, fulgt av en punktliste med forslag til nye tema:

Periode	Forslag til tema
Vår 2010	HF i ulykkesgranskinger, hvordan forstår vi Human Factors i ulykkesgranskninger
Høst 2010	HF i endringsprosesser, ”Design for resilience”, Perspektiver som Actor-network theory (ANT) i HF granskninger.
Vår 2011	Inntog i det globale: Språk, kultur, tidsforskjell, HF i global setting.
Høst 2011	Fokus på HF i andre land, somUSA og SørøstAsia – erfaringer, muligheter og trusler

Tabell 1: Forslag til tema fra tidligere diskusjoner

Av tema som spesielt ble trukket fram denne gangen var:

- Storulykkesrisiko (evt større prosess hendelser) og Human Factors, evt i kombinasjon med sikkerhetskultur
- Interaksjonsdesign forelest av Ingrid Danielsen. Hvordan håndtere kompleksiteten i informasjonspresentasjonen.

- Designprosess og HMI løsninger for kontrollsystemet. Hvordan har man gått frem for å idenfisere feks barrierer og alarmer, hvordan er de valgt løst og hvorfor.
- Krav til storskjerm i samhandlingsrom og i CCR. Utforming av storskjerm og bilder på operatørstasjon.
- Menneskelig pålitelighet. Hvordan mennesket er med på å påvirke risikobildet (positiv/negativ påvirkning). Hvordan legge forholdene til rette slik at feil unngås. Hvordan sette sammen team (Crew), hvordan måle ytelse og hvordan få til godt samspill mellom menneske og maskin?
- Den verdiskapende effekten som samhandling i ulike former kan ha for eksempel i forbindelse med ”Collaboration and decision-making” – evt”Organizational Resilience in Drilling” som er aktuelt i Nordområde.
- Human Factors fra forskjellige industrier.

Av forelesere ble følgende nevnt:

- C. Weick eller James Reason.
- Jurgen Saner (U.Darmstadt) og Bob Hockey (Univ of Leeds).
- Ingrid Danielsson – ønskes mht interaksjonsdesign.
- David Woods.
- Gjerne Stanton igjen, men annet tema.
- Gjerne noen som kan diskutere sikkerhetskultur – en blanding av industrierfaring, myndighetsnivået og akademia. Fokus på metoder som er validert og teknikker som kan brukes i praksis. Hvordan kan kvalitative og kvantitative metoder blandes for å få fram et godt resultat? Aktuelle forelesere fra University Aberdeen , Eurocontrol Barry Kirwin, Avinor, DNV
- Interessant å utvide HF mot community of practice og praksisfellesskap J.S.Brown, P.Duguide – eks hvordan mobiliserer man et praksisfellesskap?
- K. Haukelied

1.5 Oversikt over relevante kurs og forelesninger

I det vedlagte har vi gitt en oversikt over relevante kurs og forelesninger innen området Human Factors:

- Kurset ”MTO-Human factors” ved UiS høst – http://www.uis.no/kurs/evu/teknologi_og_naturvitenskap/?courseID=MTOH09&timeCode=2009H
- Kurset "Introduksjon til HF og integrerte operasjoner" går på våren 2010, Samlinger: 8. - 10. februar, 15. - 18. mars, 26. - 28. april. Påmelding http://videre.ntnu.no/link/nv11413
- Kurset CRM (Crew Resource Management) - fra 18/11 til 19/11 på First Hotel, Linköping i Sverige

2 Agenda for møtet

Dag 1	Foredrag med spørsmål etter foredragene;	Ansvar/Beskrivelse
11:30-12:30	Registrering og lunsj	Ingrid Aalberg
12:30-13:00	Velkommen til møtet – presentasjon av møtedeltakere	HFC
13:00-13:30	Setter scenen – situational awareness, team cognition..	G. Hauland/DNV
13:30-13:45	Diskusjon	
13:45-14:00	Kaffe/Pause	
14:00-15:00	"Distributed team cognition "	M.Rosen – (for E.Salas/ Univ. of Central Florida)
15:00-15:30	Diskusjon	
15:30-15:45	Kaffe og noe å bite i/Pause	
15:45-16:45	Theory and methods to analyse and design distributed situational awareness	Prof. N.Stanton/Brunel Univ.
16:45-17:15	Discussion	
17:15-18:00	Integrerte operasjoner og betydning for HMS nivået	A.Ringstad/StatoilHydro P.Næsje Coldevin/DnV
18:30	Middag i Studentersamfundet - Strossa	HFC
20:30	Ukerevy i Studentersamfundet	Billetter ved registrering
Dag 2	Foredrag med spørsmål etter foredragene;	
08:30-10:00	Besøk Fremtidens Operasjons Rom (FOR) – Hovedinngangen til St. Olavs hospital	Prof T.A.N. Hernes
10-10:30	Transport tilbake& Kaffe/Pause	
10:30-11:15	Challenges related to distributed collaboration across organizational borders	C. Tveiten/NTNU/SINTEF
11:15-11:45	Distributed team communion - reusable fighter jock experiences	A.Arntzen/Weatherford Petroleum Consultants AS
11:45-12:15	Collaboration Training in Distributed Virtual Reality Environments	E.Nystad/ IFE
12:15-13:00	Lunsj	
13:00-14:45	Workshop – Distribuert samhandling – Praktiske metoder og verktøy for sikkerhet og kvalitet. (N.Stanton, M.Rosen/ E.Salas)	HFC deltakere

2.1 Møtedeltakere – HFC forum

Vedlagt følger en liste over møtedeltakerne i HFC forum.

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HFC

Setter scenen - “What is Situation Awareness?”

G. Hauland/DNV

Attached papers/ Papers of interest:

Hauland, G. and Eisinger, S. (2007): “A case of man - technology - organisation system relations in helicopter operations offshore as subject matter in a failure mode effect and criticality analysis.” In: Aven and Vinnem (Eds.): Risk, Reliability and Societal Safety, Vol I: Specialisation, Proceedings of ESREL 2007, pp. 35-43, Taylor & Francis, London.

ABSTRACT: There is an increasing need within many industries for a better integration of Human Factors (HF) in risk analyses. Still, analyses of HF often become an add-on to risk analyses. It is suggested here that the improved integration of HF in risk analyses can be facilitated by defining the subject matter to be analysed in terms of Man, Technology and Organisation (MTO) systems. Such a systems perspective implies defining any system consisting of MTO-factors and the relations between these factors. The complexity of such systems, and the difficulties associated with quantification, represent methodological challenges. However, it may often be sufficient to rank risks in relation to each other, i.e. in order to support risk based decision making. Therefore semi-quantitative risk analysis methods, like the Failure Mode Effect and Criticality Analysis (FMECA), may be used. FMECA is traditionally used for the analysis of technical systems and components. It is suggested here that FMECA can be used also to analyse complex MTO-systems, emphasising the relations between MTO-factors. FMECA, as a methodological framework, can be based on inputs from various quantitative and qualitative techniques. This paper addresses methodological challenges associated with such use of FMECA in the form of a case study from aviation: The case study was performed in order to support risk based decisions regarding the optimal organisation of airspace for the safety of helicopter operations offshore.

Hauland, Gunnar (2008): “Measuring Individual and Team Situation Awareness During Planning Tasks in Training of En Route Air Traffic Control.” International Journal of Aviation Psychology, 18:3, 290 - 304

ABSTRACT: The situation awareness (SA) of air traffic controller (ATCO) students, including the temporal aspect of SA, was measured by means of their visual information acquisition during simulator training. The measurements were defined both at an individual level and at a team level. SA and team SA (TSA) were measured by means of eye-movement data: first, the extent to which individual ATCOs focused or distributed their visual attention in the interface; second, the extent to which ATCO teams were actively involved in planning tasks. Planning was measured based on how ATCO teams attended to tactical and strategic monitoring tasks. This enabled process-oriented measurements of SA and TSA that predicted aspects of performance and were sensitive to situational changes.

What is Situation Awareness?

Human Factors in Control, 21. October 2009

Gunnar Hauland

MANAGING RISK DNV

Introducing Situation Awareness (SA)

- What is individual SA - and Team Situation Awareness (TSA)?
- Measuring SA & TSA – an example from research within Air Traffic Control
- How can you apply SA and TSA concepts in your work?

The Concept of Situation Awareness (SA)

- Smith and Hancock (1995) defined SA as externally directed consciousness, as it is not until the externally defined task is made explicit that the observed behavior can achieve the status reserved for SA.

Perhaps the Most Well Known Definition of SA …

"Knowing what is going on"

Situation awareness is the **perception** of the *elements* in the environment within a volume of time and space, the **comprehension** of their meaning, and the **projection** of their status in the near future.

(Endsley, 1987b, 1988b)

Correct SA?

- Endsley’s (2000) notion of measuring SA as a relation between operators’ understanding of a situation and the situational requirements, as identified in task analyses.

- Endsley's (2000) operational definition of SA is the *Situation Awareness Global Assessment Technique* (SAGAT)

SA & Planning

- Many definitions emphasize the temporal aspect of SA (Shrestha, Prince, Baker,& Salas, 1995).

- Intuitively, being ahead of the developing situation seems relevant for having a good overview or good SA.

Some Specifications

- Situation – not prior knowledge and not introspection
- Available and relevant elements – not everything in the situation – defined *a priori*
- Process or state … or just varying resolution? – SA is a dynamic phenomenon
- Understanding without prediction?
  - is it possible to understand a particular situation, frozen in time, and at the same time not be able to forecast how the situation will develop?

Team SA?

- Measuring TSA does not imply that individual SA becomes irrelevant, rather that the concept of SA includes both the individual and the team aspects (Shrestha et al., 1995).
- According to Cannon-Bowers and Salas (1997), team competencies exist at different levels of measurement with corresponding units of analysis. The units of analysis are related to:
  - Individual competencies
  - Team competencies held at the individual level
  - Team competencies held at the team level.

Measuring TSA – An Example from Research

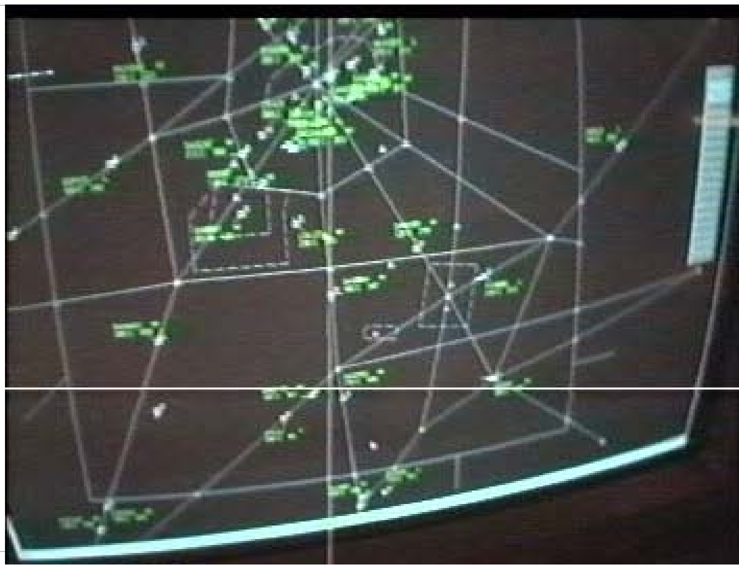
Team: Radar & Planner Controller

 9

Measuring Teamwork in the Simulator

 10

Eye Movement Data: Point-Of-Gaze



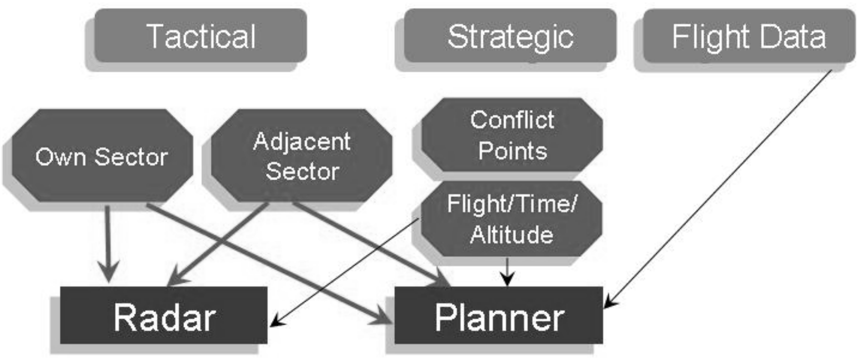
Overview of the Scene

Radar

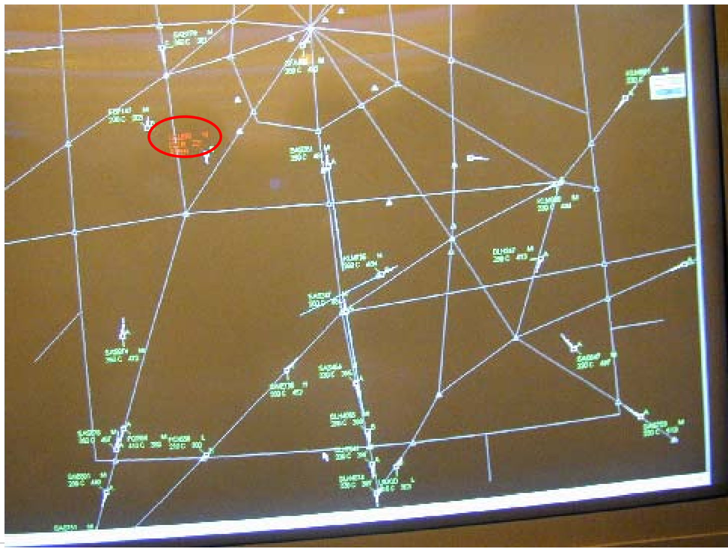
Planner

Team SA

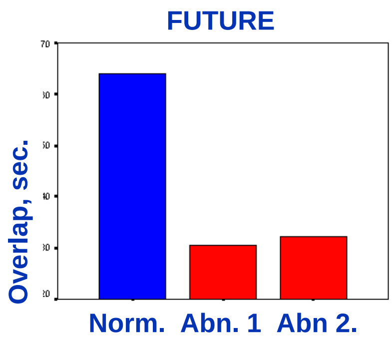
Current and Future Situation Elements

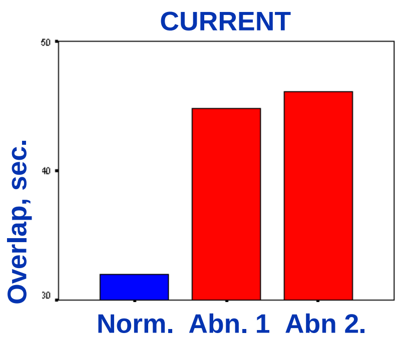


EMERGENCY – abnormal scenario



The Team's *Planning*

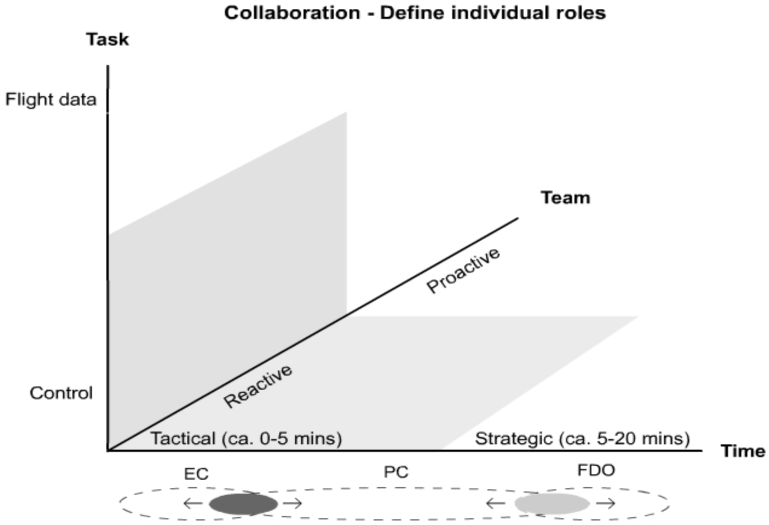




Abnormal scenarios; less oriented towards the future

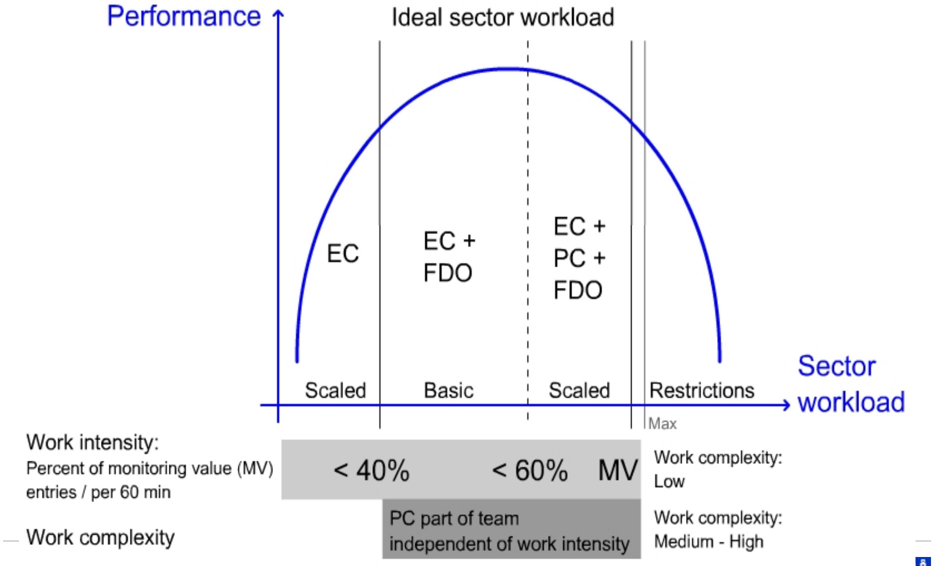
Applying TSA – Team Resource Management in ATC

Defining the Manning Concept - TSA



Overlap: Degree of redundancy in monitoring tasks, both visual and auditive

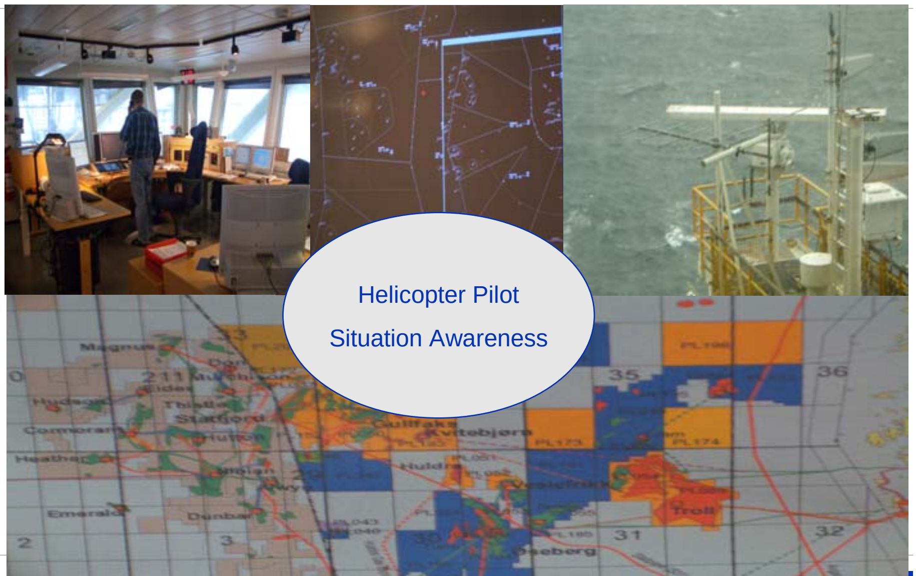
Maintaining SA & TSA



Other applications of SA and TSA

CBT Training; Possible Application?

Example Helicopter Operations Offshore



Breakdown Structure - example

- Interfaces; the **relationship** between types of airspace
  - Actors in the interface
    - Tasks to be carried out by the actors in the interface
      - Error mode; what can go wrong with the task
- Un-controlled/Avinor – Un-controlled/Statoil
  - Air Traffic Controller (information service)
    - Hand-over to Helicopter Flight Information Service
      - Delayed hand-over (error mode #)

Error modes influencing pilots' SA

Example Control Room Design (GFA)

Safeguarding life, property
and the environment

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“Theory and methods to analyse and design distributed situational awareness”

M.Rosen/ Univ. of Central Florida

<u>Attached papers:</u>
“Managing Virtual Teams: Strategies for Team Leaders” R.Lyons, H.A.Priest, J.L.Wildman, E.Salas; (Ergonomics in design – Winter 2009).

<u>Papers of interest:</u>
“Distributed Team Performance: A Multi-Level Review Of Distribution, Demography, And Decision Making” Kevin C. Stagl, Eduardo Salas, Michael A. Rosen, Heather A. Priest, C. Shawn Burke, Gerald F. Goodwin and Joan H. Johnston; (Multi-Level Issues in Organizations and Time Research in Multi-Level Issues, Volume 6, II-58 **2007 Elsevier**

“Distributed coordination space: toward a theory of distributed team process and performance” Stephen M. Fiore, Eduardo Salas, Haydee M. Cuevas and Clint A. Bowers (Theor. Issues in Ergon. Sci. July/December 2003, vol. 4, nos. 3–4, 340–364)

“Virtual Teams: Effects of Technological Mediation on Team Performance” James E. Driskell, Paul H. Radtke, Eduardo Salas (Group Dynamics: Theory, Research, and Practice 2003, Vol. 7, No. 4, 297–323)

“The Wisdom of Collectives in Organizations: An Update of the Teamwork Competencies” Eduardo Salas, Michael A. Rosen, C. Shawn Burke, and Gerald F. Goodwin (Team Effectiveness in Complex Organizations 2008)

“Understanding Team Adaptation: A Conceptual Analysis and Model” C. Shawn Burke, Kevin C. Stagl, and Eduardo Salas, Linda Pierce, Dana Kendall. (Journal of Applied Psychology 2006, Vol. 91, No. 6, 1189–1207)

“Tightly Coupling Cognition: Understanding How Communication and Awareness Drive Coordination in Teams” Michael A. Stephen M. Fiore Eduardo Salas, Michael Letsky , Norman Warner . (The International C2 Journal, Vol 2, No 1, 2008)

Team Cognition:

Principles & Strategies for Improving Team Effectiveness in Distributed Systems

Michael A. Rosen
Department of Psychology, and
Institute for Simulation and Training
University of Central Florida

University of Central Florida
Institute for Simulation & Training

Why worry about team cognition in distributed systems?

- **Connect <u>understanding</u> with <u>agency</u>.**
  - Put people who know what's happening and people who have the authority/ability to do something about it on the same page.
- **Adaptability.**
  - Rapidly reconfigure personnel 'on demand' to address problems. The expertise in an organization is a resource (an expensive one). Make the most of it.

This presentation…

- Focuses on integrating the theory and practice of team cognition…
  - Knowledge/expertise of team members
  - Dynamic understanding
  - Group processing of information
  - Learning, development, and adaptation at the team and multi-team level
- Starts with the end in mind… **the goal is improved team effectiveness.**
  - Better decisions
  - Higher levels of efficiency/productivity
  - Safer working conditions

Core Questions Addressed…

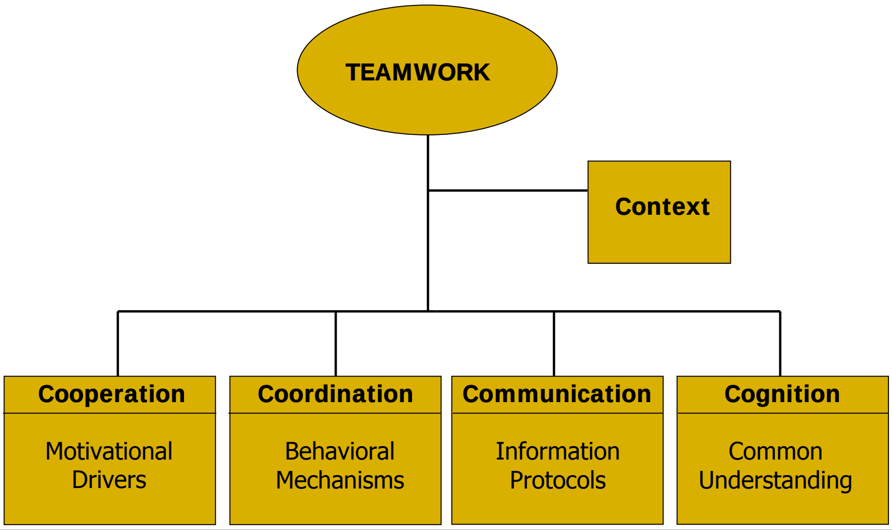
- **What is team cognition?**
  - Theories, perspectives, definitions, and findings
- **How can team cognition be improved?**
  - Interventions and strategies
- **How can team cognition be managed in distributed environments?**
  - Some challenges and strategies

I. WHAT IS TEAM COGNITION?

Team Cognition is about **Team Performance**

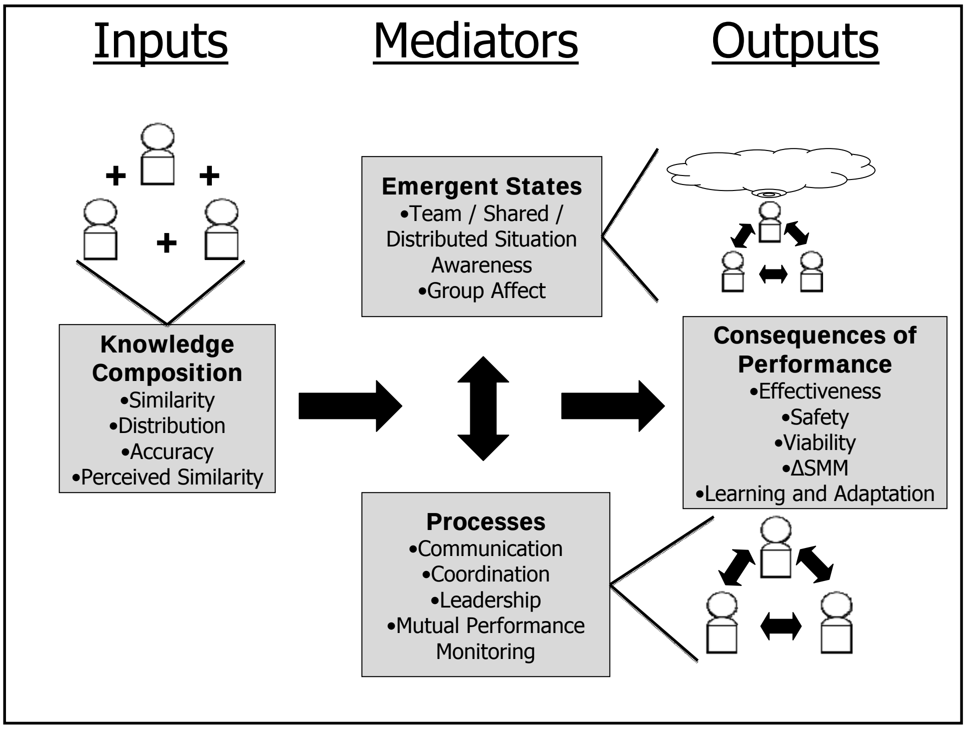
- A team is…
  - Two or more individuals interacting in meaningfully interdependent ways to accomplish a shared goal
- A multi-team system is…
  - At least two teams interfacing directly and interdependently in order to accomplish a shared *distal* goal
- Challenges to identifying teams in the wild:
  1. Boundary permeability
  2. Member turnover

A Framework of Team Performance



Team Cognition is…

- …a general perspective (not a specific theory) that views groups as information processing units (Hinsz, Tindale, & Volrath, 1997)
- …the interaction between intra-individual (i.e., internal cognitive) and inter-individual (i.e., external social) level processes (Fiore & Schooler, 2004)
- **Multi-level**
  - Comprising aspects of individuals and the team as a whole
- **Dynamic**
  - Changes moment by moment within a performance episode
  - Develops over time across performance episodes



Inputs of Team Cognition

- Knowledge Composition Constructs
  - Shared Mental Models (SMMs)
    - "knowledge structures held by members of a team that enable them to form accurate explanations and expectations for the task, and in turn, to coordinate their actions and adapt their behavior to demands" (Cannon-Bowers et al., 1993, p. 228)
  - Transactive memory systems (Hollingshead et al., 1998)
    - Understanding of who knows what
- Content of SMMs
  - Teamwork
  - Taskwork
- Structure
  - How representations are distributed, shared, or integrated across team members

Inputs of Team Cognition

- Configurations of team member knowledge structures (DeChurch et al., 2010; Smith-Jentsch, 2010)
  - What needs to be shared?
    - Roles & Responsibilities
    - Knowledge of team mission; Objectives, Norms & Resources
    - Familiarity with Teammates
    - Cue-strategy Associations
    - Knowledge on how to get "K"
  - What can be distributed
    - Role specific expertise
- Specific configurations depend on context

Processes of Team Cognition

- **Team processes** are:
  - "members' interdependent acts that convert inputs to outcomes through cognitive, verbal, and behavioral activities directed toward organizing taskwork to achieve collective goals" (Marks, Mathieu, & Zaccaro, 2001, p. 357)
- There are many models and frameworks of team processes (over 100)… Salas et al., 2007
- A temporally-based framework (Marks, Mathieu, & Zaccaro, 2001)
    - **Transition Processes** occur during planning
    - **Action Processes** occur when team directly pursues goals
    - **Interpersonal Processes** manage conflict during both

Processes of Team Cognition

- Is 'more' process better?
  - Not always…
    - Communication overhead
    - Implicit Coordination
    - Offering help isn't always helpful
      - Back-up behavior and legitimacy of need
- Process is effective when it addresses task demands…. When it is **functional**
- Convergent Processing Bias
  - Focus on shared information

Emergent States of Team Cognition

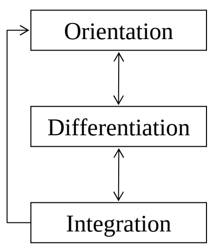
- **Emergent states** at the team level are:
  - "properties of the team that are typically dynamic in nature and vary as a function of team context, inputs, processes, and outcomes" (Marks et al., 2001, p. 357)
- Temporally transient
  - Dynamic understanding
- Compilaitonal vs. compositional
  - There is not a direct mapping from the individual to the team level.

Emergent States of Team Cognition

- Team Situational Awareness
  - A "situation model which is partly shared and partly distributed and, from which [team members] can anticipate important future states" (Artman, 2000, p. 1113)
- Spreading activation analogy
  - **Bottom-up origins:** Individual SA + Group Process
  - **Top-down constraints:** Culture, communication structure, leadership structure, etc.

Outputs of Team Cognition

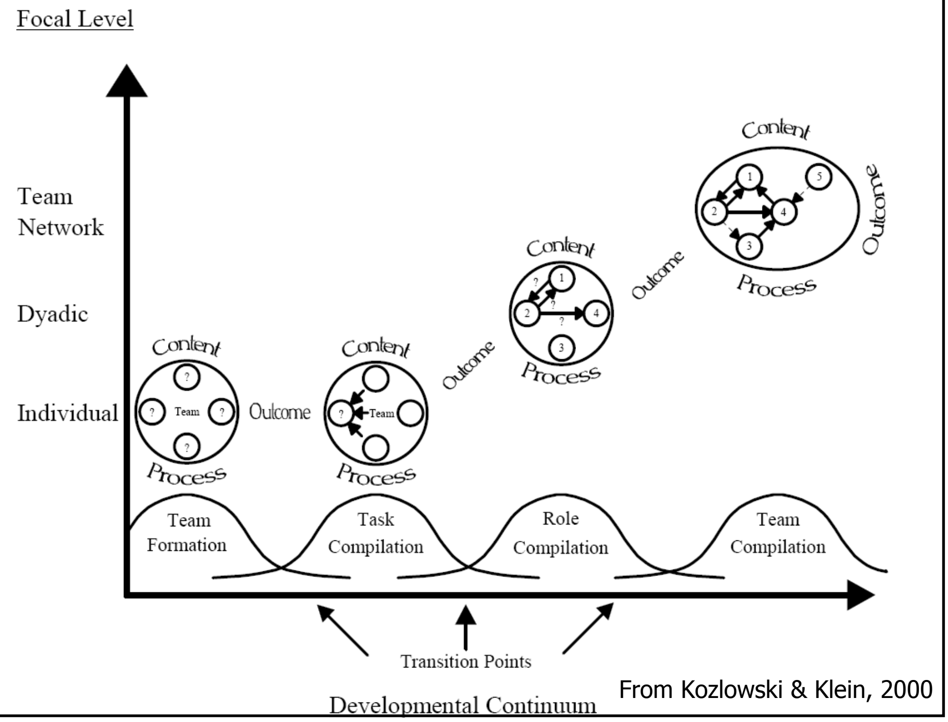
- ΔSMM (Convergence/divergence)
- Three phase model of SMM development (McComb, 2008)
  - **Orientation**
    - Team members are introduced to team domain
  - **Differentiation**
    - Individual MM of the team are formed which may or may not be shared
  - **Integration**
    - Different views are integrated into a 'team perspective'



- Occurs at the individual level through team level interaction

Outputs of Team Cognition

- Adaptation, Learning and Development (Burke et al., 2006; Kozlowski & Bell, 2009)
  - Changing the behavioral repertoire of the team based on past experience
- Deliberate learning processes initiated when (Gersick & Hackman, 1990)
  - Novel situations arise
  - Discrepancies between expectations and reality occur
  - Milestones are achieved
  - A structural change is initiated
  - An intervention is implemented



From Kozlowski & Klein, 2000

Section I Summary Principles

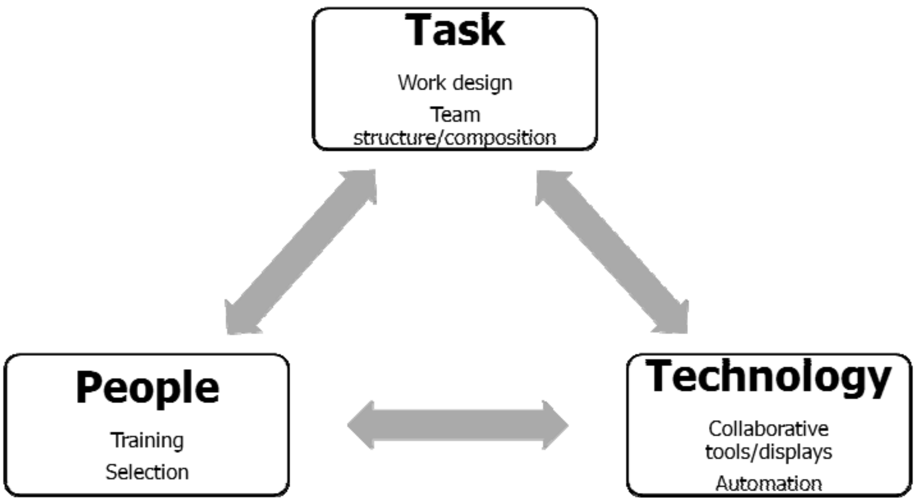
- Take a systems view.
  - Knowledge, dynamic awareness, and team cognitive processing are intertwined.
- Consider time… short and long scale.
  - Changes in team cognition within and across performance episodes.
  - Even stable knowledge changes.
- Match team knowledge configurations to <u>team</u> and task demands.
  - SMMs should be distributed to meet coordination demands

Section I Summary Principles

- Share 'the basics' of teamwork.
  - The whole team should have an understanding of team roles, composition, and interaction processes.
- Support mechanisms of learning and development in teams.
  - Change happens anyway, but not necessarily positive change.
- Attend to enabling conditions of distributed dynamic awareness.
  - Context and process shape what 'the team knows' and what it does with that understanding

II. HOW CAN TEAM COGNITION BE IMPROVED?

Interventions to Improve Team Cognition



Training for Team Cognition

- Improve **Inputs**
  - Target team member knowledge
- Improve **Processes**
  - Target team member behavior
- Improve **Outputs**
  - Target team 'post-processing' of performance.

Training the **Inputs** of Team Cognition

- **Cross-training**
  - Increases 'interpositional knowledge'
- **Perceptual contrast training**
  - Builds similarity in task related mental models
- **Leadership training and briefings**
  - Leader's can improve organization of task in pre-performance briefings or collaborative planning sessions.

Training the **Processes** of Team Cognition

- Simulation-based team training
  - Event-based methods

1. Teamwork KSAs
- **Competencies:** Knowledge, Skills, and Attitudes (KSAs) underlying effective teamwork

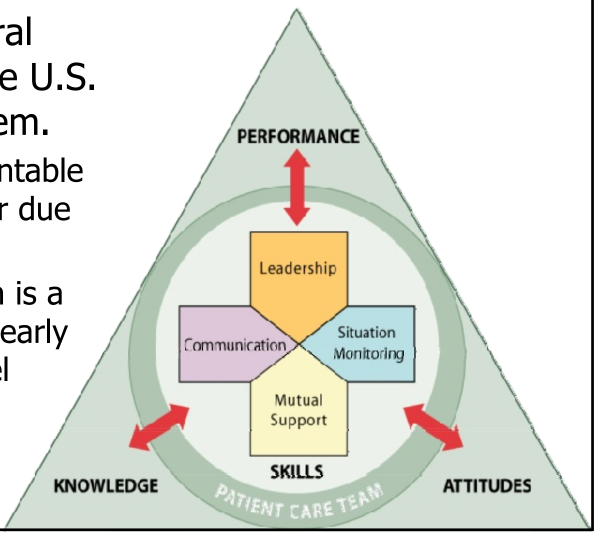
2. Opportunities to Perform
- Embedded Trigger Events that require a team response
- Specify targeted teamwork responses

2. Perf. Diagnosis and Feedback
- Identify deficiencies in KSAs
- Guide learning process

See Fowlkes et al., 1998; Rosen et al., 2008

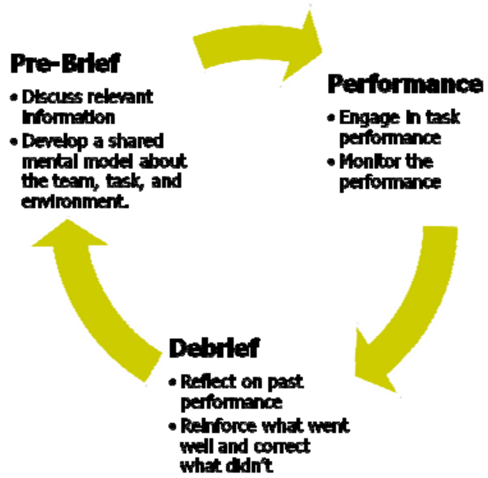
Example: TeamSTEPPS™

- There's a 'cultural revolution' in the U.S. healthcare system.
  - ≈98,000 preventable deaths per year due to error
  - Communication is a root cause of nearly 70% of sentinel events



Training the **Outputs** of Team Cognition

- **Team Self-correction Training**
- Pre-brief → Performance → Debrief cycles are a trait of high performance teams.
  - Builds Shared Mental Models.
  - Creates 'self-learning' teams.



Example: MOES Debriefs

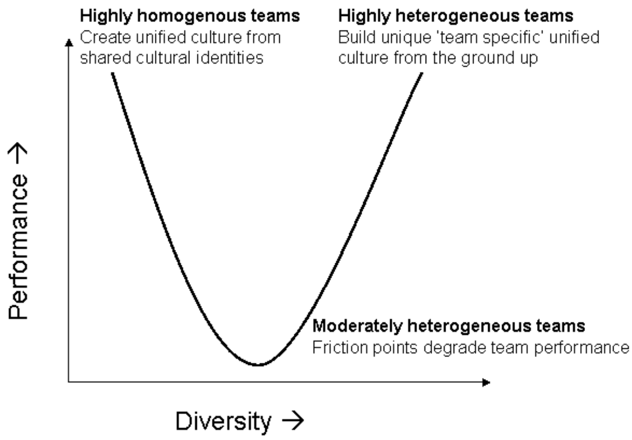
From Deering, Rosen, Salas, & King, 2009

Selection/Composition for Team Cognition

- Does team composition matter?
  - **YES!!**
  - But, some members matter more than others
    - Identify and focus on the 'strategic core' (Humphrey, Morgensen, & Mannor, 2009)
- **What makes a good team player?** (Bell, 2007; Driskell, Goodwin, Salas, & O'Shea, 2006)
  - General mental ability
  - Preference for teamwork / collective orientation
  - Emotional intelligence
  - Personality
    - Agreeableness (minimum)
    - Conscientiousness (mean)
    - Openness to experience (mean)
    - Collectivism (mean)

Example: Cultural Composition and Team Performance

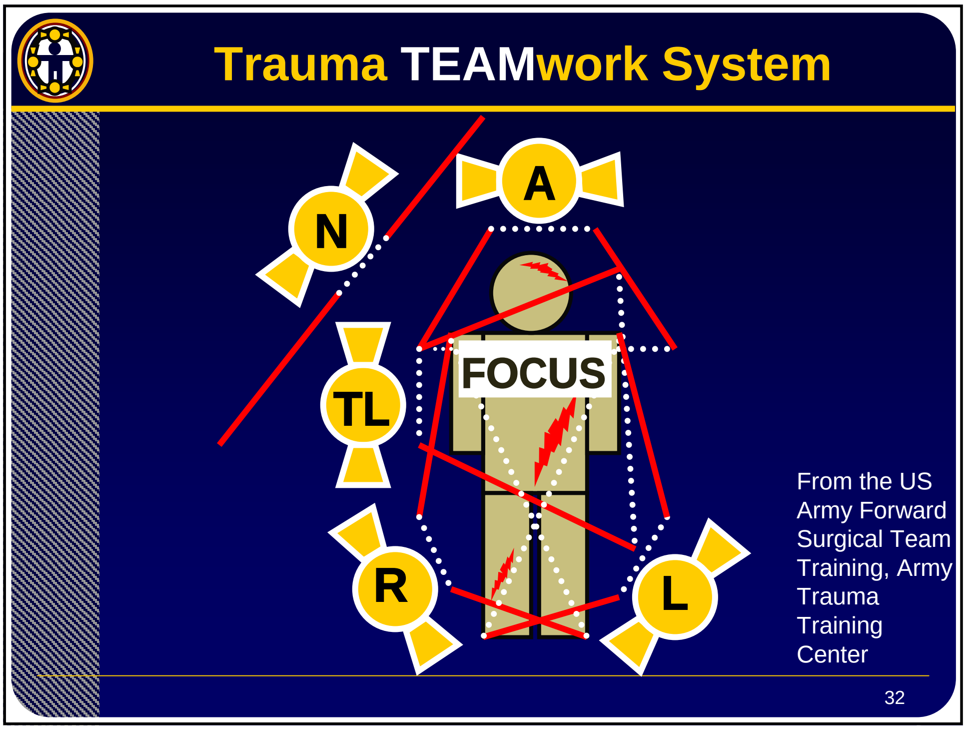
- **Friction points…**
  - Misalignment in team processes rooted in subgroups of shared cultural identities
  - Create team performance inefficiencies
  - Block development of a 'team specific' culture



From Rosen, Wildman, Bedwell, Fritsche, Salas, & Burke, 2008

Designing Work for Team Cognition

- **Distribution of roles and tasks**
  - Functional vs. divisional roles
- **'Fit' of team structure and task**
  - Team Coordination Audit
  - Match coordination demands with information flow.
- **Reduce 'communication overhead'**
  - Reorganize tasks to remove coordination demands.
  - Increase activities that build shared awareness.
- **Reduce variability in team processes**
  - Structure high-criticality aspects of performance



Example: Role Structure in Explosive Ordinance Disposal Teams

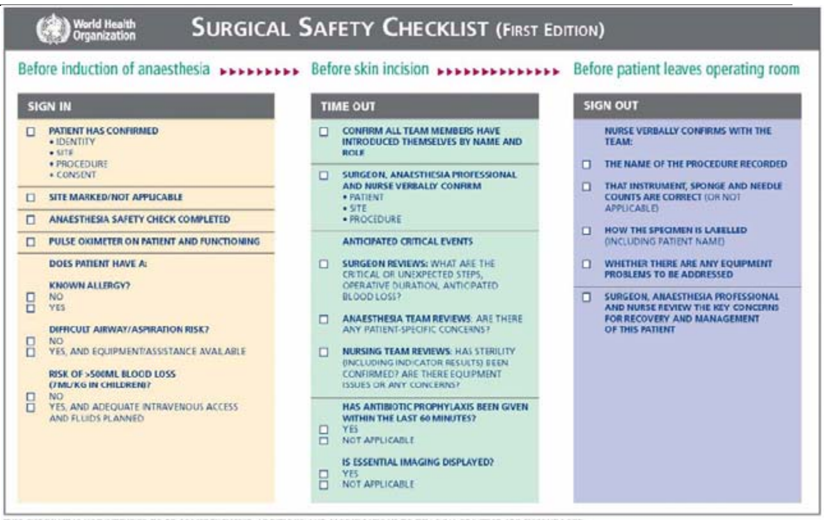
- 4 person teams disposing of 'live' explosives
- If necessary, one team member walks downrange to disable the device.
- One approach:
  1. Anyone but the team leader goes
  2. Only the team leader goes
- Which is better?

Example: WHO Surgical Safety Checklist

Decreased mortality rates (1.5% to 0.8%)

Decreased inpatient surgical complications (11.0% to 7.0%)

Haynes et al., 2009



World Health Organization

SURGICAL SAFETY CHECKLIST (FIRST EDITION)

Before induction of anaesthesia ▸▸▸▸▸▸▸▸▸ Before skin incision ▸▸▸▸▸▸▸▸▸▸▸▸▸▸ Before patient leaves operating room

SIGN IN

- ☐ PATIENT HAS CONFIRMED
  - IDENTITY
  - SITE
  - PROCEDURE
  - CONSENT
- ☐ SITE MARKED/NOT APPLICABLE
- ☐ ANAESTHESIA SAFETY CHECK COMPLETED
- ☐ PULSE OXIMETER ON PATIENT AND FUNCTIONING

DOES PATIENT HAVE A:

KNOWN ALLERGY?
- ☐ NO
- ☐ YES

DIFFICULT AIRWAY/ASPIRATION RISK?
- ☐ NO
- ☐ YES, AND EQUIPMENT/ASSISTANCE AVAILABLE

RISK OF >500ML BLOOD LOSS (7ML/KG IN CHILDREN)?
- ☐ NO
- ☐ YES, AND ADEQUATE INTRAVENOUS ACCESS AND FLUIDS PLANNED

TIME OUT

- ☐ CONFIRM ALL TEAM MEMBERS HAVE INTRODUCED THEMSELVES BY NAME AND ROLE
- ☐ SURGEON, ANAESTHESIA PROFESSIONAL AND NURSE VERBALLY CONFIRM
  - PATIENT
  - SITE
  - PROCEDURE

ANTICIPATED CRITICAL EVENTS
- ☐ SURGEON REVIEWS: WHAT ARE THE CRITICAL OR UNEXPECTED STEPS, OPERATIVE DURATION, ANTICIPATED BLOOD LOSS?
- ☐ ANAESTHESIA TEAM REVIEWS: ARE THERE ANY PATIENT-SPECIFIC CONCERNS?
- ☐ NURSING TEAM REVIEWS: HAS STERILITY (INCLUDING INDICATOR RESULTS) BEEN CONFIRMED? ARE THERE EQUIPMENT ISSUES OR ANY CONCERNS?

HAS ANTIBIOTIC PROPHYLAXIS BEEN GIVEN WITHIN THE LAST 60 MINUTES?
- ☐ YES
- ☐ NOT APPLICABLE

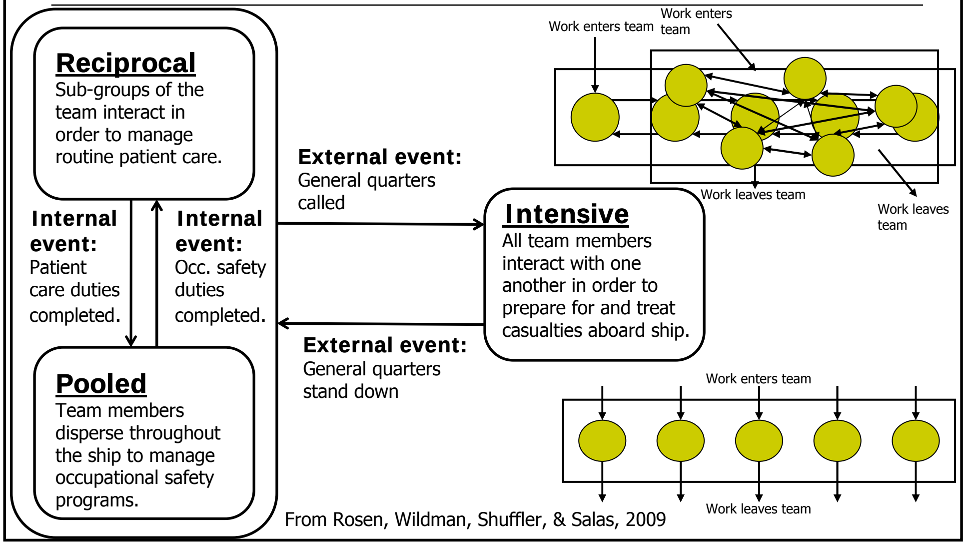
IS ESSENTIAL IMAGING DISPLAYED?
- ☐ YES
- ☐ NOT APPLICABLE

SIGN OUT

NURSE VERBALLY CONFIRMS WITH THE TEAM:
- ☐ THE NAME OF THE PROCEDURE RECORDED
- ☐ THAT INSTRUMENT, SPONGE AND NEEDLE COUNTS ARE CORRECT (OR NOT APPLICABLE)
- ☐ HOW THE SPECIMEN IS LABELLED (INCLUDING PATIENT NAME)
- ☐ WHETHER THERE ARE ANY EQUIPMENT PROBLEMS TO BE ADDRESSED
- ☐ SURGEON, ANAESTHESIA PROFESSIONAL AND NURSE REVIEW THE KEY CONCERNS FOR RECOVERY AND MANAGEMENT OF THIS PATIENT

THIS CHECKLIST IS NOT INTENDED TO BE COMPREHENSIVE. ADDITIONS AND MODIFICATIONS TO FIT LOCAL PRACTICE ARE ENCOURAGED.

Example: Task Interdependency Shifts in US Navy Medical Teams



From Rosen, Wildman, Shuffler, & Salas, 2009

Using Technology to Support Team Cognition

- External representations
  - Information or knowledge embedded in the environment (Zhang & Norman, 1994)
  - **Scaffolds** team cognition
    - Improves effectiveness of team process
  - **'Offloads'** team cognition
    - Replaces team process
- Workspace awareness
  - "up-to-the-moment understanding of another person's interaction with a shared workspace" (Gutwin & Greenberg, 2002, p. 417)

Section II Summary Principles

- Take a multi-method/intervention approach to improving team cognition.
  - Training, selection, work and technology design.
- Custom fit interventions.
  - Match teamwork competencies to task functions.
  - Match team design to task and environmental demands.
- Do the groundwork.
  - Needs analysis, team task analysis, coordination demand analysis
- Avoid static characterizations of teams.
  - Fundamental properties change over time in (sometimes) predictable ways.

III. HOW CAN TEAM COGNITION BE MANAGED IN DISTRIBUTED ENVIRONMENTS?

Challenges of Distribution for Team Cognition

- Team members become 'decoupled'
  - Operating in different temporal and informational environments
- Fewer cues (non-verbal, paralinguistic, sensory) means…
  - More Abstraction, Ambiguity, Complexity, Opacity
  - Difficulty building and maintaining…
    - Situational Awareness
    - Shared Mental Models
  - Feedback Ambiguities (sending, receiving, interpreting information)
  - Less Trust
  - Lower levels of group identity
  - Social Isolation

More Trends in Distributed Teams

- Distributed/Virtual teams tend to…
  - Have less cohesion
  - Stifled innovation
  - Increased counter-normative behavior
  - Increased social loafing
  - Take longer to reach decisions

'Pre-process' Strategies for Dealing with Distribution

- **Establish clear roles and responsibilities**
  - Use pre-briefs or 'kick-off' meetings
  - Set expectations for:
    - Who is doing what
    - Goals for the performance episode
    - Ground rules for interaction
- **Develop communication protocols**
  - Communicate in a standard form to 'get the most from the least' & minimize misunderstandings.

‘Pre-process’ Strategies for Dealing with Distribution

- **Establish procedures for resolving conflict**
  - Distribution → more task conflict → interpersonal conflict → ‘bad’ outcomes
- **Use structured pre-planning**
  - Facilitate TSA from the start
  - Use agendas and protocols to ensure important information is being shared

‘Pre-process’ Strategies for Dealing with Distribution

- **Develop some level of familiarity**
  - Know your teammates… ideally by name.
  - Recurring face to face meetings if possible (monthly, yearly).
- **Provide an ‘expertise map’**
  - People need to know who knows what
- **Define coordination demands**
  - People need to know where their work intersects with someone else's

‘In-process’ Strategies for Dealing with Distribution

- **Provide routine and event-driven ‘big picture’ updates**
  - Maintains dynamic understanding
  - Cross-checking
  - Error-correction
- **Encourage participation of all members in decision making**
  - Share unique information, interpretations, ideas
  - Facilitates shared goals and situational understanding

‘In-process’ Strategies for Dealing with Distribution

- **Structure critical aspects of interaction**
  - Dangerous tasks requiring interdependence
  - Transitions of authority
  - Team member changes
- **Share new information**
  - Especially when it is novel or unexpected.

'Post-process' Strategies for Dealing with Distribution

- **Conduct post-performance debriefs**
  - Discuss specific team behaviors linked to key events
  - Set goals, and hold people accountable
  - Leader self-correct first
  - Create psychological safety
  - Help develop SMM
- **Implement a team-level feedback system**
  - Track performance over time

Concluding Thoughts…

- There is a proven yet maturing **science and practice of team cognition**….
  - …but more is needed.
- Consider different **perspectives**
  - Inputs, processes, emergent states, outputs
- Use different **tools**
  - Training, work design, technology
- Measure wisely
  - What you measure is what you get IF (and only if)…
  - …what you measure can **drive performance and change.**

Thank you.

Questions?

How can we help?

HFC

“Distributed Situation Awareness”

N.Stanton/ University of Southampton

Attached papers:

Stanton N.A., Chambers P.R.G., Piggott J., (2001). "Situational awareness and safety." Safety Science, 39(3), 189-204

Suggested papers:

Stanton N.A., Salmon P.M., Walker G.H., Jenkins D.P., (2009). "Genotype and Phenotype Schema and their role in Distributed Situation Awareness in Collaborative Systems." Theoretical Issues in Ergonomics Science, 10(1), 43-68

Salmon P.M., Stanton N.A., Walker G.H., Jenkins D.P., Baber C., McMaster R., (2008). "Representing Situation Awareness in Collaborative Systems: A Case Study in the Energy Distribution Domain." Ergonomics, 51(3), 367-384

Salmon P.M., Stanton N.A., Walker G.H., Jenkins D.P., (2008). "What really is going on? Review of Situation Awareness Models for Individuals and Teams." Theoretical Issues in Ergonomics Science, 9(4), 297-323

Stanton N.A., Stewart R., Harris D., Houghton R.J., Baber C., McMaster R., Salmon P.M., Hoyle G., Walker G.H., Young M.S., Linsell M., Dymott R., Green D., (2006). "Distributed situation awareness in dynamic systems: theoretical development and application of an ergonomics methodology." Ergonomics, 49(12-13), 1288-1311

Salmon P.M., Stanton N.A., Walker G.H., Green D., (2006). "Situation Awareness measurement: A review of applicability for C4i environments." Applied Ergonomics, 37(2), 225-238

Distributed Situation Awareness

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University of Southampton

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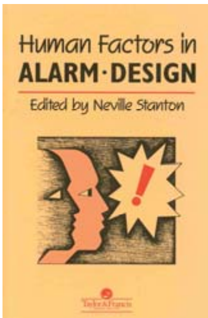
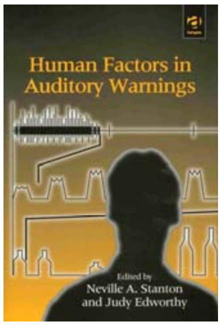
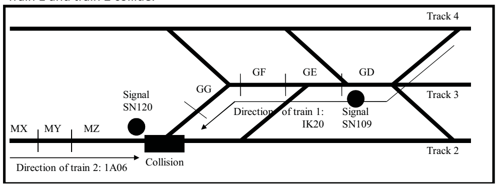
Human Factors….

– …is the scientific study of the relationship between man and his working environment (Murrell, 1965)
– …is the study of how humans accomplish work-related tasks in the context of human-machine system operation (Meister, 1989)
– …discovers and applies information about human behaviour, abilities, limitations, and other characteristics to the design of tools, machines, tasks, jobs, and environments (Sanders and McCormick, 1993)
– …is that branch of science which seeks to turn human-machine antagonism into human-machine synergy (Hancock, 1997)
– …strives to improve the safety and usability of systems, tools, products and environment for human use (Cooke and Salas, 2007)



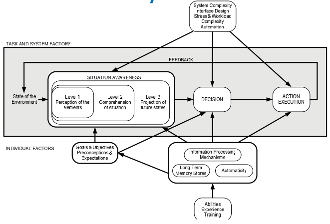


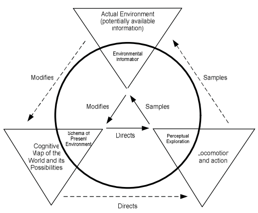
- **08:08:29** A ‘track circuit GE occupied IK20’ warning message is presented on the alarm screen in the signaller’s work station (see figure for a general picture of the work station) and auditory ‘tweet’ sounds (an auditory track occupation alarm referring to the same track circuit GE occupation by train 1) – at the same time a red line appears on the track layout on the track display and the train headcode of IK20 stays at signal 109, the red signal.
- **08:08:32** The oncoming train 2 occupied track circuit MZ and a red line appears on the appropriate track display with the headcode 1A06 (the number associated with train 2).
- **08:08:34** Auditory alarm ‘tweet’ sounds as rear of train 1 clears track circuit GD (i.e., the track circuit before GE) and the track circuit is shown as cleared on track display.
- **08:08:36** Track circuit GF occupied message displayed and auditory ‘tweet’ sounds (track occupation alarm referring to the occupation of track circuit GF by train 1 – at the same time a red line appears on the track layout on the track display).
- **08:08:41** Rear of train 1 clears track circuit GE (i.e., the track circuit before GF) and track circuit shows as cleared on track display.
- **08:08:42** The rear of the oncoming train 2 clears track circuit MY and track circuit MY shows as cleared on track display.
- **08:08:49** Track circuit GG occupied by IK20 alarm message displayed and auditory ‘tweet’ sounds referring to track circuit GG by train 1 – at the same time a red line appears on the track layout on the track display.
- **08:08:50** Train 1 and train 2 collide.



What is Situation Awareness?

- Knowing what's going on - Awareness of the situation
- Perception – Comprehension – Projection
- Externally-directed consciousness





How can we support the commander's involvement in the planning process?

Is SA all in the mind?

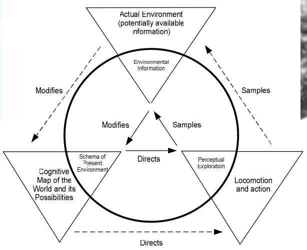
		Distributed Planning (B)				
	Co-located (A)	Video+Data (B)	Video Only (B)	Data Only (B)	No Video No Data (B)	Co-located (A)
Time						
Game Play						
Communication (Quantity)						
Communications (Content)						
SA (Probe Recall)						
Overall Workload						

Stanton N.A., Salmon P.M., Walker G.H., Jenkins D.P., (2009). "Is situation awareness all in the mind?." Theoretical Issues in Ergonomics Science, Special Issue on Situation Awareness, in press

Walker G.H., Stanton N.A., Salmon P.M., Jenkins D.P., (2009). "How can we support the commander's involvement in the planning process? An exploratory study into remote and co-located command planning." International Journal of Industrial Ergonomics, 39(2), 456-464

Systems perspective of DSA

Perceptual Cycle (Neisser, 1976)



"Suppose I am making a stroke in a quick game, such as tennis or cricket. How I make the stroke depends on the ***relating of certain new experiences, most of them visual, to other immediately preceding visual experiences and to my posture, or balance of postures, at the moment****. The latter, the balance of postures, is a result of a whole series of earlier movements, in which the last movement before the stroke is played has a predominant function. When I make the stroke* ***I do not, as a matter of fact, produce something absolutely new, and I never merely repeat something old.*** *The stroke is literally* ***manufactured*** *out of the living visual and postural 'schemata' of the moment and their interrelations. I may say,* ***I may think that I reproduce exactly a series of text-book movements, but demonstrably I do not****; just as, under other circumstances, I may say and think that I reproduce exactly some isolated event which I want to remember, and again demonstrably I do not."* (p. 201-202, Bartlett, 1932).

Stanton, N. A. & Stammers, R. B. (2008) Bartlett and the future of ergonomics. Ergonomics 51 (1), 1 - 13.

Features of schemata

- organized meaningfully (to the person).
- embedded in other schemata and itself contains sub-schema.
- changed moment-by-moment as information is received.
- reorganized when incoming data reveals a need to restructure the concept.
- gestalt mental representations.

CDM 'Cognitive Cues'

Goal Specification	**What were your specific goals at the various decision points?**
Cue Identification	What features were you looking for when you formulated your decision? How did you that you needed to make the decision? How did you know when to make the decision?
Expectancy	Were you expecting to make this sort of decision during the course of the event? Describe how this affected your decision making process.
Conceptual	Are there any situations in which your decision would have turned out differently? Describe the nature of these situations and the characteristics that would have changed the outcome of your decision.
Influence of uncertainty	At any stage, were you uncertain about either the reliability of the relevance of the information that you had available? At any stage, were you uncertain about the appropriateness of the decision?
Information integration	What was the most important piece of information that you used to formulate the decision?
Situation Awareness	What information did you have available to you at the time of the decision?
Situation Assessment	Did you use all of the information available to you when formulating the decision? Was there any additional information that you might have used to assist in the formulation of the decision?
Options	Were there any other alternatives available to you other than the decision you made?
Decision blocking - stress	Was their any stage during the decision making process in which you found it difficult to process and integrate the information available? Describe precisely the nature of the situation
Basis of choice	Do you think that you could develop a rule, based on your experience, which could assist another person to make the same decision successfully? Why/Why not?
Analogy/ generalisation	Were you at any time, reminded of previous experiences in which a similar decision was made? Were you at any time, reminded of previous experiences in which a different decision was made?

O'Hare, D., Wiggins, M., Williams, A. and Wong, W. (2000). Cognitive task analysis for decision centred design and training. In: J. Annett and N.A. Stanton (Eds.) Task Analysis (pp. 170-190). London: Taylor and Francis.

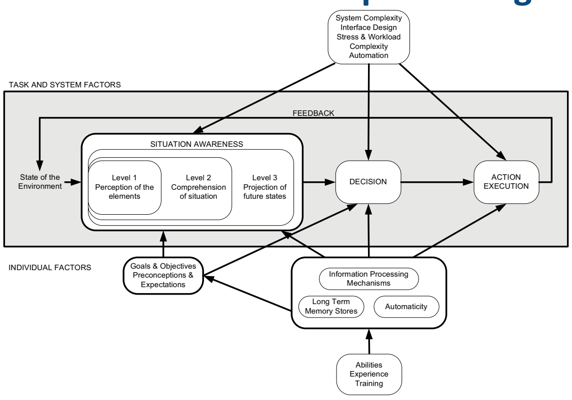
Schemata

Genotype schema + environment + random variation = phenotype schema

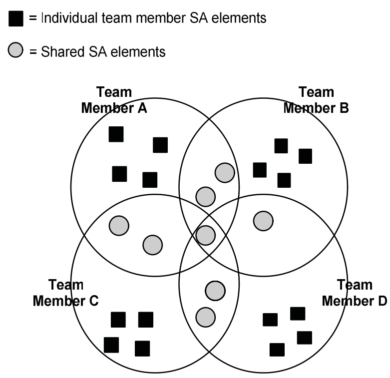
Research questions

- Can the idea be extended to teams?
- Can we collect the data on phenotype schema?
- Can we model the schema: phenotype and genotype?
- Is this any improvement on the 3-level model?

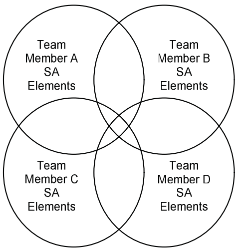
SA as information processing

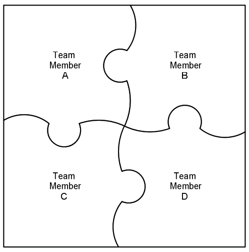


Shared awareness?



Shared or distributed SA?



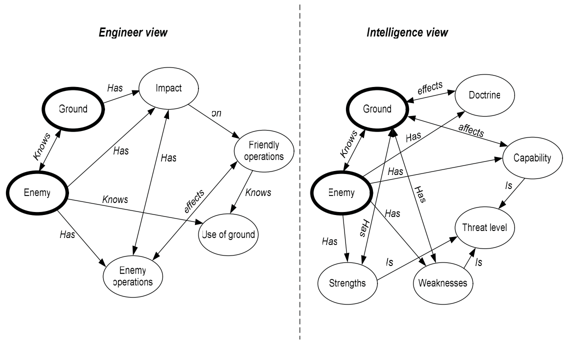


Shared SA (e.g. Endsley & Jones, 2001)

Compatible SA (e.g. Stanton et al, 2006)

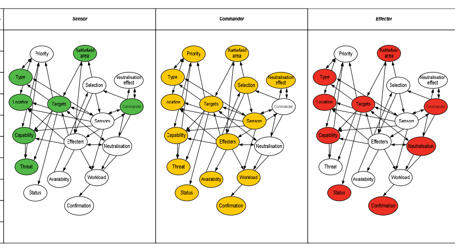
Stanton N.A., Stewart R., Harris D., Houghton R.J., Baber C., McMaster R., Salmon P.M., Hoyle G., Walker G.H., Young M.S., Linsell M., Dymott R., Green D., (2006). "Distributed situation awareness in dynamic systems: theoretical development and application of an ergonomics methodology." Ergonomics, 49(12-13), 1288-1311

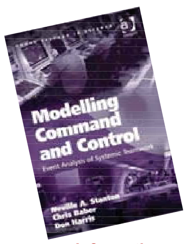
Compatible awareness



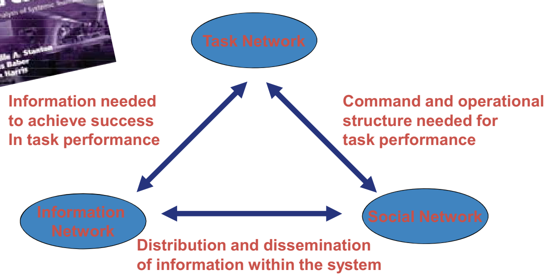
Distributed Awareness

Function	Situation Awareness Requirements	Allocation of Function
Search for targets	Battlefield area Targets	Sensor
Record info on target type and location	Target type Target location	Sensor
Calculate target threat	Target type Target location Target capability Other targets (type, location & capability)	Sensor
Calculate target priority	Target threat Other targets & threat levels Target priority	Commander
Evaluate implications of neutralising target	Effect of neutralising target	Commander
Determine if targets need to be neutralised	Target threat Target priority Effect of neutralising target Other targets (threat, priority, effects)	Commander
Assign effecter to target	Available effecters Target & Effecter locations Effecter workloads Effecter capability	Commander
Determine target to be neutralised	Target selection Neutralising effecter	Effecter
Neutralise target	Target location Target status Outcome	Effecter
Confirm target neutralised	Neutralisation confirmation	Effecter & Commander



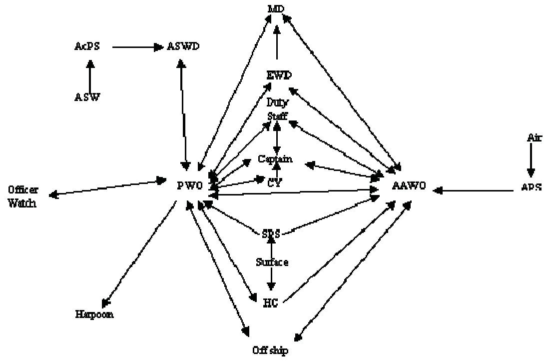


EAST framework

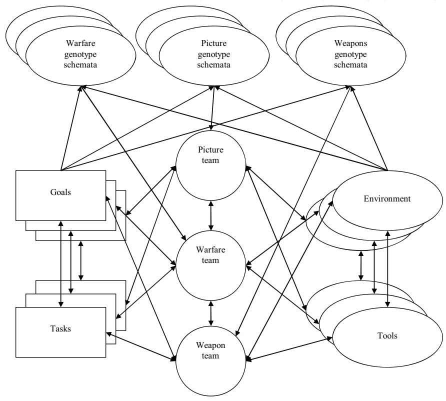


Walker G.H., Gibson H., Stanton N.A., Baber C., Salmon P.M., Green D., (2006). "Event Analysis of Systemic Teamwork (EAST): A novel integration of ergonomics methods to analyse C4i activity." Ergonomics, 49(12&13), 1345-1369

Social network of an ops team



Command teams

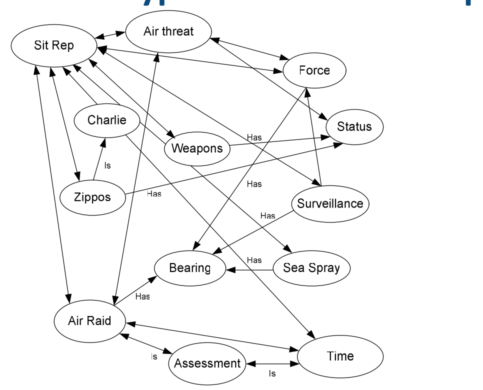


'Complex systems cannot be understood by studying parts in isolation [...] the essence lies in the interaction [...] the system must be analysed as a whole' (p. 293, Ottino, 2003)

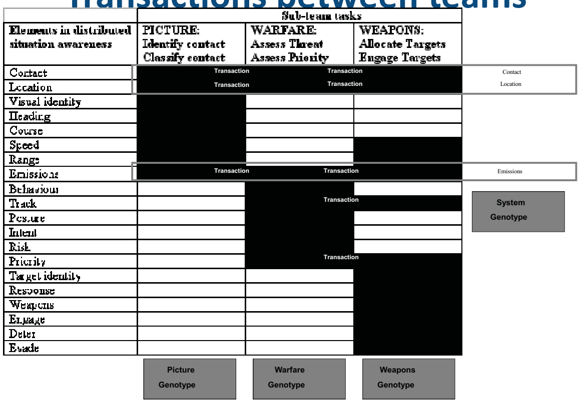
SitRep

"Air threat warning yellow, weapons are safe, Zippo Charlie is in force, Zippos are loose, force currently under surveillance from the North. There is evidence of sea spray from the North. I assess air raid will build in the next 2 minutes"

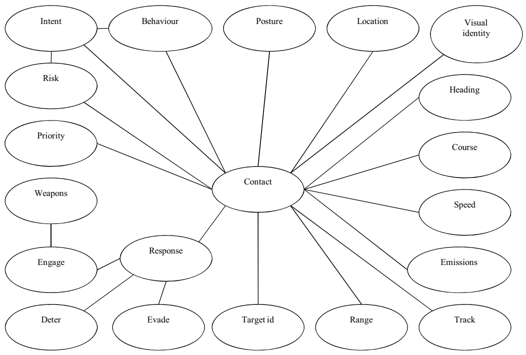
Phenotype schema of SitRep



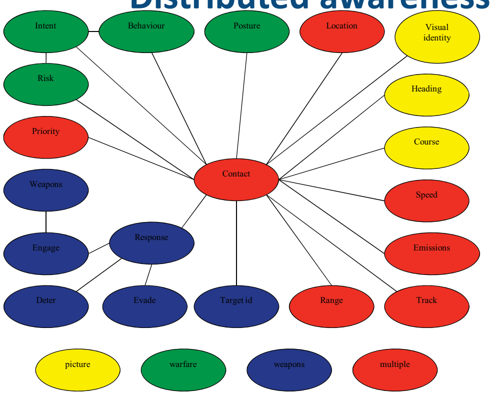
Transactions between teams

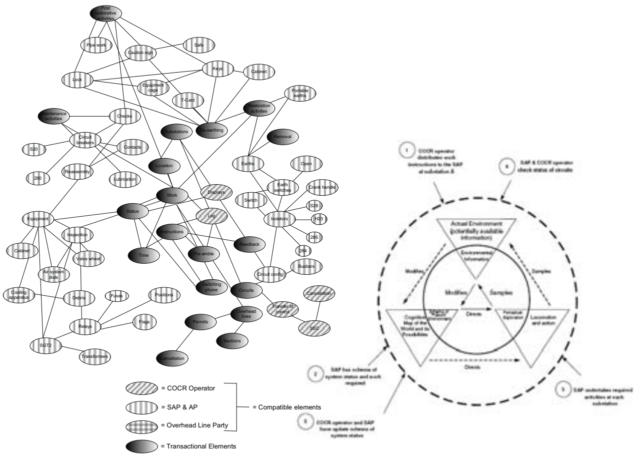


Genotype schema



Distributed awareness





Stanton, N. A., Salmon, P. M., Walker, G. H., & Jenkins, D. P. (2008). Genotype and Phenotype Schema and their role in Distributed Situation Awareness in Collaborative Systems. Theoretical Issues in Ergonomics Science. 10 (1) 43-68.

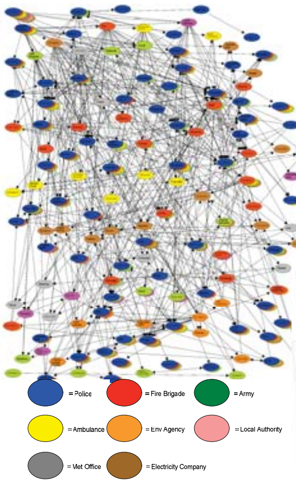
Multi-agency coordination

- In the future requirement for military to work with civilian organisations likely to increase
- Coordination between agencies during emergency response found to be a significant problem (e.g. Smith & Dowell, 2000)
- Aim of this research was to:

1. Identify issues that hinder coordination between the military and civilian organisations,
2. Specify guidance on how coordination between the military and civilian organisations might be augmented during emergency scenario responses.

MACA Incident Case Study

- Op Merlin Aware, October 17 – 19th
- 15th Brigade, Imphal Barracks, York
- Flooding scenario which develops into a chemical incident
- Aim was to practice strategic command and Brigade staff procedures in a multi-agency environment



Analysis Methodology

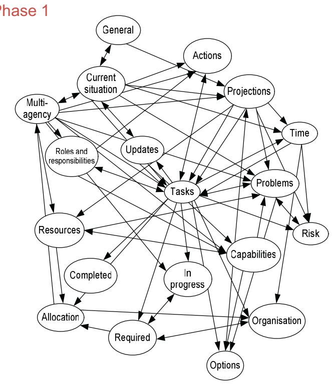
- ***Design*** – Direct observational study
- ***Participants*** – Gold command representative from each agency
- ***Materials*** – Resources in Brigade and SCG HQ, video recorder, CDM and social network pro-formae, pen and paper
- ***Procedure*** – 3 analysts undertook direct observation of SCG meetings and held discussions with SMEs, CDM method applied post task, prop nets developed based on verbal transcripts

Results – SCG meeting Propositional Networks

SCG Meeting Phase 1

Results – SCG meeting Propositional Networks

SCG Meeting Phase 1

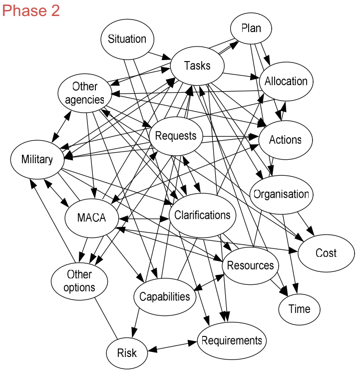


Results – SCG meeting Propositional Networks

SCG Meeting Phase 2

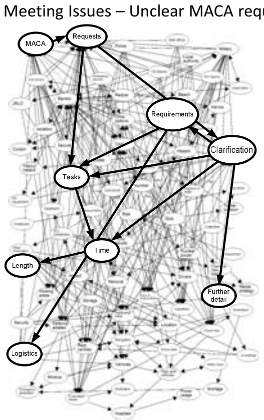
Results – SCG meeting Propositional Networks

SCG Meeting Phase 2



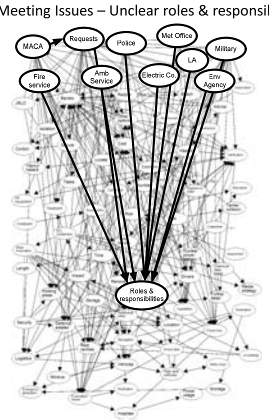
SCG Meeting Issues – Unclear MACA requests

SCG Meeting Phase 2



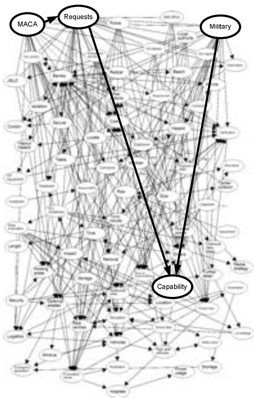
SCG Meeting Issues – Unclear roles & responsibilities

SCG Meeting Phase 2



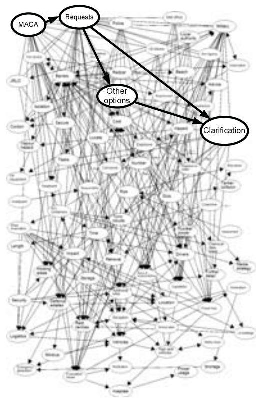
SCG Meeting Issues – Misunderstanding of Military Capability

SCG Meeting Phase 2



SCG Meeting Issues – Lack of trust

SCG Meeting Phase 2



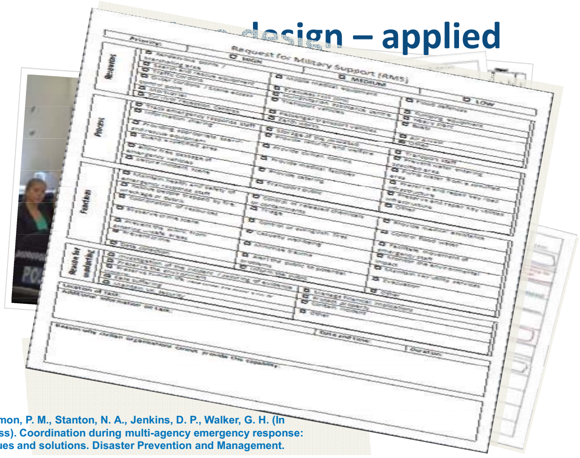
MACA Conclusions

- Various problems associated with the communication of information between agencies
- Inadequate levels of distributed situation awareness
- MACA requests often unclear & inappropriate
- No procedures/devices to support information sharing and distributed situation awareness

MACA Recommendations

- The use of cognitive artefacts to support DSA and coordination recommended
- Artefacts developed in accompanying work package e.g.
  - Mission analysis record;
  - List of resources;
  - Effects schematic;
  - Critical information requirements;
  - Synchronisation matrix
  - Record of actual events
  - MACA request pro-forma

…design – applied



Salmon, P. M., Stanton, N. A., Jenkins, D. P., Walker, G. H. (In Press). Coordination during multi-agency emergency response: issues and solutions. Disaster Prevention and Management.

Benefits of cognitive artefacts

- Information present in the world not in the heads of individual actors
- Supports development & maintenance of distributed SA
- Reduces load associated with remembering
- Extension of cognitive abilities (Hutchins, 1995)
- Consistency of information display and understanding
- Division of cognitive labour e.g. “How a cockpit remembers it’s speed” (Hutchins, 1995)

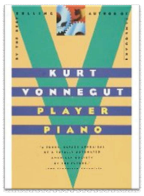
Conclusions for DSA

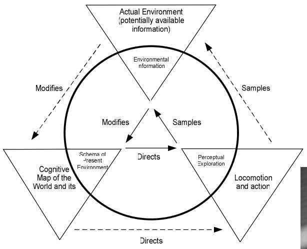
- Departure from linear, feedback models of cognition (of the sort that underlies Endlsey’s three level model) in favour of a cyclical, parallel, generative model
- Not ‘shared SA’ (which tacitly assumes ‘identical’ SA and an objectively definable situation) but rather compatible and transactive SA
- SA as a systemic emergent property (the phenotype) which is the product rather than the sum of each team’s schema-based ‘theory of the world’ (the genotype)
- Recognition of socio-technical systems view: systems comprising people, artefacts and their interaction, and using DSA to design the whole distributed system
- SA neither resides solely in the person nor solely in the world, rather it emerges from the interaction between people and the world (i.e., collective product of embedded cognition)

Journal papers on DSA

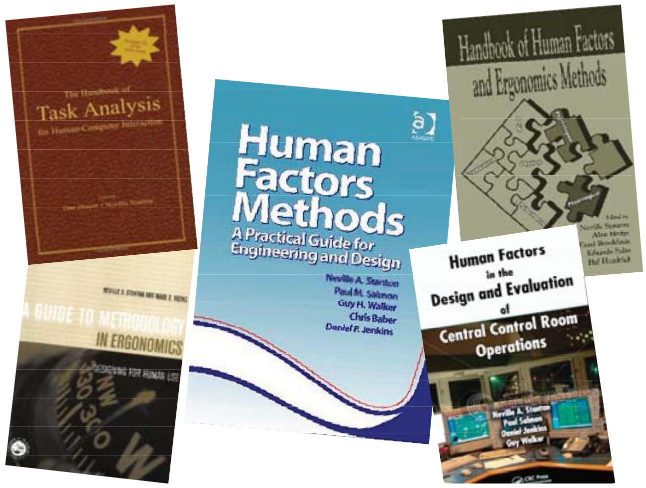
- Stanton N.A., Stewart R., Harris D., Houghton R.J., Baber C., McMaster R., Salmon P.M., Hoyle G., Walker G.H., Young M.S., Linsell M., Dymott R., Green D., (2006). "Distributed situation awareness in dynamic systems: theoretical development and application of an ergonomics methodology." **Ergonomics**, 49(12-13), 1288-1311
- Walker G.H., Gibson H., Stanton N.A., Baber C., Salmon P.M., Green D., (2006). "Event Analysis of Systemic Teamwork (EAST): A novel integration of ergonomics methods to analyse C4i activity." **Ergonomics**, 49(12&13), 1345-1369
- Salmon P.M., Stanton N.A., Walker G.H., Jenkins D.P., (2008). "What really is going on? Review of Situation Awareness Models for Individuals and Teams." **Theoretical Issues in Ergonomics Science**, 9(4), 297-323
- Salmon P.M., Stanton N.A., Walker G.H., Jenkins D.P., Baber C., McMaster R., (2008). "Representing Situation Awareness in Collaborative Systems: A Case Study in the Energy Distribution Domain." **Ergonomics**, 51(3), 367-384
- Stanton N.A., Salmon P.M., Walker G.H., Jenkins D.P., (2009). "Genotype and Phenotype Schema and their role in Distributed Situation Awareness in Collaborative Systems." **Theoretical Issues in Ergonomics Science**, 10(1), 43-68
- Walker G.H., Stanton N.A., Salmon P.M., Jenkins D.P., (2009). "How can we support the commander’s involvement in the planning process? An exploratory study into remote and co-located command planning." **International Journal of Industrial Ergonomics**, 39(2), 456-464
- Salmon P.M., Stanton N.A., Walker G.H., Jenkins D.P., Rafferty L.A. Is it really better to share? Distributed situation awareness and its implications for collaborative system design. **Theoretical Issues in Ergonomics Science**, Special Issue on Situation Awareness, in press
- Stanton N.A., Salmon P.M., Walker G.H., Jenkins D.P., (2009). “Is situation awareness all in the mind?." **Theoretical Issues in Ergonomics Science**, Special Issue on Situation Awareness, in press
- Stanton, N. A. Situation awareness: where have we been, where are we now and where are we going? **Theoretical Issues in Ergonomics Science**, Special Issue on Situation Awareness, in press

"If it weren't for the people, the god-damn people" said Finnerty, "always getting tangled up in the machinery. If it weren't for them, the world would be an engineers paradise." Kurt Vonnegut, Piano Player (1952: 59)





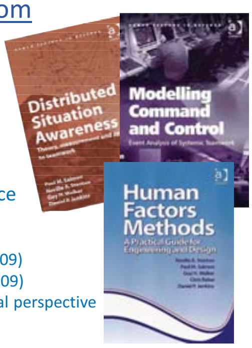
n.stanton@soton.ac.uk



Where to find out more…

www.hfidtc.com

- Published journal papers
  - TIES: Situation Awareness
  - Ergonomics: Command and Control
  - IJHCI: NDM with Computers
  - Cognition, Technology and Work:
    - HFI in Defence
- Book Series: Human Factors in Defence
  - Cognitive Works Analysis (2009)
  - Modelling Command and Control (2008)
  - Distributed Situation Awareness (Nov 2009)
  - Digitising Command and Control (Nov 2009)
  - Command and Control: the sociotechnical perspective
  - Trust in Military Teams (due late 2010)



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HFC

"Integrerte operasjoner og betydning for HMS nivået"

A.Ringstad/StatoilHydro og P.Næsje Coldevin/DnV

Attached report:

P.Næsje " Effects of Integrated Operations on Offshore Installations' Health and Safety Performance" SINTEF A122025

Suggested papers:

D. J. Teece, G. Pisano, and A. Shuen, "Dynamic Capabilities and Strategic Management," Strategic Management Journal, vol. 18, pp. 509-533, 1997.

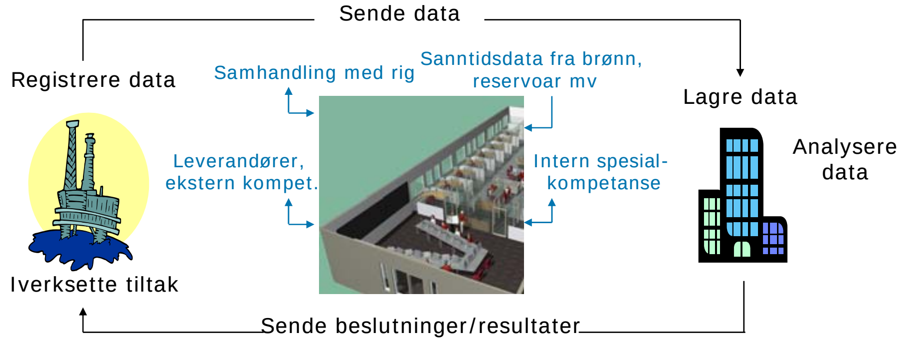
J. S. Brown and P. Duguid, "Organizational Learning and Communities-of -practice: Toward a Unified View of Working, Learning and Innovation," Organization Science, vol. 2, pp. 40-57, 1991.

W. J. Orlikowski, "Knowing in practice: Enacting a collective capability in distributed organizing," Organization Science, vol. 13, p. 249, 2002.

K. S. Cameron, J. E. Dutton, and R. E. Quinn, Positive organizational scholarship: Foundations of a new discipline: Berrett-Koehler Publishers, 2003.

IO gir oss bedre beslutninger

På mange områder vil IO erstatte den gamle styringssløyfen med beslutningsprosesser som er raskere, bedre og sikrere. Dette gir oss helt nye muligheter for kontinuerlig overvåking og korreksjon.



Integrerte operasjoner og betydning for HMS nivået

Pål Næsje Coldevin
02 September 2009

MANAGING RISK DNV

Point of departure

- Analytical framework used in my SINTEF projects -> 2009
- Based on earlier and parallel qualitative projects
- Cooperation with
  - Gunnar Lamvik, Kari Skarholt, Vidar Hepsø, Arne Bye, Arne Jarl Ringstad, Berit Moltu

Elements

- Four variables central to operations excellence
- IO Compliance
- Installation HSE performance

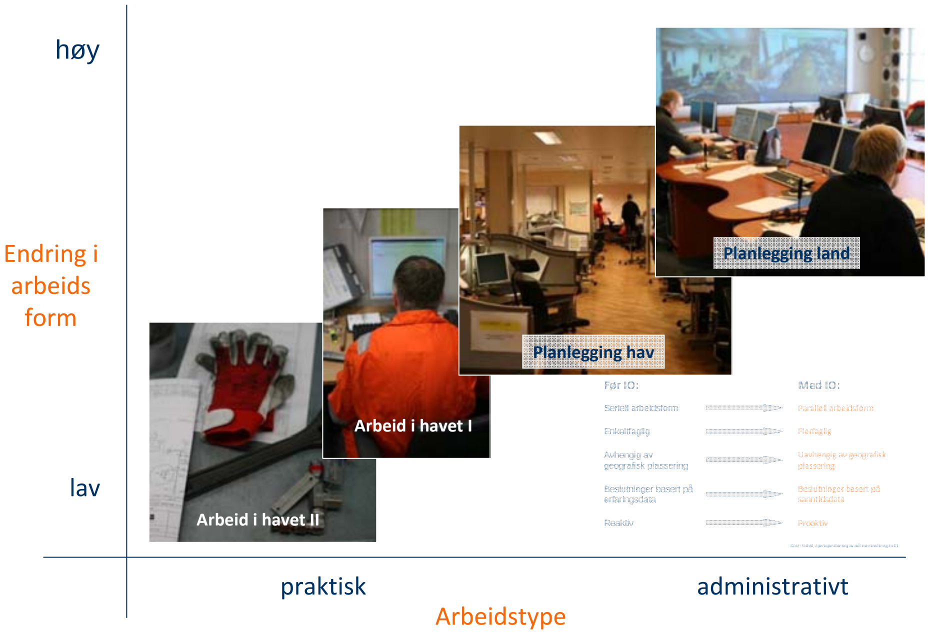
Operational changes and Integrated Operations

In our (qualitiative) projects we have observed changes in…

- Work processes: planning/execution/reporting
- Decision-making: strategy/discipline/coordination issues
- Role of supervisors: integrated in teams/moved onshore

Also, IO compliant installations introduced new organizational concepts:

- Increased *Shared Situational Awareness* (SA)/Team SA
- *Self-synchronization* instead of coordination
- Changes in management styles (Situational/Transformational)



Kilde: B.E. Madsen & Næsje Coldevin 2008

Relevant Variables for IO

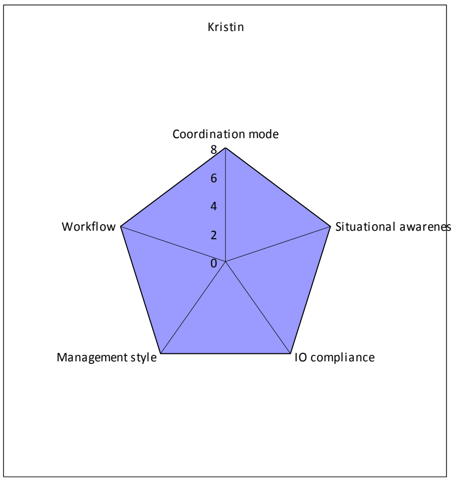
- Coordination -- Self-synchronization
  - **Coordination mode**: hierarchical coordination vs. self-synchronization
  - **Situational awareness**/information: Shared vs. specific
  - Knowledge base: Shared/integrated knowledge base in social field vs. expert/discipline
  - Decision-making: Distributed vs. hierarchical
  - **Work-processes**: Full-loop work-processes vs. handovers and planners-doers model
- **IO compliance** (Interoperability)
  - Connectedness, sharing of information: to have knowledge and information available. Includes technical solutions
- **Management style** (Direction)
  - Hands-on management = Control vs. Involvement
  - Empowerment, co-determination

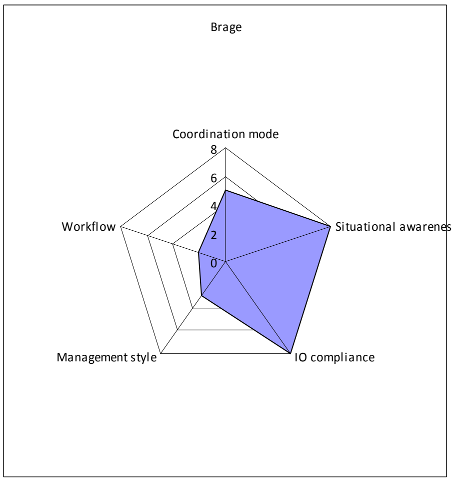
Example: Selfsynchronization as a part of IO

Self-synchronization as an alternative to traditional coordination

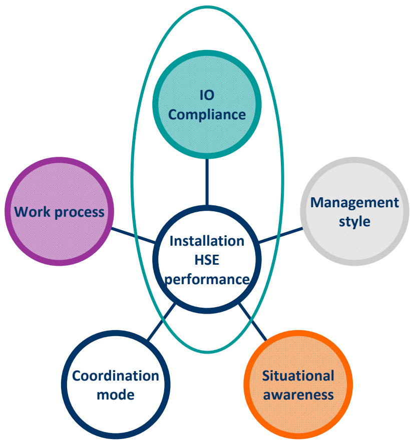
- Trad, hierarchical coordination (foreman-model)
  - precise coordination form, but it does little to promote knowledge sharing and motivation
  - does not promote flexibility, innovation etc

- SA and empowerment is used to enhance knowledge sharing and promote motivation
  - Increased responsibility for every worker
  - Use transparency to increased awareness of status of tasks for different functions
- ➢ Increases the drive in the team to coordinate material and personnel by itself. This mode of coordination is self-synchronization
- ➢ Better problem solving, less slack, better resource utilization





Variables 1.0 – IO and HSE performance



Introduction HSE and IO

- In what way does Integrated Operations have an impact on the HSE-performance of offshore installations (H1)? If any (H0)
- Of interest are IO related changes, if observable:
  - In work processes
  - In how coordination is conducted between the roles and functions involved in operations
  - In the degree of shared problem awareness in the offshore crew and between offshore operations and onshore support
  - In managerial practices such as hands-on involvement

Changes are operationalized in RNNP-survey data, and analyzed together with SH HSE-performance indicators, as well as an assessment of IO-compliance

Central elements in the analysis

We are interested in:

- **Positive Deviance** (Cameron, Dutton & Quinn, others)
  - ”…especially positive outcomes, processes, and attributes of organizations and their members”
- Nature of **Work Practices** (Brown & Deguid, others)
  - ”…the **robust** working, learning, and innovating communities and practice of the workplace ”
- …thus, findings that point to **best practice**

RNNP/IO

Dataset combines three elements:

- RNNP
  - StatoilHydro employees offshore
  - N=1817, n=1754 in most analyses
  - Response rate low on larger installation (skewed distribution?)
  - Installations with lower than 15 respondents excluded
- SH installation HSE-data (only **lagging** HSE indicators)
  - TRIF and SIF, as well as dropped objects, LTI, yellow incidents
  - Worked hours
- IO compliance
  - SINTEF and SH assessments of "IO-level" in license
  - Includes onshore and offshore aspects

IO compliance

- Qualitative assessment of IO-status on installation

- SH assessment in 3 levels
  - Qualitative assessment conducted by IO initiative core team
- SINTEF assessment by scoring

  Used installation IO status report, some variations on degree of details in report

  Looked at four areas: Management, Operations & Maintenance and Production Optimalization, Drilling (where relevant).

  - Changes in work processes
  - Changes in technological enablers (such as use of collaboration rooms)
  - Score 1 for every change (max 8)

IO Compliance assessment

IO level	Installation	*SINTEF*
6	Brage Visund Kristin	
5	Huldra	
4	Troll B Statfjord A/B/C	Troll C
3	Snorre A/B Heidrun Kvitebjørn	Veslefrikk Åsgard A/B
2	Oseberg Feltsenter Oseberg Sør Oseberg Øst	Sleipner A/B Oseberg C
1	Gullfaks A/B/C Norne Grane	Heimdal Njord Troll A Volve

IO level	Installation	***StatoilHydro***
1 6 inst.	Troll B Brage Visund Snorre A/B Kristin	
2 19 inst.	Gullfaks A/B/C Heidrun Åsgard Norne Oseberg Feltsenter (+) Oseberg Sør Oseberg Øst (3)	Troll C Kvitebjørn Veslefrikk Huldra Sleipner Statfjord A/B/C
3 6 inst.	Troll A Grane Heimdal Volve Oseberg C Njord	

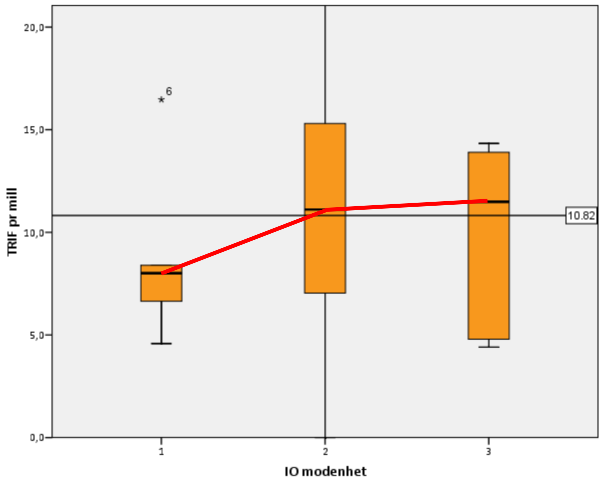
IO compliance assessment

- SINTEF and SH assessment gives similar results
  - Different placements of *Snorre A/B* and *Huldra*
- Analytically score 5 and 6 and level 1 seem to be most robust, overlaps are larger for the other categories
- Distribution of size of installations argument for placing using SH assessment

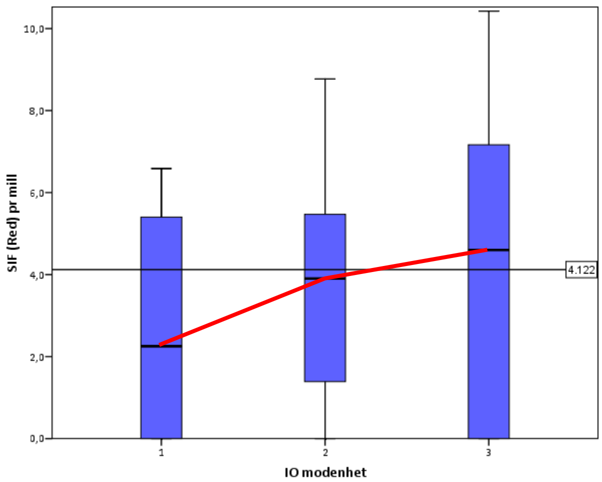
SH assessment gives the following distribution of size:

IO compliance	Mean Work Hours	N	Std. Dev
High	481 206	6	299 359
Medium	577 258	19	335 521
Low	409 199	6	66 034

- We proceed with **SH three-level assessment,** holding level 1 (high compliance) as **positive deviance**



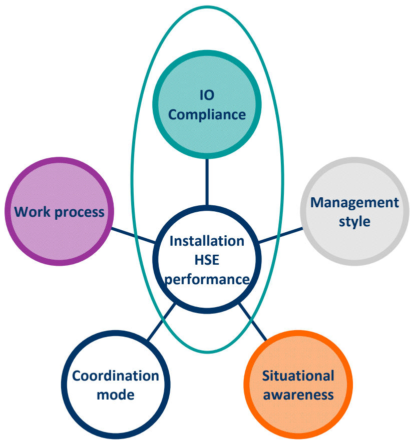
Level 1 installations have fever TRIFs than the other groups
TRIF (Total Reported Incidents Frequency) pr mill hours. Mean and distribution.
Mean for all installations 10.82 (N=31)



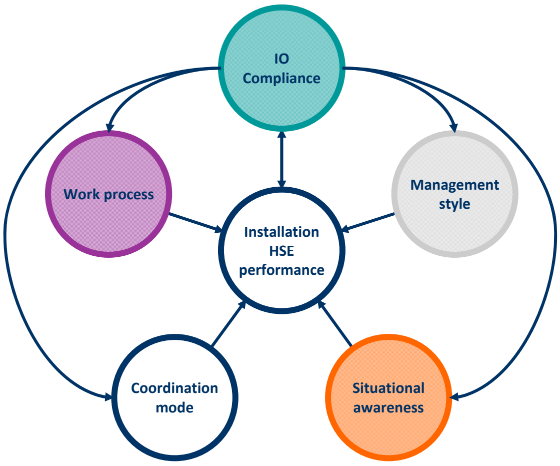
Level 1 installations have fever SIFs than the other groups
SIF (Serious Incidents Frequency) pr mill hours. Mean and distribution.
Mean for all installations 4.12 (N=31)

What can explain this?

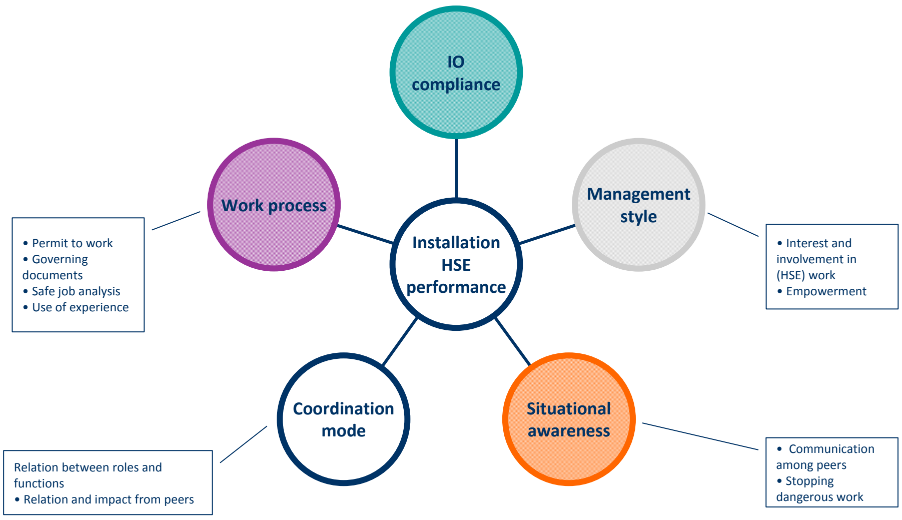
Variables 1.0 – IO and HSE performance



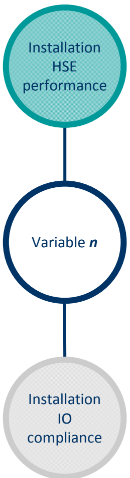
Model for IO and HSE performance



Variables 2.0 – operationalized with RNNP



Methods



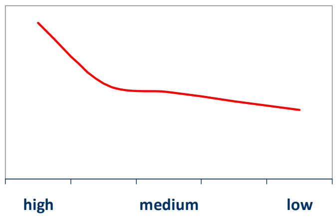
- Positive deviance in
  - IO compliance
  - HSE performance
- Relation with variables
  - Work process
  - Management style
  - Coordination mode
  - Situational awareness
- Analysis/test-metrics
  - ANOVA (df=1719-1721)
  - Measurement levels hinder some statistical methods

Methods II: Positive Deviance in HSE performance and safety culture

- Non-linear relation between safety culture reports and HSE performance
- Recurring pattern where the best fifth reports better safety culture, whereas the other four-fifths are more similar

Might indicate the following:

1. That the best fifth represent a **best practice**
2. That there is a baseline in safety culture where work practices are **robust**



- Example on relation between HSE performance (horizontal) and Safety culture questions (vertical)

Work process

- Permit to work
- Governing documents
- Safe job analysis
- Use of experience
- ....

Reported changes in work processes

IO	HSE	Work process
	✓	Risikofylte arbeidsoperasjoner blir alltid nøye gjennomgått før de påbegynnes
✓	✓	Systemet med arbeidstillatelser (AT) blir alltid etterlevd
	✓	Informasjon om uønskede hendelser blir effektivt benyttet for å hindre gjentakelser
✓	✓	Jeg har enkel tilgang til prosedyrer og instrukser som gjelder mitt arbeid
	✓	Jeg har god kjennskap til HMS-prosedyrer
✓		Jeg synes det er lett å finne fram i styrende dokumenter (krav og prosedyrer)
	✓	HMS-prosedyrene er dekkende for mine arbeidsoppgaver

Green (Red) means that installations with **high degree of IO compliance/better HSE performance** score signfikant (p<0,05) better (worse) than the control group

Changes in Work Process – Discussion

IO

Positive deviance:

- Formal work processes (AT) are improved
- Governing Documents are more available

Thus:

- Work processes are utilizing formal knowledge more extensively
- Effect on work that has HSE-elements

But:

- IO not used to improve learning
- No changes in effect on the HSE-work itself (such as “HSE-procedures”)

HSE

- Better work processes over all
- Positive deviance on all items except governing documents
  - Better general risk assessment/communication
  - Better application of permit to work (AT) system
  - Learning from incidents
- Availability of *important* HSE procedures are central in individuals’ work processes

But:

- “Availability of governing documents” not related to positive HSE deviance

Example: Improving Permit to work system (AT)

- AT requests and <u>approval</u> are a offshore responsibility (OIM, supervisors, safety delegate, involved personnel)
- But different practices in how far planning for AT can be taken in onshore planning/preparation

Small changes at some installations, larger at some. Observations:

- Work packages might include a prepared AT, but…
  - ”…local handling ate the installation. Area supervisor are responsible. OIM approves. Local decision and approval. Onshore are not involved in AT”
  - ”Work packages should be made onshore – where ATs are prepared and a part of the packages. But final approval must be done on the installation”
  - ”AT 1 and 2 are unchanged. They are written offshore, and approved there”
- Shared workspaces and meetings are used to bring attention to activities and accompanying ATs
  - ”[On activities] … look at which disciplines are involved. Look at what risks are involved in the activity. Increases ownership to the activity, and spreads out the HSE-assessment [among the different roles]. When an AT is requested, it is not only the OIM who has considered the risks, the whole team has done so”

Coordination mode

- Relation between roles and functions
- Relation to and impact from peers
- Interoperability
- …

Reported changes in coordination mode

IO	HSE	Coordination mode
✓	✓	Jeg vet alltid hvem i organisasjonen jeg skal rapportere til
		Gir IT-systemene du bruker nødvendig støtte i utførelsen av dine arbeidsoppgaver?
✓	✓	Økt samarbeid mellom innretning og land gjennom bruk av IT-systemer har ført til mindre sikre operasjoner
	✓	Ofte pågår det parallelle arbeidsoperasjoner som fører til farlige situasjoner

Green (Red) means that installations with **high degree of IO compliance/better HSE performance** score signfikant (p<0,05) better (worse) than the control group

Coordination mode – Discussion

IO

Positive deviance:

- Clarity of reporting and responsibility
- No threat from collaboration with onshore support

Positive stability:

- Parallel work processes are **not** seen as more of a HSE-challenge

Thus:

- Supports that organizational visibility is improved with IO
  - Use of shared work spaces
  - Meetings

HSE

Positive deviance:

- Clarity of reporting and responsibility
- No threat from collaboration with onshore support

And

- Parallel work processes are handled better than average

Thus:

- Supports that organizational visibility is central to excellent HSE performance

Management styles

- Interest and involvement in (HSE) work
- Empowerment
- ...

Reported changes in management style

IO	HSE	Mangement style
	✓	Jeg kan påvirke HMS-forholdene på min arbeidsplass
		Jeg diskuterer helst ikke HMS-forhold med min nærmeste leder
	✓	Min leder er engasjert i HMS-arbeidet på installasjonen
	✓	Min leder setter pris på at jeg påpeker forhold som har betydning for HMS
		Blir dine arbeidsresultater verdsatt av din nærmeste leder?
	✓	Om du trenger det, kan du få støtte og hjelp i ditt arbeid fra din nærmeste leder?
		Får du tilbakemeldinger på hvordan du har utført jobben fra din nærmeste leder?

Green (Red) means that installations with **high degree of IO compliance/better HSE performance** score signfikant ($p<0,05$) better (worse) than the control group

Discussion

IO

No reported changes in management style

and

Not more empowered

- Managerial practices are robust, or…
  - High turnover on offshore managers, 2 years on a installation is not uncommon
  - Culture of single installations influence in little degree individual managerial practice
- Management styles varies according to installations' operation model (Brage – Kristin)

HSE

Positive deviance in degree of

- Support from ...
- Interest in work ..
- Positive reinforcement
- Percieved sway over tasks

In management/employee relations

These are key elements in positive HSE deviance

Situational awareness

- Communication among peers
- Stopping dangerous work
- …

Reported changes in situational awareness

IO	HSE	Situational awareness
✗		Kommunikasjonen mellom meg og kolleger svikter ofte på en slik måte at farlige situasjoner kan oppstå
		Jeg opplever gruppepress som går utover HMS-vurderinger
	✓	Jeg ber mine kolleger stanse arbeid som jeg mener blir utført på en risikabel måte
		Mine kolleger stopper meg dersom jeg arbeider på en usikker måte

Green (Red) means that installations with **high degree of IO compliance/better HSE performance** score signfikant (p<0,05) better (worse) than the control group

Discussion

IO

Changes in situational awareness

- Increased communication, meetings, coordination means increased miscommunication
- Higher degree of complexity

But also …

- basic elements in (communities of) work practices are unchanged

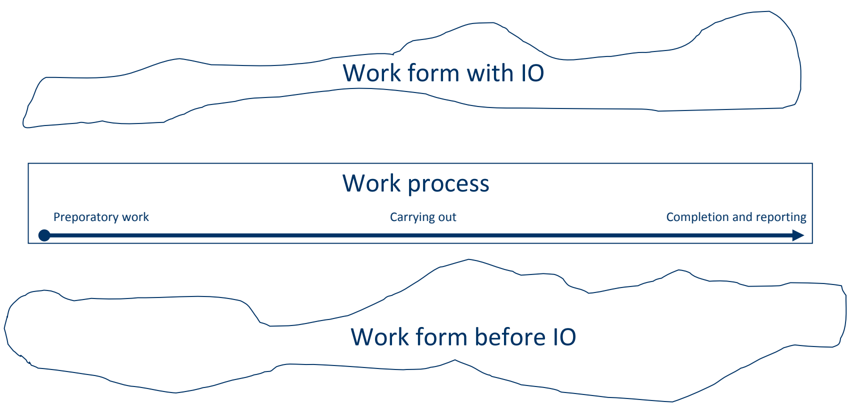
HSE

- Basic elements in (communities of) work practices are unchanged
- Stopping work is improved

Thus:

- Acceptance in crew for stopping work is important and should be fostered

Changes in work processes



Summary: IO compliance

HSE performance in IO compliant installations improved by

- Improved (formal) work processes
- Clearer roles and responsibilities

But:

- Management styles not changed
  - Might differ between IO compliant installations
- No improvement in Situational Awareness related to HSE

Summary: HSE high performers

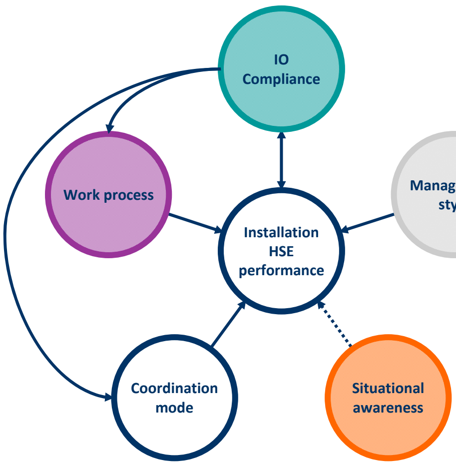
Positive deviance in

- Formal work processes
- Coordination mode that lends itself to high visibility
  - Handles parallel processes well
  - Clarity of roles and responsibility
- Managerial practices
  - Hands-on
  - Gives room for personal initiative

Some improvements in

- Situational awareness

Summary – IO and HSE performance



02 September 2009

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TITLE

Effects of Integrated Operations on Offshore Installations' Health and Safety Performance

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StatoilHydro ASA

REPORT NO.	CLASSIFICATION	CLIENTS REF.	
SINTEF A12025	Unrestricted	Arne Jarl Ringstad	
CLASS. THIS PAGE	ISBN	PROJECT NO.	NO. OF PAGES/APPENDICES
Unrestricted	978-82-14-04826-1	505558	21
ELECTRONIC FILE CODE		PROJECT MANAGER (NAME, SIGN.)	CHECKED BY (NAME, SIGN.)
U:\prosjekt\6055-Teknologiledelse\505558 HMS IO - Statoil\Rapport\SINTEF A12025 IO and HSE report.doc		Gunnar Lamvik	Johan Ravn
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	2009-06-16	Jan Ola Strandhagen, Research Director	

ABSTRACT

This report documents changes due to Integrated Operations (IO) on the HSE performance of all StatoilHydro production installations on the Norwegian Continental Shelf. The report is based on reported HSE indicators for all installations in 2008 combined with survey responses from RNNP and an assessment of the IO compliance of the installations.

In the report, two important findings are reported and analysed.

First, that the HSE performance the six installations that were using IO most extensively is better than on other installations. Second, that work practices at the installations are robust, and handles organizational change such as represented by IO well.

In the analysis to explain the findings, the report addresses four areas that are to be improved according to other studies and presentations of IO: Work process, Situational awareness, Coordination mode and Management styles.

Analysing the areas, it is shown that improvements in HSE performance on IO compliant installation are due to improvements in work processes and in modes of coordination. Theoretical arguments for improvements in shared situational awareness or managerial practices are not substantiated.

KEYWORDS	ENGLISH	NORWEGIAN
GROUP 1	HSE	HMS
GROUP 2	Offshore	Offshore
SELECTED BY AUTHOR	Integrated operations	Integrerte operasjoner

1 Executive Summary: Effects of Integrated Operations on Offshore Installations' Health and Safety Performance

Improved HSE is an important motivation for StatoilHydro's efforts to implement Integrated Operations (IO). It is assumed that IO will improve decision making, and that this in turn will lead to improved control and regularity, and to fewer deviances and unwanted incidents.

Although IO's effect on HSE has been the subject of a number of theoretical papers and dissertations, it has been difficult to investigate the relationship empirically. This is partly due to the fact that IO and HSE are global concepts without very precise definitions. In addition, IO is a relatively recent phenomenon and many of the most common HSE parameters react slowly to the changes introduced by IO.

The present study takes an overall approach to the IO and HSE, and is the first statistically based examination on the relationship between IO and HSE performance. The study was performed in three steps:

1. All StatoilHydro's EPN installations were rated with regard to the extent each installation has implemented IO. The rating is based on an expert judgment by StatoilHydro personnel with a detailed knowledge of operational IO. The expert judgement was later confirmed by comparing the IO implementation on each installation with formal checkpoints. The installations were sorted into three levels of IO implementation.

2. For each installation TRIF (total recordable incident frequency) and SIF (serious incident frequency) were calculated (2008 data to project start up). In addition, survey data from Risk level in the Norwegian Petroleum Industry (RNNP 2007) were analysed to obtain a picture of how various HSE-related factors are perceived by employees on the different installations.

3. The TRIF, SIF and RNNP data were compared for the three levels of IO implementation.

Results can be summed up thus:

1. The HSE performance of the six installations that were using IO most extensively was better than on other installations. This is the case both for the TRIF and SIF parameters.

2. Employees' perception of HSE-related factors are more positive on the six installations that were using IO most extensively, especially related to work processes and related to how work is coordinated. This indicates a higher level of satisfaction both with HSE management and personal control on the installations with high level of IO implementation.

This first empirical study of the relationship between IO and HSE thus suggest that IO has a positive impact on HSE performance and on employees' perception of HSE-related factors. Although the findings need to be replicated by future studies, the present study points to certain elements in IO that support excellent HSE practices and thus supports StatoilHydro's effort to use IO as a tool to improve HSE. It is, furthermore, an important finding with regards to the implementation of a common operational model for EPN, as this model to a large extent is based on IO principles.

SINTEF

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Figures and Tables

2 Point of Departure

For some years now, there has been a great deal of focus on Integrated Operations (IO or 'i-field/e-field/smartfield') in the Oil & Gas industry on the Norwegian Continental Shelf. A fundamental premise underlying the industry's focus on integrated operations is that IO will improve decision making. Improved decisions should in turn lead to safer and more efficient operations. IO characteristics that are associated with better decision making include: Increased use of real time data, more multidisciplinary teamwork, more work performed independent of physical location, and more work performed in a parallel as opposed to a serial work modes [1, 2].

IO introduces potential threats to high quality decision making as well. These threats include: A sceptical workforce resisting change, group based and distributed decision making that blurs lines of command, information overload, reduced understanding of local (i.e. installation specific) factors as decision makers are removed from the drilling and production facilities, and heightened complexity and interactivity that can make it difficult for decision makers to maintain overview during an incident.

There is, however, a lack of empirical documentation and verification of the changes introduced by Integrated Operation. The analysis presented here aims to analyse and document such changes. The analytical framework used here is based on elements identified in the literature, and in earlier and parallel projects related to Integrated Operations and its impact on operational practices in the Oil & Gas industry [3, 4]. In these projects, the goals of IO are different, spanning from keeping production going in installations' late-life to design choices made in engineering and procurement phases of new installations. This report, however, will address to what degree IO has an effect on HSE performance. This report is based on the first *empirical* study of the relationship between IO and HSE performance.

The different motivation for IO notwithstanding, from our experience, several important changes are similar for all installations that are actively using IO solutions. First, the ways that work is conducted is changed, with more focus on planning and reporting, often in conjunction with onshore support. Actual work execution is little changed, although precision and coordination is improved. Second, decision-making is changed, especially due to the fact that onshore support is more available for and involved with the offshore organization. Accordingly, the degree of transparency is improved in the operations. One recurring example is that the status of outstanding prioritized actions is known by more actors (e.g. operator, management and system specialist) thus increasing the drive to close such actions. Third, management and supervisor' roles are changed, in that some supervisors are moved onshore and are more involved in planning and strategy tasks, and thus being less hands-on with daily operations. Also, with increased physical and organizational visibility, managerial practices can be challenged in new ways from operators and specialists.

In the industry's work with IO, several new organizational concepts have been introduced to describe the organizational developments. First, *shared situational awareness* points to the extra information and knowledge shared and processed in operation rooms and to the communication in the open office layouts both onshore and offshore. (This concept is actively used in Computer Supported Cooperative Work (CSCW) studies.) Second, the concept *self-synchronization* is introduced. This theoretical concept address a new way of distributing tasks and problem solving. Deviating from a more traditional hierarchical coordination, in self-synchronization, distribution of tasks is made to a larger degree between peers. This is achieved by the means of all members having peripheral views of priority tasks and resources. Last, inspired by modern strategizing, installations argue that concepts are connected to their strategic capabilities [5-7].

These elements are correlated. Analytically, however, it is possible to identify four underlying, but distinct elements, which are shared by all installations that are using integrated operations. These are:

- Improved work processes, due to changed work forms, improved planning, etc.
- Changes in management style, due to changes in decision-making and increased transparency
- Increased situational awareness, due to collaboration arenas and improved peer-to-peer relations
- Changes to how work is coordinated, as exemplified in self-synchronization

These elements will be operationalized in the following analysis.

The degree of integrated operations varies between installations, some installation were designed with fully integrated solutions, some have introduced parts of it, and some are only now starting with the process towards IO. This dimension represents an analytical variable in the material. Thus, we need to assess to which extent the different installation has introduced IO, i.e. to what degree they are IO compliant. HSE performance in this report refers to reported critical incidents for the installation. IO compliance and HSE performance are found and reported on the installation level.

Following this, the research question in this part of the project has been: In what way do integrated operations' practices have an impact on the HSE performance of offshore installations, if any? As a basic assumption we will maintain that effects of IO will be found through changes in the four elements mentioned. This is outlined in Figure 2.1.

With such a set of information on installation level, several challenges arise. First, in the industry IO is expected to lead to better HSE performance. IO represents the best operational practice among installations on NCS according to OLF. Accordingly, the deviance that is to be analyzed in this report is a *positive deviance* [8, 9]. Of interest when presented with such organizations is the elements behind such deviance"…especially positive outcomes, processes, and attributes of organizations and their members" [8].

Leaning to other studies of technical work [10-13] and especially studies that focus on the character of *work practices* [14], we are interested in the nature of work practices at the installation. We are interested in the"…the **robust** working, learning, and innovating communities and practice of the workplace" [14]. Recent publications based on findings from the NCS point to robust work practices in a HSE setting. It is argued that the practices shown on the offshore installations are, in fact, robust, and this is directly linked to the excellent HSE results on the NCS [15].

To sum up, based on qualitative investigations of IO done by the research group and IO projects' self-presentation we argue for four distinct elements of change that IO brings about. These will influence the operations of the installation and by that also influence the HSE performance of the installation. This is shown in Figure 2.1.

Figure 2.1: Theoretical factors relevant for HSE performance of production facilities

3 Empirical Data and Methods

The dataset used for the analysis combines three elements.

First, the offshore survey RNNP (Risk level in the Norwegian Petroleum Industry). This is a survey conducted by the Norwegian Petroleum Safety Authority, sent to all offshore personnel [16]. The survey includes safety culture questions, traditional HSE questions, personal HSE evaluations as well as specific HSE questions relevant for installations at the NCS: Our data consists of responses from StatoilHydro employees' offshore (N=1817, n=1754 in most analyses). When looking at the number of worked hours on each installation we see that the response rate is somewhat lower on larger installation than on smaller installations. This difference in response rate is not, however, large enough to necessitate any further investigation. Last, installations with fewer than 15 respondents have been excluded.

Second, we are using StatoilHydro installation HSE data on Total Recordable Incident Frequency (TRIF) per million worked hours in the period January to October 2008. TRIF combines the number of lost time incidents and serious incident (category *red*). TRIF is the central HSE Key Performance Indicator for installation management, and is the indicator used when discussing HSE in license management comities. The dataset also includes Serious Incident Frequency (SIF), as well as dropped objects, LTI, and yellow incidents.

Third, we have two expert assessments of IO compliance for all installations.

The first assessment has been conducted internally by StatoilHydro and includes onshore and offshore aspects. It takes into account elements related to Integrated Operations as discussed in the introduction, both technical and organizational aspects.

Second, we have reviewed status reports from installations themselves on IO. These reports list actions taken, such as whether the installation has implemented Production Optimalization Groups (POG) activities, whether the installations have and are using collaboration rooms, whether work processes have been changed, as well as planned next-steps. Then a scoring was given on technical and organizational changes in four areas; management, operations, maintenance and drilling (where relevant). Improvements in both technical and organizational elements in all four areas would give a score of 8 (6 for operations where drilling is not a part of the installation's normal operations).

The results of the two rankings are essentially the same. There are minor differences in ranking for two installations, where our ranking would place one large installation in a "medium" category, whereas the SH ranking places this installation in the "high" category. After internal discussions and discussions with SH, this installation was placed in the "high" category. The arguments for this were two: First, that the self-assessment lacked somewhat on precision for this installation, second, that there is a need for balancing larger and smaller installations in all categories. On the other hand, the scoring into a nine-step scale exceeds the robustness of the information the scale is based on. This is also an argument for a reducing the number of categories to two or three.

Empirically, the most interesting categories are whether the degree of change, where there are some installations that represents a positive deviance (high IO level), some installations are starting to adapt (medium IO level) and some installations shows no change (low IO level). All this leads into using a three-step scale on the installations.

Thus, the combined assessments, and the need for robust categories resulted therefore in a three-way index of high – medium – low.

Of the 31 relevant SH installations, 6 installations were given status as "high" IO level cf. Table 3.1. These installations are using collaboration rooms extensively, rely on real-time data onshore, and has changed work forms for many functions in terms on how work is planned and how problems are solved.

Table 3.1 Classification IO level of SH installations

IO level	Installation	
High 6 installations	Troll B Brage Visund Snorre A/B Kristin	
Medium 19 installations	Gullfaks A/B/C Heidrun Åsgard Norne Oseberg Feltsenter (+) Oseberg Sør Oseberg Øst (3)	Troll C Kvitebjørn Veslefrikk Huldra Sleipner Statfjord A/B/C
Low 6 installations	Troll A Grane Heimdal Volve Oseberg C Njord	

As discussed above, this distribution installation also gives a good distribution of installations with different sizes.

Table 3.2 IO compliance and distribution of installation size

IO compliance	Mean Worked Hours	N	Std. Dev
High	481 206	6	299 359
Medium	577 258	19	335 521
Low	409 199	6	66 034

3.1.1 Positive Deviance in HSE performance and safety culture

We have looked at the distribution of safety culture items in the survey data from Risk level in the Norwegian Petroleum Industry (RNNP 2007). In the material there is a non-linear relation between safety culture items in the survey and HSE performance: That the best fifth of installations reports better safety culture on each item, whereas the remaining four-fifths are more similar. This is a persistent pattern for most safety culture items. The finding support the following: First, that the best fifth represent a positive deviance, more than just an incremental departure from business as usual. Second, that the only smaller differences between the other installations support the argument that work practices are robust, and therefore a baseline can be identified.

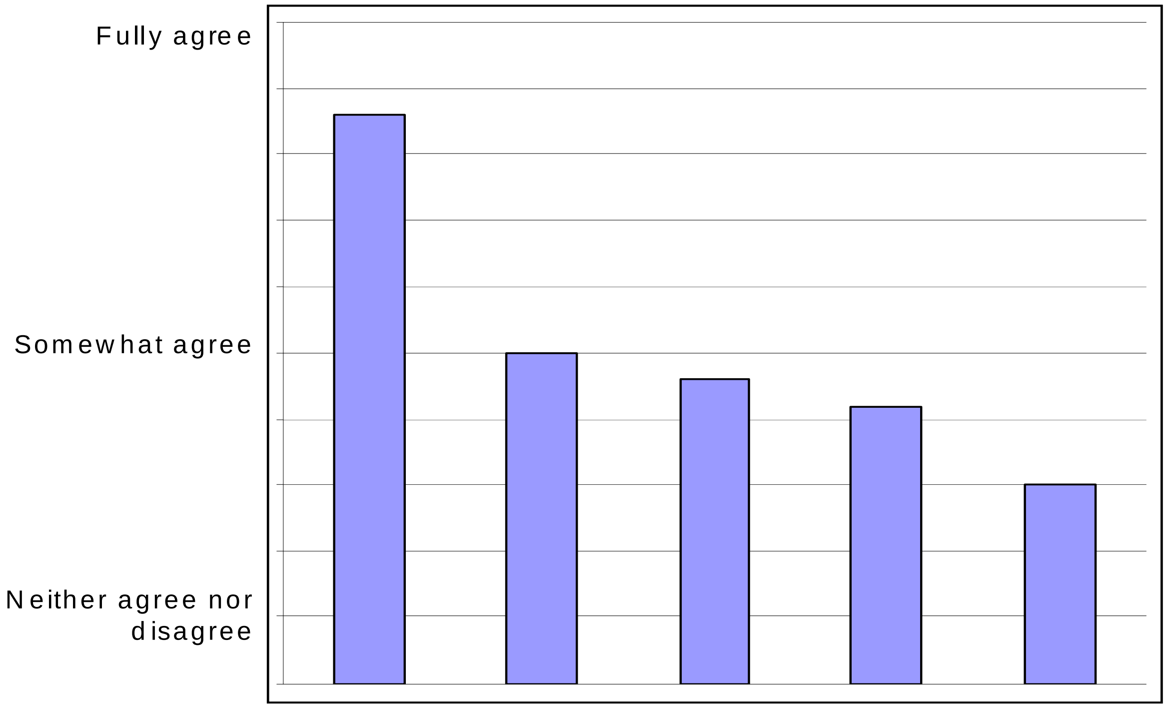

Figure 3.1: Illustration of positive deviance in safety culture. The best fifth score on average better than the other four-fifths, these are more similar

3.1.2 Statistical methods

It is important to note that measurement levels for HSE performance or IO compliance is on installation level, while reporting on the four elements (management style, etc.) is on an individual level. In addition, when grouping the sample according to HSE or IO this results in a set of independent samples. This calls for prudence in the statistical methods chosen for analysis.

As the material to be analyzed consist of one (or two) test variables, with several conditions and where subjects are different for each of the conditions, we will use one-way and two-way unrelated ANOVA as analytical tool. Where we have only *two* conditions testing *one* independent variable with different subjects, we use unrelated *t*-tests. These test-metrics are well-established and conservative.

We have chosen not to use inductive statistical methods to extract factors for the analysis. To explore the dataset, a factor analysis was conducted. This extracts two dominating factors from the safety culture items in the survey: One dimension on personal behaviour and one on management. Such dimensions are too general for our purposes.

All relevant items in the survey have a five-step Lickert scale response type (entirely agree to entirely disagree). Scales are flipped where necessary so that all positive responses go the same direction.

Test-statistics will be given for all test performed.

4 Findings and discussion

There are several indicators of the HSE performance for the installations, both lagging and leading indicators. We use the total reported incidents frequency (TRIF) per million work hours as it is the most used indicator within the company. Incidents counted for TRIF receive a lot of attention in the organization and at the installation. Also, TRIF as indicator has properties that make it stable enough for statistical purposes as the regular number of incidents for each installation is large enough to give relative stability over time.

Between the installations there is a mean TRIF of 10.82 in the reporting period (Jan-Nov 2008). Of this, the number of red incidents (SIF) was on average 4.12.

Installations that score high on IO compliance, however, score significantly *better* than other installations on both TRIF and on red incidents cf. Figure 3.1. In this result one outlier (installation 6) is included. If this outlier were excluded, the high IO compliance installations would score even better.

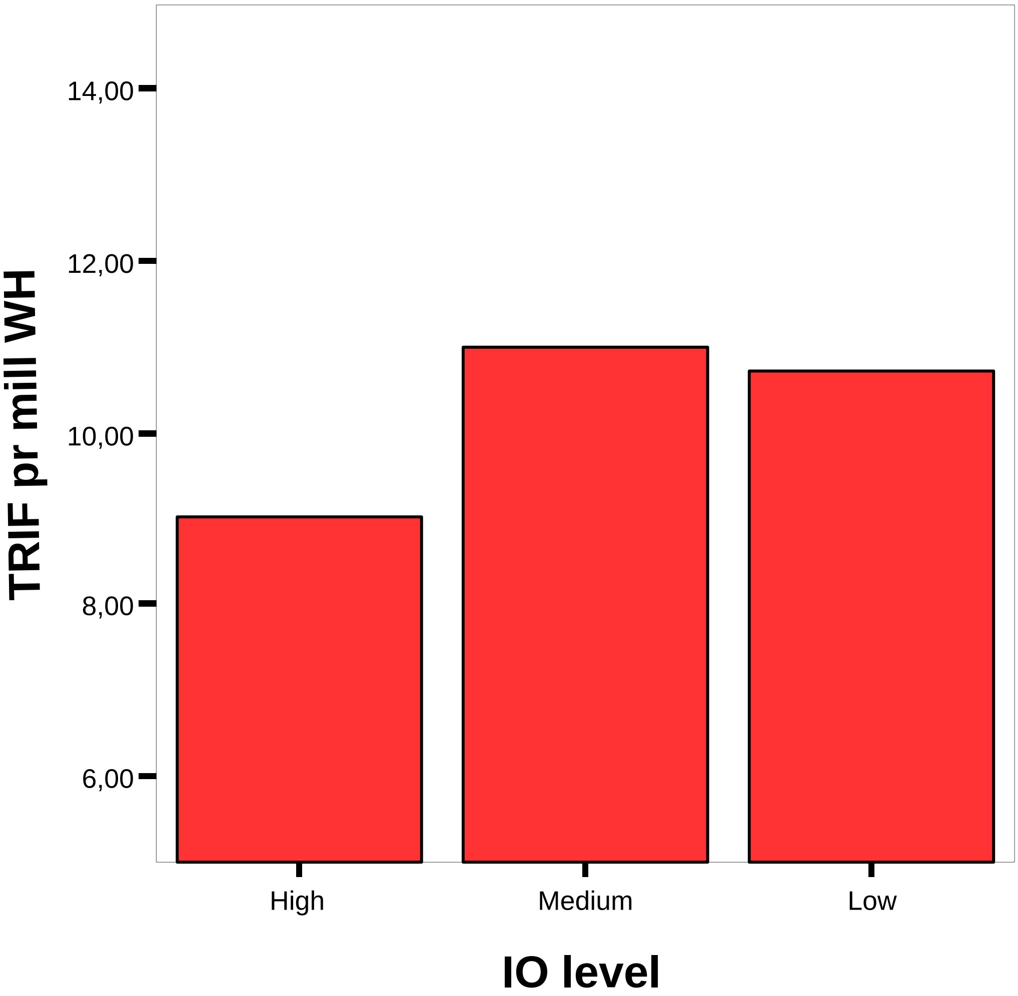

Figure 4.1: Mean TRIF (Total Recordable Incidents Frequency) per million worked hours by IO compliance level. Mean for all installations 10.82 (N=31)

As discussed when assessing IO compliance level, there are no significant structural factors that make these installations different from the rest, such as age, size, drilling or no-drilling, etc.

We will look into the elements that are or should be changed with Integrated Operations (cf. Figure 2.1) as discussed in the point of departure. We argue that changes in HSE performance induced by IO will be revealed or made visible through changes in the four elements. From other studies and the HSE literature, we know that some of these elements are correlated with HSE performance. Therefore we are interested in using installations that perform well in the field of HSE regardless of IO level as a contrast to installations with high IO level. The Figure 4.2 outlines the analytical model and relations argued for.

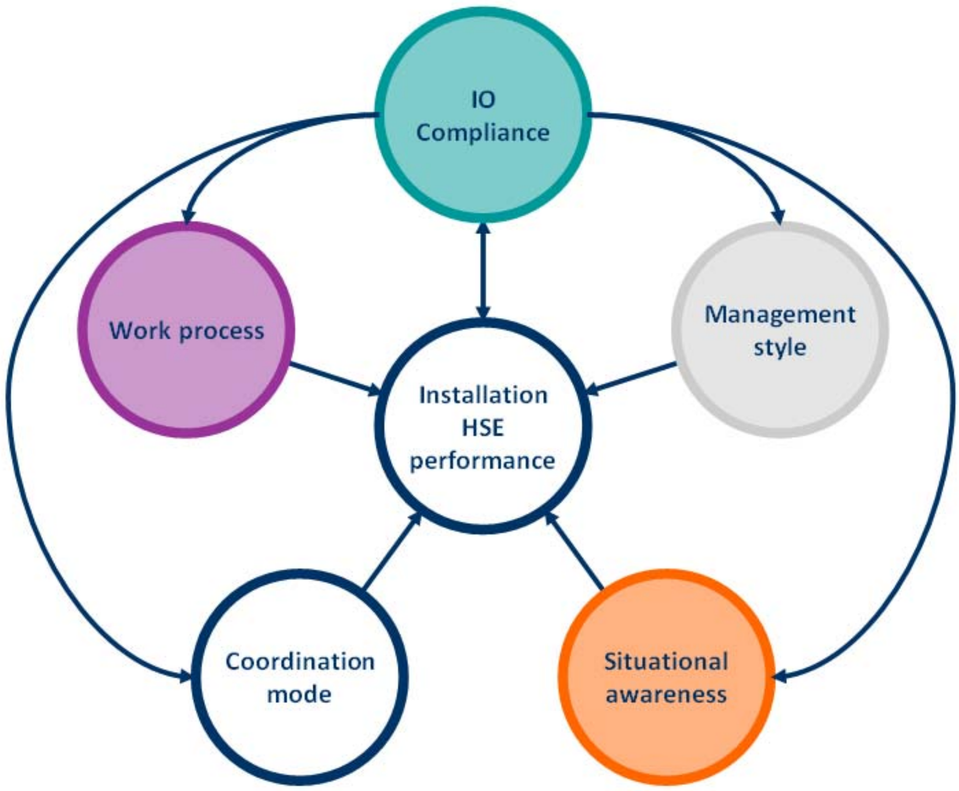

Figure 4.2: Analytical relations between Integrated Operation and HSE performance

4.1 Changes in Work Processes

Analytically it is possible and necessary to distinguish between formal work processes and actual work forms. Formal work processes represent a formal description of the ways work should be done and should represent the best practice for the process in the company. Examples of HSE critical work processes are the permit to work system (AT) and the Safe Job Analysis (SJA). In other studies we have shown that these processes are *formally* unchanged and unchallenged by Integrated Operations, but the work forms connected are in development [17].

In StatoilHydro formal work processes and corresponding governing documents are updated this year (2009) to merge governing documents from xStatoil and xHydro, and to greater extent allow for work forms that is possible with IO.

In the material, there are several items related to work process and work form. We have picked 7 items that represents this issue. These were picked analytically, in that the item represent or relate to our analytical categories.

The items chosen are found in Table 4.1 below.

Table 4.1 Deviance in items related to work processes and safety culture. Only significant deviance is indicated (p<0.05). Green indicate positive deviance, red indicate negative deviance

IO	HSE	Work process
	✓	Risk-filled operations are always carefully planned before they are begun
✓	✓	The work permit (WP) system is always adhered to
	✓	Information about undesirable incidents is used efficiently to prevent recurrences
✓	✓	I have easy access to procedures and instructions concerning my work
	✓	I am thoroughly familiar with the HSE procedures
✓		I think it is easy to find what I need in the governing documents (requirements and procedures)
	✓	The HSE procedures cover my work tasks

First of all, there are *no negative changes* in the items between the IO compliant installations and the rest. The same is – not surprisingly – the case for the installations that perform excellent on HSE.

Three items show positive deviance for the IO compliant installations. These are all related to availability of, access to, and adherence to formal work process, such as permit to work and governing documents. This support a notion that IO compliant installations have work practices that use formal knowledge better than the average installation and that HSE critical processes are improved.

On the other hand, the actual HSE related work such as planning high-risk operations and learning from incidents, are stable. No significant improvements can be found among the IO compliant installations.

Six out of seven items show positive deviance for the HSE high performing installations. There is an over-all improvement of work processes, and reported a relatively strict adherence to risk-assessment and risk-mitigating processes (such as the Work Permit system). On top of this, these installations are reporting a higher degree of learning from incidents.

When comparing IO compliant installations and HSE high performers, some interesting differentiating patters can be found. The IO compliant installations adhere to formal processes, and are stable on other items. The HSE high performers display improvements on the formal aspects, but findings indicate that HSE is a part of work practices in a higher degree than on other installations.

4.2 Coordination mode

The second area we are interested in is how work is coordinated at the installation/in the organization. We have looked for items that address relations between roles and functions, as well as relations between peers. These relations are supported with collaborations rooms between onshore and offshore, and with ICT solutions. Within the IO literature this is called degree of interoperability.

In the material we find four items relevant for the coordination mode. These are presented in Table 4.2.

Table 4.2 Deviance in items related to coordination mode and safety culture. Only significant deviance is indicated (p<0.05). Green indicate positive deviance, red indicate negative deviance

IO	HSE	Coordination mode
✓	✓	I always know who to report to in the organisation
		Do the IT systems you use provide the necessary support in the performance of your work tasks?
✓	✓	Increased cooperation between a facility and land through IT systems has lead to less safe operations
	✓	There are often concurrent work operations which lead to dangerous situations

Again, there are *no negative changes* in the items between the IO compliant installations and the rest.

There are no changes in the perception risks involved in concurrent work operations, which is interesting given the fact that IO can and should lead to a situation that more work is being done in parallel.

For two items the change is positive. First, there is less perceived threat from collaboration with onshore with ICT system. Second, there are reported improvements of clarity of reporting and responsibility.

In sum, these findings are very positive for the IO compliant installations. It supports arguments made by IO protagonist that organizational visibility and transparency is improved by use of shared work spaces and collaboration rooms. From qualitative studies we know that the important factor behind such results is the move towards deciding issues with all relevant actors present, thus avoiding hand-offs and serial decision-making processes. With hand-offs, the need to re-phrasing of issues arises, challenging consistency and transparency.

The pattern for HSE high performers is very similar to the pattern of IO compliant installation. Both items on clarity of reporting and onshore collaboration are similar. In addition, concurrent work operations are leading to fewer dangerous situations than on the average installations. These findings support that organizational visibility is an important aspect of excellent HSE performance.

4.3 Management style

The third area we are interested in is management style and the relationship between the employee and the manager. This is a type of a relationship that has been studied thoroughly, both in the management literature and in the labor relations literature. As indicated in the point of departure, we are, however, interested in managerial practices related to technical work. Following this we introduced robust communities of work practices as a central analytical concept. Such studies, cf. [15], points out that offshore installations have highly skilled personnel, employees that are used to solve problems independently. Such organizations lend itself to self-management and extensive team-work. The most recent example of an operating model where these elements are used extensively is Kristin, the first installation that was designed for IO. At Kristin, One Directed Team was used as operating model, with many steps taken towards achieving self-synchronization between functions offshore/onshore and a management style that is supportive and enabling.

Accordingly, the extent of perceived influence and control, as well as managerial support are all elements that both relate to the character of technical work and high-skilled environment, as well as relates to HSE results (as met in HSE lingo such as “walk the talk”).

In the material we find seven elements that related to the issues raised. These are presented in Table 4.3.

Table 4.3 Deviance in items related to management style and safety culture. Only significant deviance is indicated (p<0.05). Green indicate positive deviance, red indicate negative deviance

IO	HSE	Management style
	✓	I can influence HSE matters at my workplace
		I would rather not discuss HSE with my immediate supervisor
	✓	My supervisor is committed to the HSE work on the facility
	✓	My manager appreciates my pointing out matters of importance to HSE
		Does your immediate supervisor value your work results?
	✓	Does your immediate supervisor help and support you in your work, if you need it?
		Does your immediate supervisor give you feedback on your work performance?

As for the previous two areas, there are *no negative changes* in the items between the IO compliant installations and the rest.

At the same time, there are no positive changes for these installations. Personnel do not report changes in managerial practices and does not feel more empowered in the relation to management. This might indicate that managerial practices are robust, and that relatively recent changes such as IO has not trickled down to active behavior.

Also, there are high turnover on offshore managers, 2 years on an installation is not uncommon, more so for installations that are at the cutting edge. This might have as a consequence that the culture of single installations in small degree influence individual managerial practices.
Also, we know that the managerial styles vary according to installations' operation model, such as the differences between Brage and Kristin. But more importantly, at all IO installations, the presence of management is reduced. The hands-on foreman or supervisor is no longer to be found. Therefore, the managerial pressure is reduced and following-up from offshore-managers are changed from hands-on, practical guidance to more outlining scope of work, and priorities for single tasks [cf. 18]. Given this, no negative changes is in fact good.

For the HSE high performers the findings do not follow this pattern. Here we see positive deviance in four of seven items. At these, personnel report better support from management, more interest in work, more positive reinforcement, and more sway over tasks. This substantiates findings in the HSE literature and practices that hands-on management is of essence for attaining good HSE results cf. [19]. For these installations, the findings might reflect an operating model that is management intensive. Accordingly, incidents that related to orderliness and following norms are avoided.

4.4 Shared Situational Awareness

The last area to be addressed is Shared Situational Awareness. Shared Situational Awareness can be defined as the degree to which every team member possesses the Situational Awareness (SA) required for his or her responsibilities, or the Situational Awareness developed in the whole team to achieve its mission. Shared Situational Awareness is the overlap between team members, a subset of team SA or the degree to which team members possess the same SA or SA requirements.

In operations, Situational Awareness is supported in several ways. First, SA can be strengthened with the use of shared work areas, such as open office landscapes and collaboration rooms. Second, having shared goals and purpose is important for achieving a high degree of SA. This can be established in several ways, for example by involving both technical support and operators in early phases of planning or having personnel dedicated to larger projects. Through this the crew establishes a higher degree of knowledge about the artefacts, particularities, and history of the installation, and a higher degree of knowledge of the priorities of the installation. It promotes *know-what* – knowing other operators and technicians in the crew and the installation [cf. 13].

In the material, we have looked for items that relates to SA. Four items were found, and they are presented in Table 4.4.

Table 4.4 Deviance in items related to Situational awareness and safety culture. Only significant deviance is indicated ($p<0.05$). Green indicate positive deviance, red indicate negative deviance

IO	HSE	Situational awareness
✘		Communication between me and my colleagues often fail in a way that may lead to dangerous situations
		I feel a group pressure which affects HSE assessments
	✓	I ask my colleagues to stop work which I believe is performed in an unsafe manner
		My colleagues will stop me if I work unsafely

Three of four items show no change for installations with high IO compliance, which indicates stability. We find, however, the first item with a negative deviance, namely the question on communication. This might be explained in two ways:

The most obvious one is that IO should lead to more concurrent work practices and more coordination involving more roles. There will be increased communication and more meetings, coordination which means that the possibility for miscommunication increases. This is reflected in this finding.

The other possible explanation is that with increased organizational visibility, awareness of dangerous situations also increases. This interpretation is supported by qualitative findings, for example in that a larger part of the crew and more onshore relations are involved in critical incidents handling.

For the HSE high performers the pattern differs. No negative deviance is found, and there is one item showing positive deviance. This is the item on stopping work. This finding supports first that the general elements in (communities of) work practices are unchanged, i.e. that the elements for excellent HSE results can be found at all installations. The improvements that are found here are improvements in an already robust work practice, but improvements that are of great importance. So, when stopping work is improved, this shows a type of acceptance for safety and care for others that are a part of excellent HSE results.

5 Conclusions

This report has presented patterns of relations between Integrated Operations, HSE performance and a set of issues related to operations and safety culture on all StatoilHydro installations in 2008. The report is based on reported HSE indicators for all installations in 2008 (TRIF and SIF), combined with survey responses from RNNP and an assessment of the IO compliance of the installations.

Four issues have been in particular addressed, all directly relevant for IO, and for HSE practices. These factors were first, how work processes are handled, second, to what degree there were a shared situational awareness on the installation, third, which managerial practices can be found in the organization and finally, how is work coordinated between roles and functions.

The first finding is that HSE performance is better on installations that use IO extensively. I.e. on so-called IO compliant installations the TRIF and SIF figures are relatively low compared to installations that operate in another phase of the IO implementation process.

Second, most items show a large degree of stability, and does not vary a lot between installations with high IO level and other installations. This supports other analyses that point to the robust nature of technical work practices.

Third, the findings document that the better HSE performance of the high IO level installations are related to improved formal *work processes*, and to better *modes of coordination*. The latter is due to increased organizational visibility and clearer roles.

The findings do not support theoretical arguments on that IO leads to improvements in managerial practices on HSE, nor to improvement in situational awareness related to HSE.

We have seen that when using the same pattern of four areas to analyse HSE high performers, there is positive deviance in all four areas. Work processes are improved, coordination modes are improved and managerial practices are improved. Situational awareness is stable, with one item showing positive deviance.

In managerial practices, respondents report a more hands-on type of management and a management style that gives room for personal initiative in HSE matters. At the same time, this finding reflects a more traditional organization, where management has broader scope and more presence in operations. In leaner organizations, such presence is not a part of the operational model.

To conclude, the findings document that improved HSE on IO compliant installations are achieved through better coordination and better work processes. HSE performance as such is improved with these two areas, but also with more supportive managerial practices and to lesser extent with improved shared situational awareness. The findings are summed up in Figure 5.1.

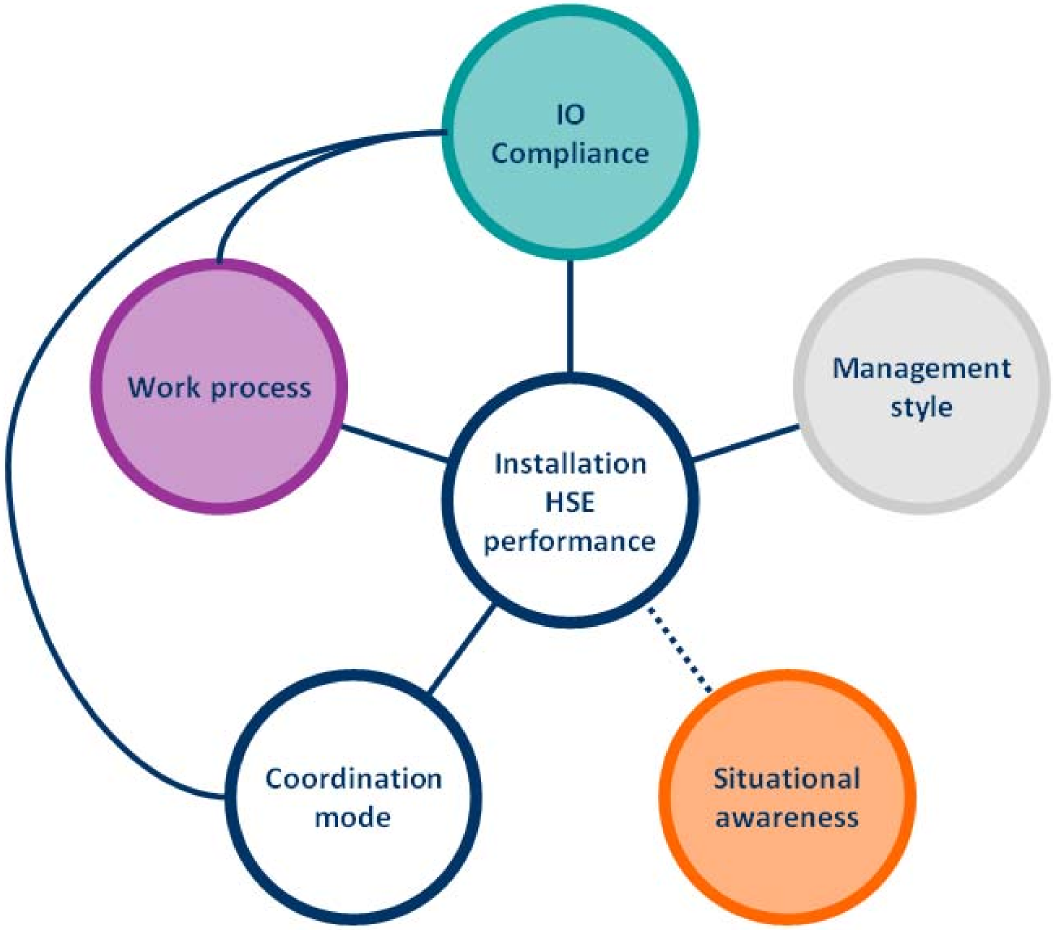

Figure 5.1: Documented relations between Integrated Operations and installation HSE performance

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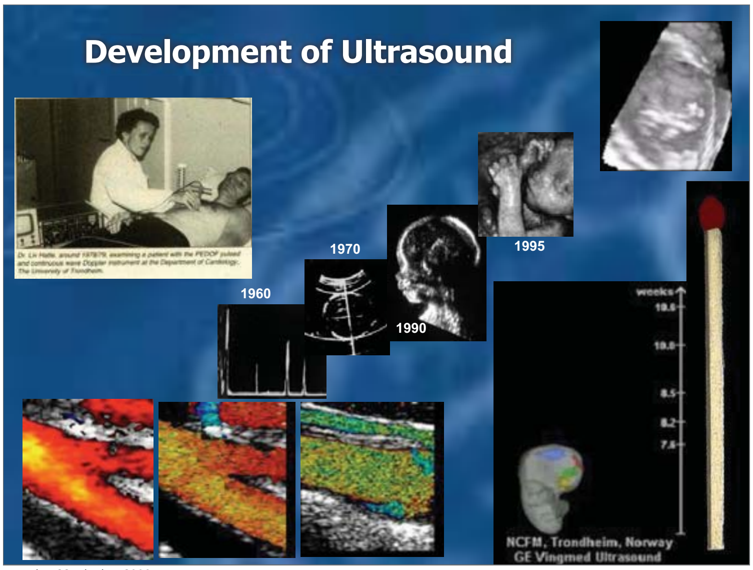

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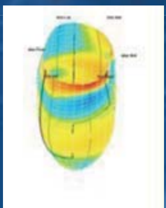
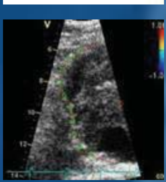
Modelling and measurement of biomechanical and structural information pre- , intra- and postoperatively



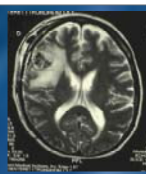


Courtesy Brekken

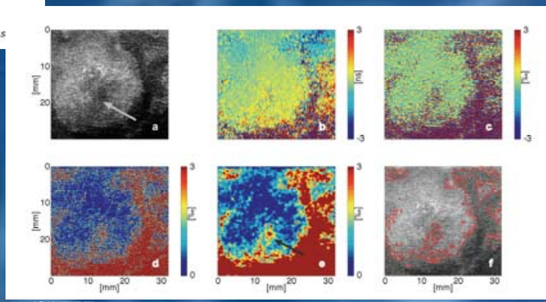
Strain in brain

http://www.ntnu.no/~stoylen/strainrate/

$$\varepsilon = \frac{L - L_0}{L_0} = \frac{\Delta L}{L_0}$$



Metastasis tumour



Courtesy: Tormod Selbekk (SINTEF)

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Development of ultrasound technology

Rel 20 oct 09

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Trondheim R&D Group
Medical Imaging and medical technology

- Internationally recognized research groups - ultrasound and MR
- National Centre of Competence 3D ultrasound in minimally invasive surgery (since 1995)
- National center for Fetal medicine - ultrasound (since 1995)
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- Operating Room of the Future (since 2005)
- SFI - MI Lab (since 2006)
- Simulator Centre
- Research School: Medical Imaging
- Close industrial collaboration
  - BIA - Mini Ultrasound - GE Vingmed
  - BIA - Future Image guidance - MISON
  - BIA - Ultrasound simulation - Laerdal Medical

More than 100 people are working with ultrasound related research in Trondheim

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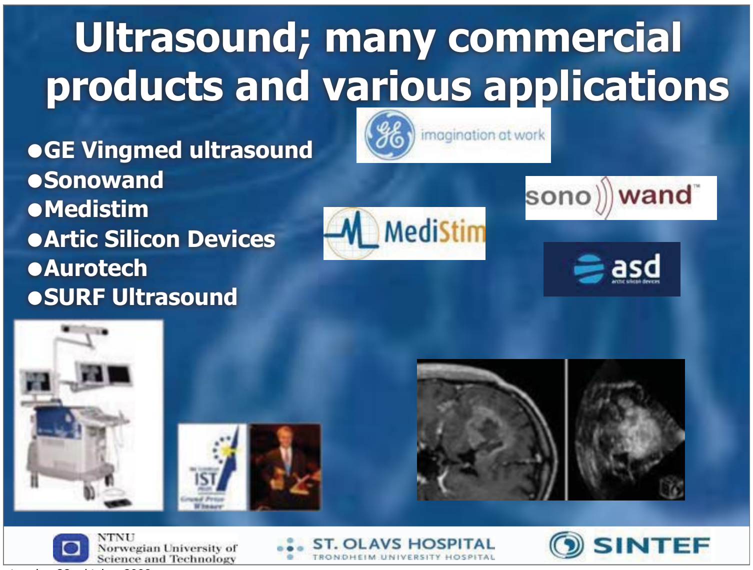

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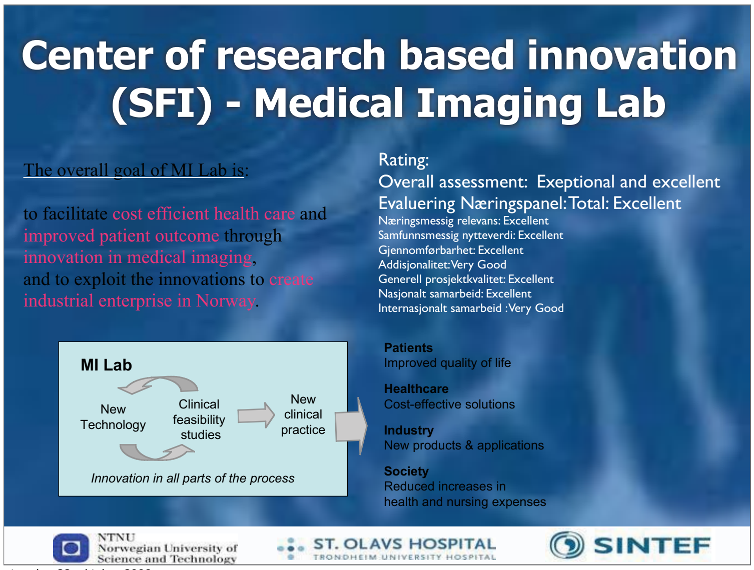

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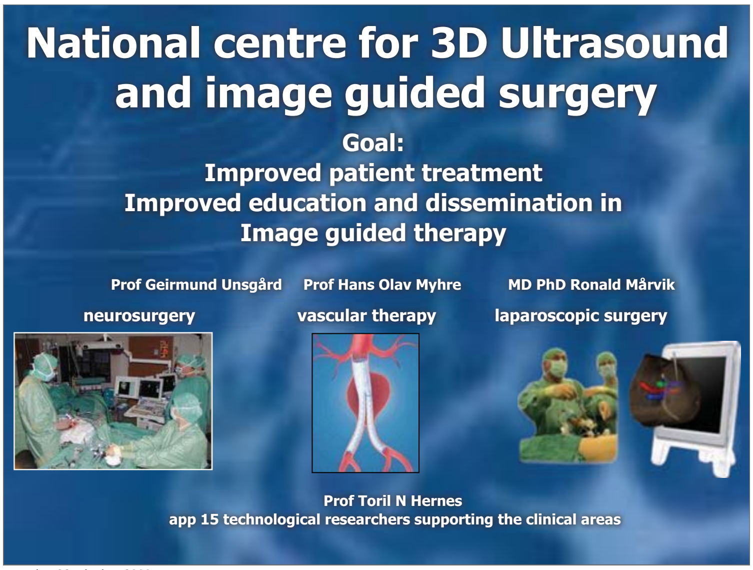

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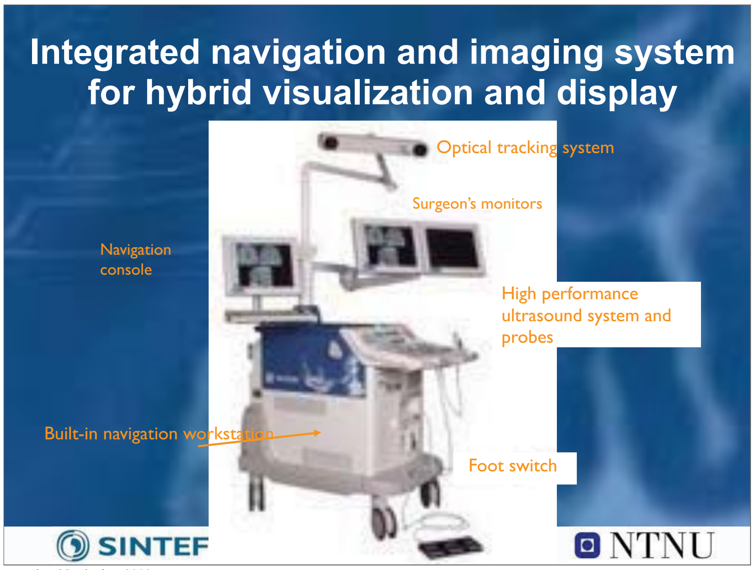

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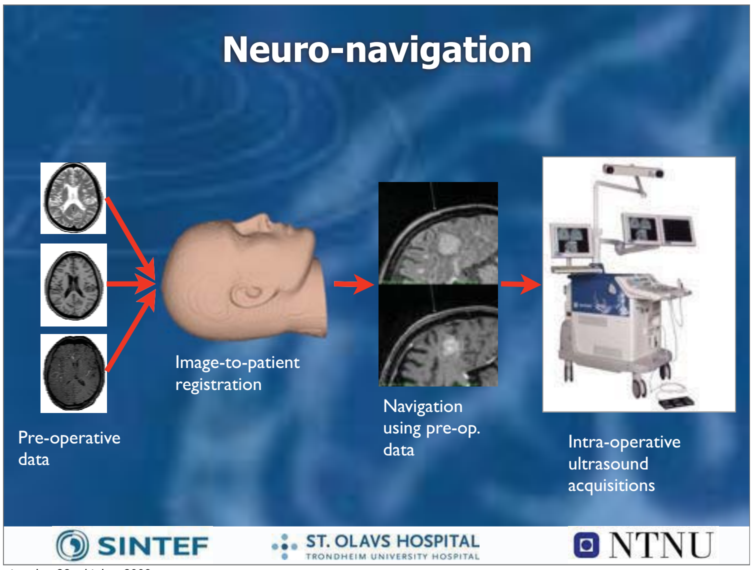

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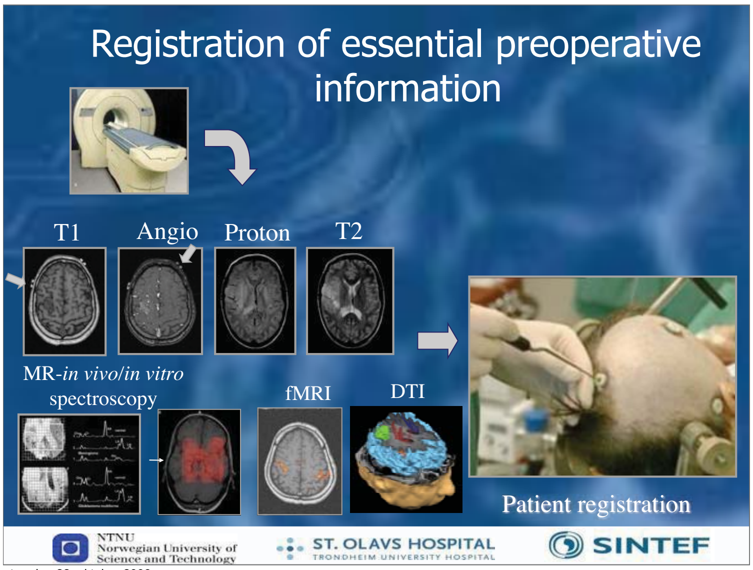

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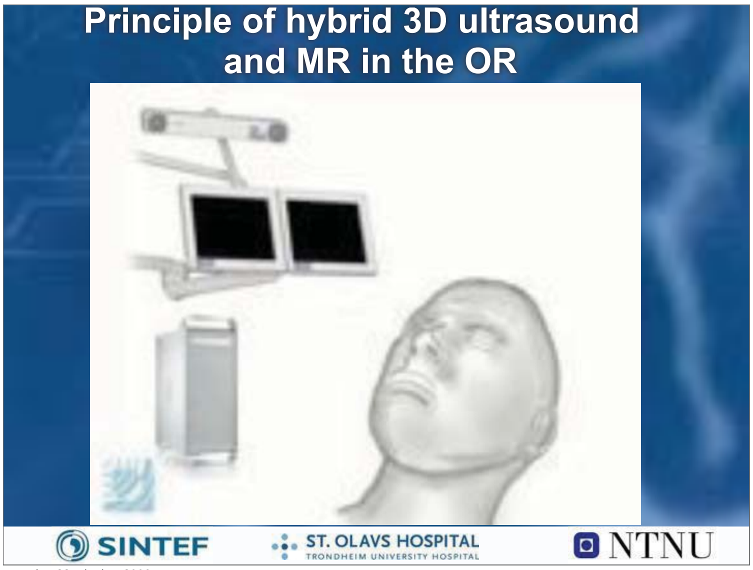

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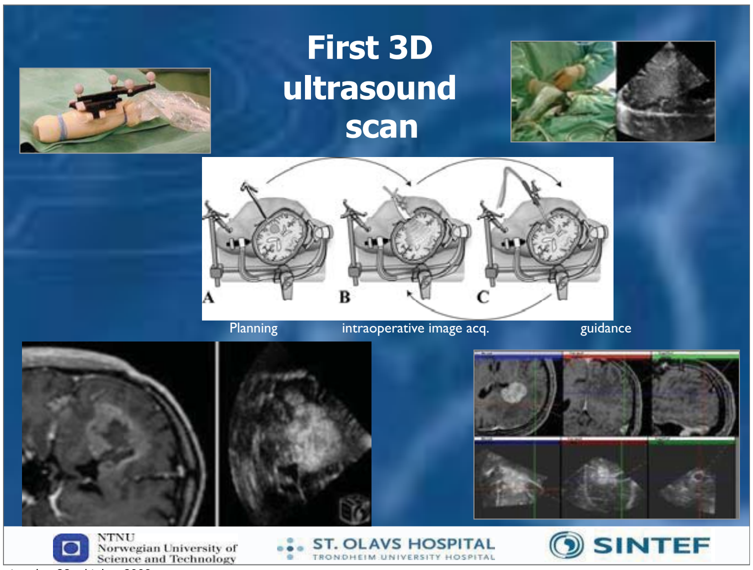

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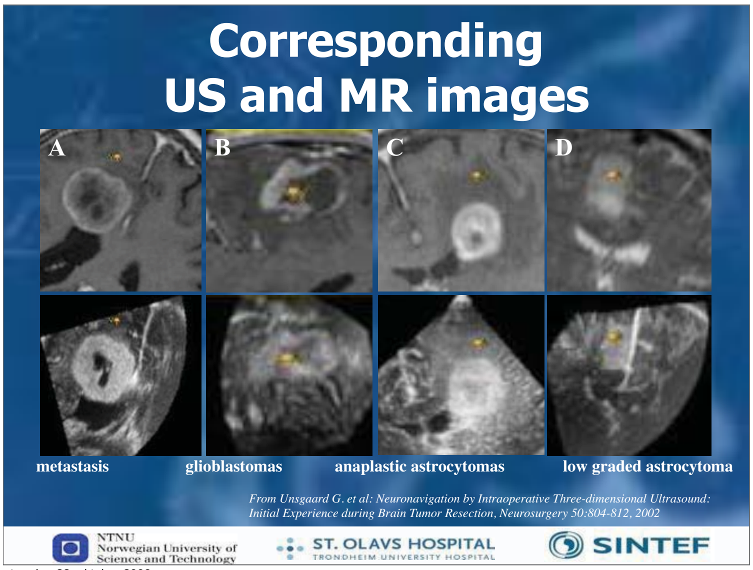

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Mismatch between MR and US

B-mode US on top of T1-weighted MR image

Inaccurate image-to-patient registration

Brain tissue displacement (*"brain shift"*)

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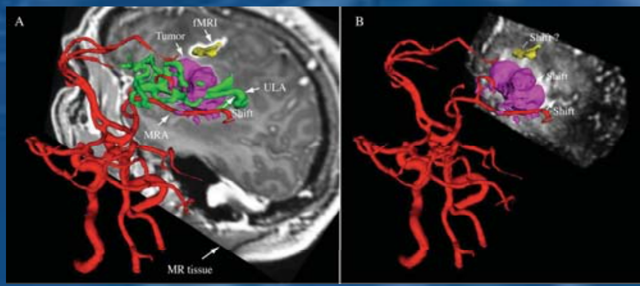
Multimodal and Multivolum visualization



Easy detection of brain shift

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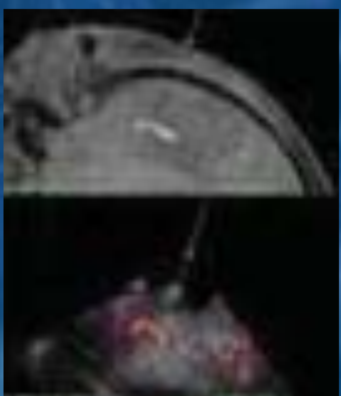
Correction of brain shift



MRA and Power Doppler ultrasound

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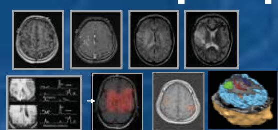
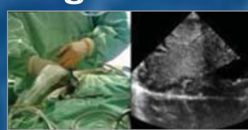
Optimal use of important preoperative images



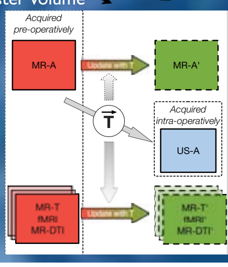
Preoperative MRI

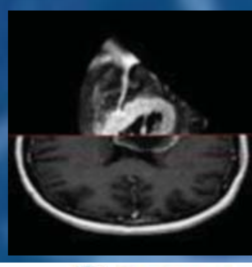


Intraoperative 3D Ultrasound imaging

Selection of master volume

Finding a registration transform makes it possible to update all preoperative volume data





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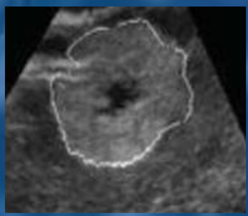
Shift correction - Tumor boundary

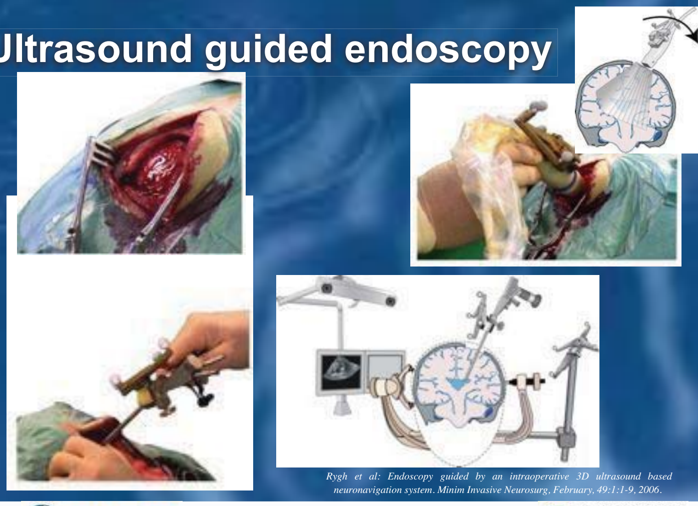
Before registration



After registration

Ingerid Reinertsen et al

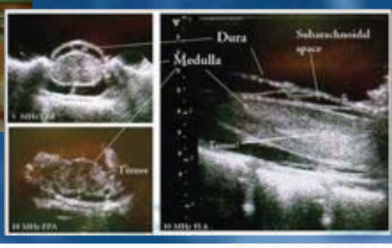
Ultrasound guided endoscopy



Rygh et al: Endoscopy guided by an intraoperative 3D ultrasound based neuronavigation system. Minim Invasive Neurosurg, February, 49:1:1-9, 2006.

3D ultrasound in in spinal surgery

Kolstad F, Rygh OM, Selbekk T, Unsgaard G, Nygaard OP Three-dimensional ultrasonography navigation in spinal cord tumor surgery. Technical note. J Neurosurg Spine. 2006



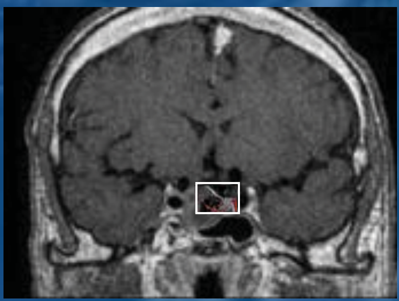
Soft tissue visualization enables identification of tumor tissue and 3D US-guided biopsy and resection

Intraspinal tumuors

Courtesy Selbekk, Solheim

Ultrasound in Pituitary surgery

localization of carotid artery and resection control



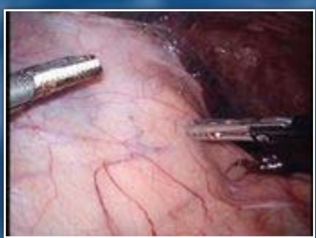
Courtesy Selbekk, Solheim

Ultrasound in pituitary surgery

Courtesy Selbekk, Solheim

Laparoscopic surgery

Ronald Mårvik/Brynjulf Ystgård/Thomas Langø/Toril Hernes et al



Limitations:

- unable to plapate
- unable to detect arteries and veins below surfaces of the organs

Consequences:

- slow resection to avoid unexpected bleedings
- vessel and abnormality definition is time consuming

Navigation during adrenalectomy

Langø, Mårvik et al

Multicenter study in collaboration with Mesos Medical Centre, Utrecht

MD, Clinical project leader: Maurits de Brauw, PhD, Christiaan van Swol, Surgeon, MD: Anke B Smits

Navigation during adrenalectomy

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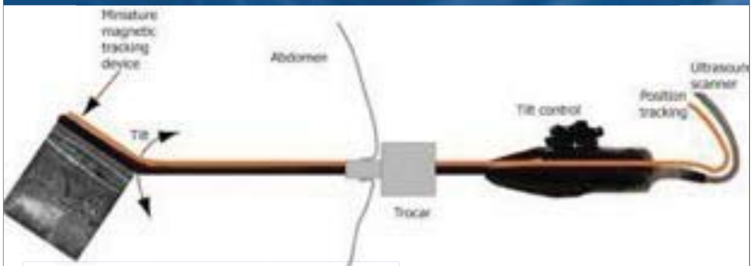
Laparoscopic ultrasound



Using miniature position tracker on tip

Only one calibration necessary

EU 6 - IP project: VECTOR ENDOSCOPIC CAPSULE


Her er teknopillen som skal
FINNE KREFT

VECTOR : Versatile Endoscopic Capsule for gastrointestinal TumOr Recognition and therapy

Start Sept 2006, Collaboration with MiNa Lab , budget of 10 mill Euro

Endovascular treatment of AAA

Faster recovery, Reduced risk of complications


Open AAA repair, 1 day after surgery


Min. inv. surg. 1 day after surgery

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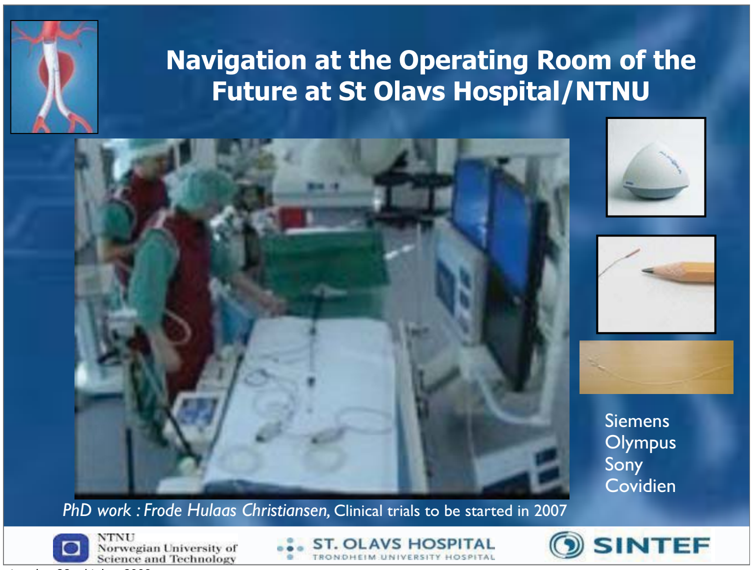
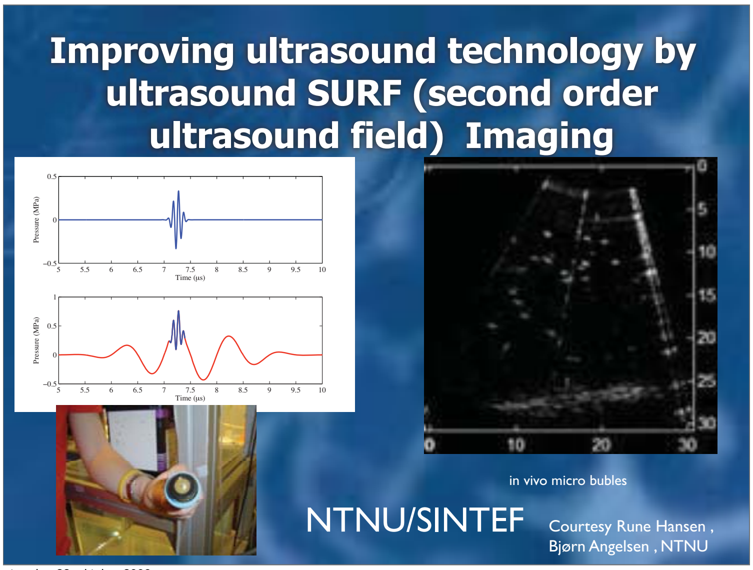


torsdag 22. oktober 2009



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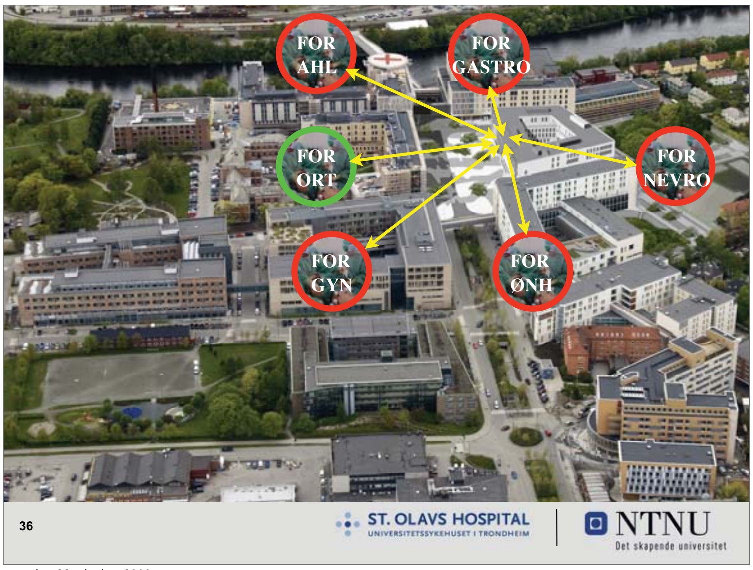

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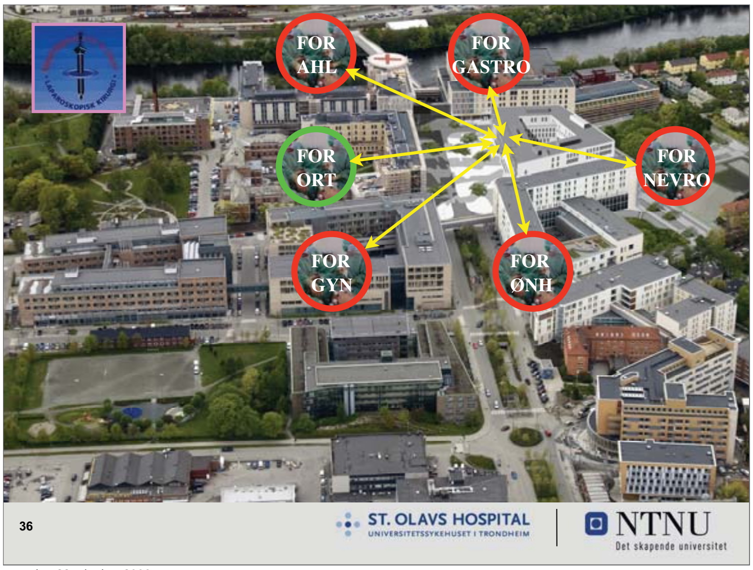

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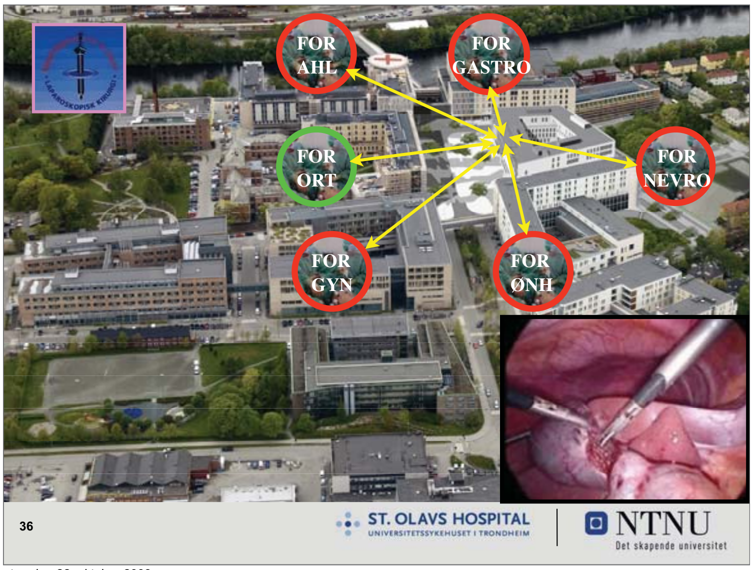

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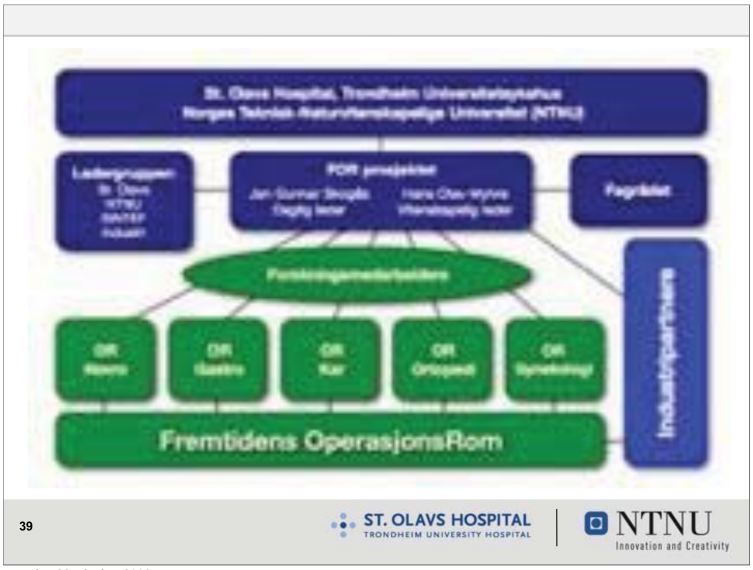

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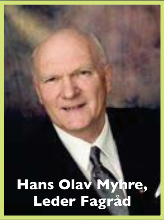
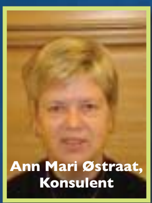
FOR-org, daglig drift



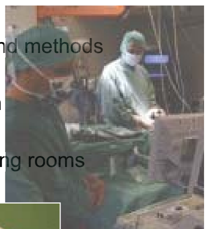


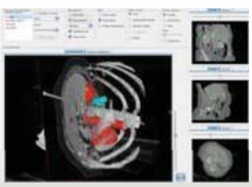
Scientific board, 2009-2012

- Professor, Hans Olav Myhre, leder
- Overlege, Conrad Lange
- Professor, Gudmund Marhaug
- Overlege, Jon Erik Grønbech
- Professor, Olav Haraldseth
- Professor, Toril N. Hernes
- Professor, Per Farup
- Overlege, Staal Hatlinghus
- Professor, Olav Sellevold
- Overlege, Arild Aamodt

Main areas of research and development 2009-2012

- Clinical testing of new medical technology and methods
- Minimal invasive image guided procedures
- Logistics, workflow and process optimization
- Communication
- Design, infrastructure and running of operating rooms
- User driven innovation





Partners and collaborators

NASJONALE:

- NTNU
- SINTEF
- HIST
- NSALK
- NSEP
- COSTT
- MIDGARD MEDIALAB
- HELSEAKADEMIET, HMN
- SIEMENS
- OLYMPUS
- SONY
- COVIDIEN
- Nasjonalt Senter For Telemedisin
- National Centre of 3D ultrasound in Surgery
- Intervensjonssenteret, Rikshospitalet
- AV-arena Norway
- Innovasjon Norge
- Research Council of Norway
- MedITNor
- OCTAGA
- HelseBygg
- KITH
- Network Electronics

INTERNASJONALE:

- Massachusetts General Hospital, Boston
- Technical University in Munich
- Yonsei University Health System, Seoul
- New York Medical Center
- Many university collaborations, application for EU funding etc

Operating Rooms of the Future
St. Olavs University Hospital

Tett samarbeid med :
Olympus, Siemens, Sony,
Covidien, Medistim, SINTEF

National Centers for 3D Ultrasound in surgery
Laparoscopy,Vascular surgery , Neurosurgery

NTNU Norwegian University of Science and Technology — ST. OLAVS HOSPITAL TRONDHEIM UNIVERSITY HOSPITAL — SINTEF

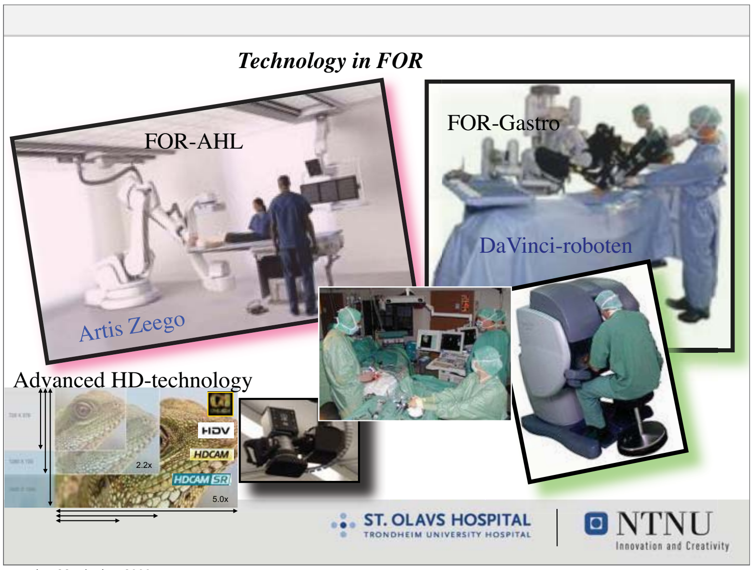
Operating Rooms of the Future
St. Olavs University Hospital

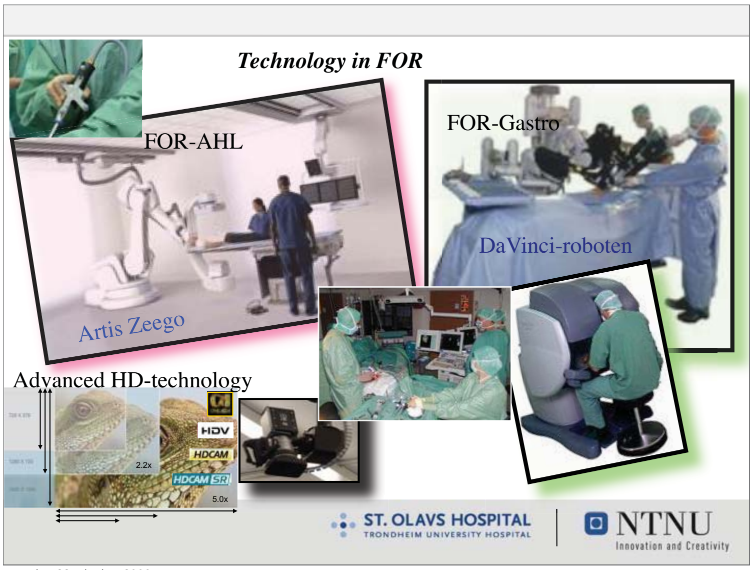
Goal:
- Improved minimally invasive treatment
- Efficient use of hospital resources
- Better education and training

Tett samarbeid med :
Olympus, Siemens, Sony,
Covidien, Medistim, SINTEF

National Centers for 3D Ultrasound in surgery
Laparoscopy,Vascular surgery , Neurosurgery

NTNU Norwegian University of Science and Technology — ST. OLAVS HOSPITAL TRONDHEIM UNIVERSITY HOSPITAL — SINTEF





torsdag 22. oktober 2009

torsdag 22. oktober 2009

Challenges related to distributed collaboration across organizational borders

HFC meeting
Oct. 21.-22. 2009
Trondheim

Distributed and virtual teams

- A distributed team: "A team in which at least one member is located in a geographically distant location"
- A virtual team: "A team that span distance and organizational boundaries"… often used to describe distributed teams that exist for a while to obtain a goal or solve a problem. Outside this the team cease to exist.

Real time vs. sequential cooperation

- When we talk about distributed teams in IO settings, we mostly refer to real time cooperation

- Team work also includes sequential cooperation.

Example – engineering and maintenance

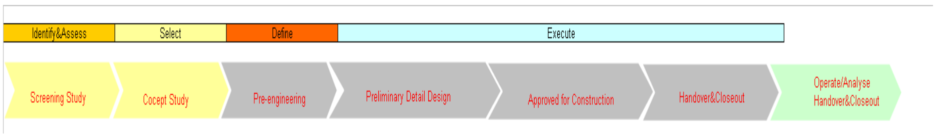
- Normally based on contracts between operator and contractor
- May include regular maintenance, **modifications** and engineering projects
- Often long time contracts, may be characterized as "outsourced work"

The relationship between operator and contractor

- Contracts
  - Integrated service contracts or full service contracts
- ICT
  - Also contract dependent
- Type of work
- Distance
  - Use the  or  ? Or must use  ,  and  ?
- Habits
  - The customer – supplier relationship

Different view of the work process

- The operator view:
  - An internal decision process until "execute work" starts
  - Then "just" follow up the contractor
  - Make sure not to exceed the cost limits



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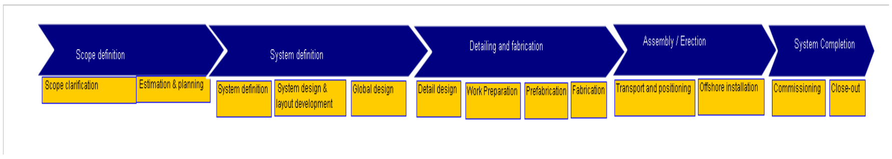
Different view of the work process

- From the contractors view:
  - An engineering process
  - Competence development
  - Keeping to the contract
  - Keep costs down
  - Etc…



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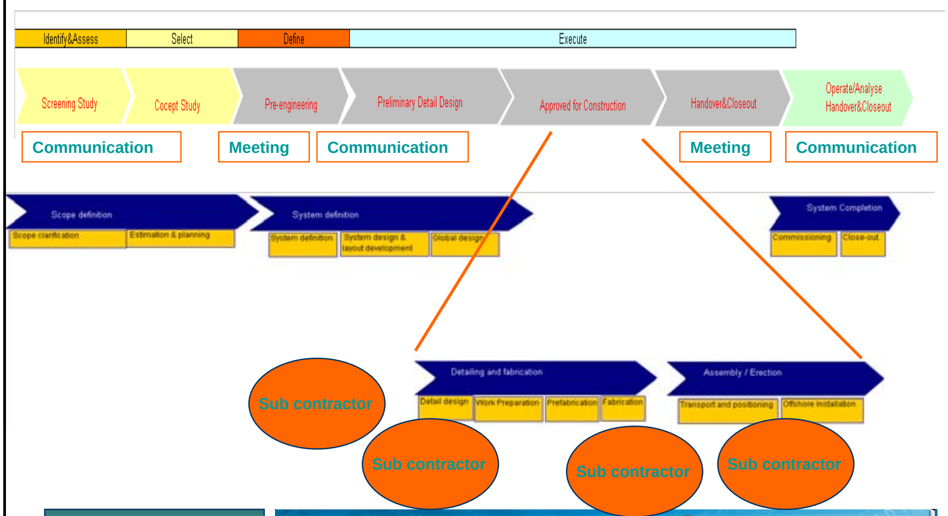
All together…



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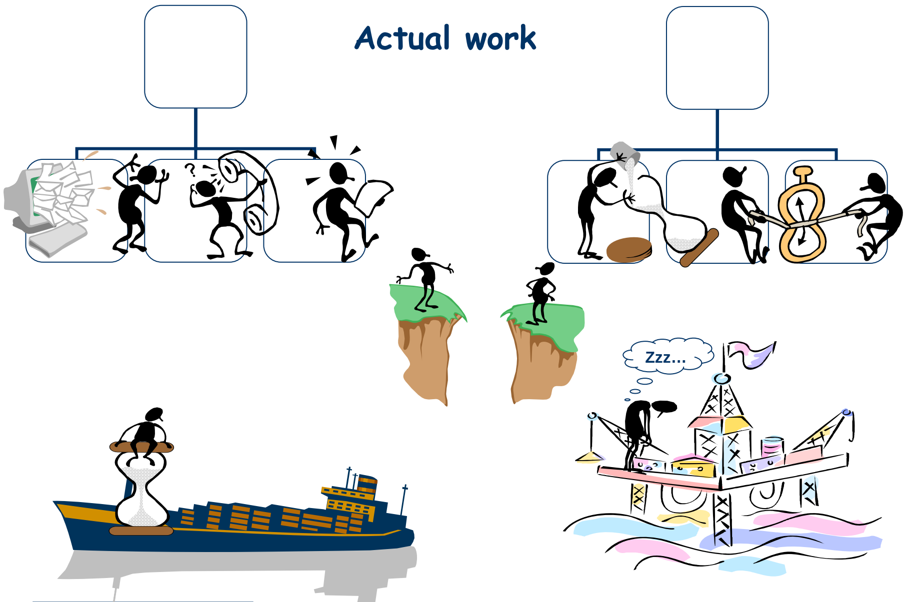
Ideal mental model of work

Camilla K Tveiten 2009

ioCENTER

Actual work



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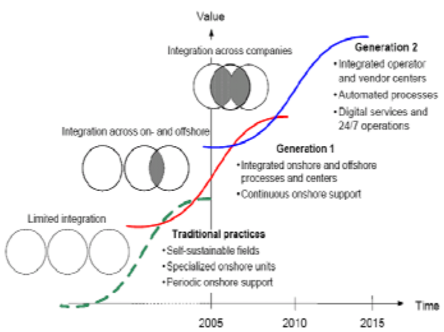
ioCENTER

Collaboration across the contract

- Meeting arenas
  - Onshore
  - Offshore
- Communication
  - The telephone is the project worker's best companion…
  - Obese ('private') e-mail inboxes
- Information sharing
  - Yes, it exists (somewhere), but you don't have access to it…
  - Access through <u>citrix</u> or 'adjusted computers'

Camilla K Tveiten 2009

OLF IO generation 2



- Integrated operator and vendor centers (virtual or physical?)
- Words used; "Seamless integration"

Camilla K Tveiten 2009

IO and maintenance management - status

- Low pace in IO implementation for engineering- and maintenance contractors

> *"…the operating companies take a more positive view of the IO process than the contractors. While the companies believe many of the goals have been achieved, the contractors call for a better sharing of the profit and risks. The contractors are dissatisfied as regards to information and access to data. This may be due to matters relating to contracts or IT security "*
>
> *(Ptil website 31.10.08)*

- Challenges for aging installations

> *"…Lack of knowledge, standards and clear-cut procedures are some of the challenges the petroleum industry is facing as the lifetime of an increasing number of facilities on the Norwegian Shelf is extended. "*
>
> *(Ptil website 26.11.08)*

Are they 'on to something'?

- Ormen Lange (Norske Shell)
  - Integrated maintenance and modification contract
  - Aker Solution is the major partner
  - Ormen Lange strategy is to have large parts of (the E&M) organization manned by contractors
    - On Nyhamna site
    - "Onshore"

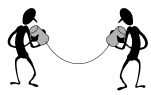
Photo: Øivind Leren

> "We have a tight and closely-integrated relationship with Shell. Some of our people are assigned to Shell's offices in Kristiansund, and work closely with Shell personnel. Others sit in our local offices in Løkkemyra, or work on site"
> *(shell.no website, retrieved Oct 12th 2009, unknown publishing date)*

More 'on to something'?

- **The Greater Ekofisk Modification Project (GEM) (CoPNo)**
  - Main Contractor: Vetco Aibel.
  - The GEM Onshore Project Center:
    - Take control and ownership of the offshore modification worksite by forming an integrated ConocoPhillips and main contractors work team.
    - Adapt and change work processes in order to apply new technology for cooperation between offshore & onshore, and between ConocoPhillips and contractors

Summing up



- Long term contracts and contact on an everyday basis makes E&M a good 'distributed team candidate'
- Bad ICT, 'dusty' habits, 'customer – supplier oriented' relationships, and 'lean' contracts frustrate the work
- Engineering and maintenance is an important piece of the 'IO construction'…
  - … but has not reached the desired level
  - … and is (perhaps) the Oil&Gas field/area with most organizational borders
- Any examples of integrated E&M teams we should draw our attention to?

Weatherford®

Distributed Team communion

Arent Arntzen
Senior consultant – Operations Analysis
Weatherford Petroleum Consultants AS

Overview

- Teamwork Ecology
- Team context
- Team cognition
- The problem
- Roles, ceremonies,artifacts and practices

Teamwork Ecology

Common Operating Picture

Mental models

Game

Strategy

Network

Organization

Situational Awareness

Liaison

Component

Distance

Standardization

Rules of engagement

Hierarchy

Task Force

Multi disciplinary

Structure

Team

Task

Specialization

Skills

Improvisation

Stepwise refinement

Training

Drill

Interface

Recursion

Ceremonies

Methodology

Planning

Education

Divide and conquer

Experience

Affection

Chain of command

Optimization

Decision Support system

Coordination

Synchronization

Authority

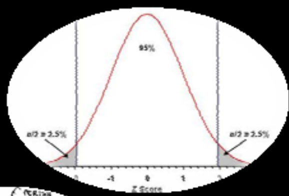
Commanders intent

Team Context

- Individuals with talent
- Skill-sensitive
- Training
- Tools
- Resource limited
- Planned
- Improvised
- Fun
- Challenging
- Dangerous

Team Cognition

- Jointly mainitaining a set of working hypotheses
- Generating
- Falsifying



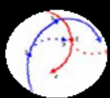
The Problem

- Achieve goal oriented, collective and controllable action
- Communication and community
- Communion, a joining together of minds and spirits

Roles

- Lead
- Wingman

Artifacts



- Checklists
- Goodies
- Whiteboard
- Rank/Insignia

Ceremonies

- Morning briefing
- Fligth briefing/debriefing

Best Practice

- Formation flying
- Two chains of command
- Authority and experience
- Liaiason
- Lifelong requalifications and education/training

Scrum

- Roles
- Ceremonies
- Artifacts
- Practices

Collaboration in distributed Virtual Reality environments

Espen Nystad, IFE
espenny@hrp.no

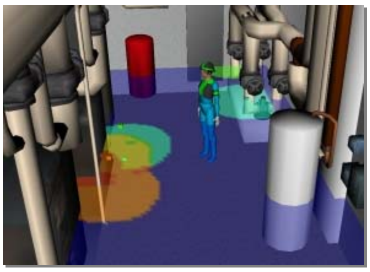
Overview

- What is VR and collaborative virtual environments?
- Challenges to collaboration in VR
- Example of a collaborative VR system
- How can VR be used in IO?

- Needs for communication in integrated operations
  - offshore – onshore
  - operator - supplier
- Current communication technologies
  - Telephone
  - Video conference
  - Groupware - shared information surfaces

Virtual Reality (VR)

- Definition:
  - A computer system that creates an artificial world.
  - The user has the impression of **being in** that world, the ability to **navigate through** the world and may **manipulate objects** in the the world.
- VR can provide **realistic**, three-dimensional simulations of:
  - Work area and equipment
  - Work tasks
  - Hazards
- Can support communication
  - VR is **clear**, illustrative and **easy to comprehend**



vr-info@hrp.no

VR technologies

Static vs dynamic simulation

- VR can contain different degrees of interaction
- Static VR models
  - Navigate in the model to explore the simulated location
  - Can support communication
- Provide a common reference point
- Common understanding
- Dynamic VR models
  - Includes object behaviour. The simulation responds to user actions
  - Can perform a job in the simulation (e.g. pre-job briefings)
  - Requires more resources to build the simulation (work is being done by IFE to simplify this)
  - May be reused for different purposes
  - Experience what can go wrong in VR so you do not make the same mistakes in the real situation (trial-and-error learning)

Collaborative virtual environments

- A collaborative virtual environment (CVE) lets a group of users meet and collaborate in a virtual space, regardless of their physical geographical location
  - Users can see and interact with representations of other users (avatars)

Collaboration challenges in VR

- Low fidelity of cues for collaboration may be a problem
  - Lack of facial expressions, cues for turn-taking in communication
  - Low fidelity of avatar actions
  - Limited field of view
- Gutwin and Greenberg (2000) described a set of mechanics of collaboration, i.e. the basic tasks that are necessary in order to achieve successful teamwork. These tasks include
  - Explicit communication
  - Consequential communication
  - Planning and coordination of action
  - Monitoring of the work that others are doing.
- A collaborative virtual environment should be able to support the mechanics of collaboration

Gutwin, C. and Greenberg, S. (2000): The Mechanics of Collaboration: Developing Low Cost Usability Evaluation Methods for Shared Workspaces.

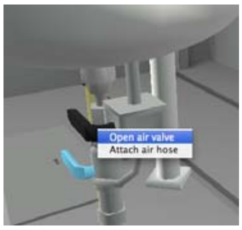
Collaboration challenges in VR

- Collaboration in VR is influenced by technology and task
- More immersed users tend to dominate or take control
- Collaboration improves if the team members are aware of the technological capabilities of the others
- Usability
- Meta-collaboration is more frequent when tasks are unstructured
- Social presence
  - Avatar fidelity

A CVE for collaborative training

- VR simulation of a nuclear maintenance activity – from the fuel bunker building at the Halden Reactor.
- An operaton with potential hazards.
- Prototype developed by IFE as part of research within the Halden Reactor Project
  - Tested with Halden Reactor maintenance staff

Interacting with the simulation



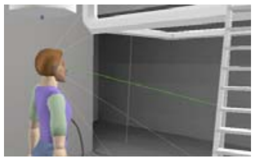
- Users can navigate in the virtual environment with a mouse and keyboard
- Can perform tasks by clicking on objects and selecting menu actions

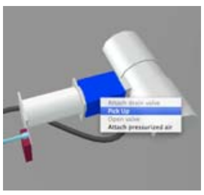
Visualisation of user actions

In the CVE users can see...

... what object another user is carrying

... to which object a user is pointing





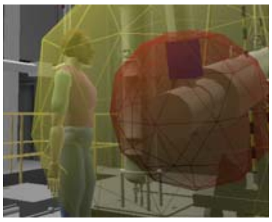
... what object another user is working on

... what other users are looking at

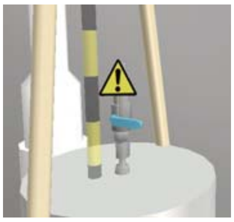
Visualisation of hazards

The simulation includes visualization of various hazards:

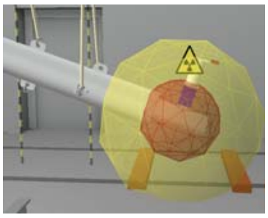
Radiation



Omission of procedure step



Equipment damage



Visualising hazards make the personnel focus on safety and how to perform the job safely

Error reduction through better planning and training

- May increase skills, knowledge, experience transfer
  - Train execution of work procedures, pre-job briefing
    - Soft skills: Communication, coordination of work
  - Support experience transfer
    - Trigger tacit knowledge
- May change risk perception
  - “To influence behavior, knowledge must be supported by attitudes that help the individual perceive the relevance of that knowledge to his or her daily life.” (Gagne)
  - People’s risk perception is formed through social processes
    - Risk perception may best be influenced in group training
  - Understand consequences of actions
  - Shared understanding of risks

Using CVEs in distributed teams

- The CVE puts everyone in the same environment and provides a concrete representation that may facilitate communication
- Can combine expertise onshore and offshore for improved work planning
  - Perform pre-job briefings in VR with offshore and onshore personnel (e.g. safety leader)
  - Include suppliers for problem solving or planning complicated operations
  - Suppliers could get a virtual tour of the plant to familiarize with the work environment or work tasks before going offshore
  - A support for handover meetings

Example: pre-job briefing supported by a CVE

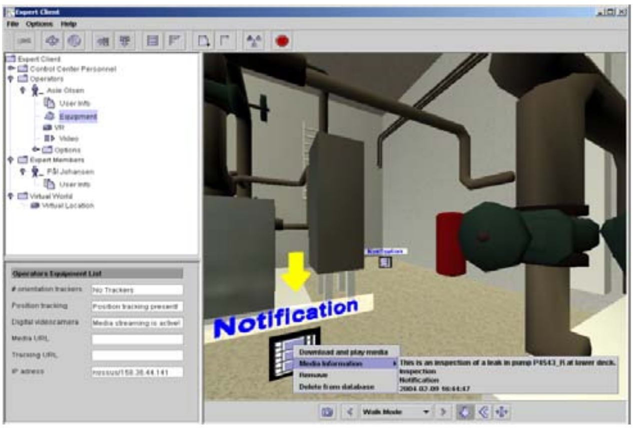
- Perform walkthrough of the job
  - what to do and how to do it
  - who does what (task allocation)
  - what equipment is needed
  - elements of the work place to consider
  - what plant systems will be affected
- Safety assessment
  - what hazards may occur
  - what safety measures

Synchronous online collaboration

Time - space matrix

	Co- located **Same space**	**Remote** **Different space**
Synchronous **Same time**	Face to face communication	Telephony/video conference/ **VR**
Non-synchronous **Different time**	Written material	Electronic communication /**VR**

Non-synchronous collaboration



Virtual notes created in the virtual model or in the real world

Summary

- VR – a technology to support IO?
- A clear representation of the work space to support collaboration
- May be an aid for planning and training

Thank you

HFC forum 21-22. October, Prinsen hotel, Trondheim

Minutes of meeting - workshop 22. October

Questions discussed were:

1. Which concepts are least and most transferrable between the military domain and to e.g. offshore?
    a. Situational awareness is domain independent. Methods, techniques etc are domain independent, but helps in understanding the domain.
    b. A lot within HF is also domain independent.
2. Will moving the “brain” from offshore to onshore have a negative effect on safety?
    a. Too large to answer.
    b. Integrated Operations (IO) currently experience communication breakdowns.
    c. Strong focus on onshore control rooms, less on offshore.
    d. All CCs controls the system(s) remotely. It is only a matter of distance.
    e. IO does not aim at moving the CCs onshore, but building onshore support centres.
    f. Safety can be hard to measure.
    g. IO brings the problem to the expert, not the expert to the problem. Strong tool for emergency preparedness. (Due to clear goals/objectives).
3. It was mentioned in one of the presentations that large displays are not really used as intended (more as decoration).
    a. Global view might be incorporated in the local solution, without the use of large displays.
    b. People do different jobs in the daily work, so they don’t really have a shared view.
    c. Need to separate between normal operations and emergency.
    d. Important to have the same information to take decisions together.
    e. Important that each person take decisions appropriate to his/her domain.
    f. The usefulness of large displays depends on the work processes.
    g. Large displays ensure that everybody can see the same, but many are poorly designed and only show the same information as small screens.
    h. Large displays give everybody less than they need.
4. How much effort is really spent on putting together teams?
    a. Team composition is important.
    b. Co-location (if possible). E.g. kick-off.

Systems must fit their purpose and be simple and easy to use!

INVITASJON

Human Factors in Control

21-22 Oktober 2 0 0 9

Samhandling i distribuerte team

27. oktober 2009

Kjære deltaker!
Vi vil med dette invitere til møte i HFC- forum (Human Factors in Control).

Møtet holdes onsdag 21. og torsdag 22.oktober 2009 i Trondheim. Vi starter kl 11:30 onsdag på Prinsen hotell og avslutter etter lunsj på torsdag med workshop.

Vi har reservert rom på Prinsen Hotell i Trondheim. Frist for beskjed om rombestilling er 14.oktober. Fint om dere tar kontakt direkte tlf: 73807000, eller www.prinsenhotell.no. (SINTEF kan også bestille rom for dere – kryss da av på siste side).

Program
Tema for møtet vil være "Samhandling i distribuerte team" og vi vil se på eksempler fra forskjellige næringer og sektorer angående dette. Foredrag holdes bl.a. av Prof. E.Salas og Prof N.Stanton. Det blir besøk hos fremtidens operasjonsrom på St. Olavs hospital/SINTEF (se http://www.stolav.no/templates/StandardMaster____94146.aspx)

Forumets visjon og hovedoppgave
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 håper du har anledning til å delta, og ønsker at du fyller ut og returnerer det vedlagte registreringsskjemaet så raskt som mulig, senest 14.oktober. Vi ser frem til din deltakelse.
Vi har også bestilt og fått billetter til ukeforestillingen, revyen, den 21/10 fra 20:30.

Vi vil også benytte anledningen til å minne om kurset "MTO-Human factors" ved UiS i høst – http://www.uis.no/kurs/evu/teknologi_og_naturvitenskap/?courseID=MTOH09&timeCode=2009H
Og Kurset "Introduksjon til HF og integrerte operasjoner" går på våren 2010, Samlinger: 8. - 10. februar, 15. - 18. mars, 26. - 28. april. Påmelding http://videre.ntnu.no/link/nv11413

Vennlig hilsen

Thor Inge Throndsen /StatoilHydro, Atoosa Tunem/IFE, M. Green/HCD, Ole Klingsheim/ConocoPhillips, Stig Ole Johnsen; Camilla Tveiten; Irene Wærø/SINTEF.

Vær vennlig og returner registreringen innen 14.oktober 2009 til:
Ingrid.Aalberg@sintef.no Sintef Teknologi og samfunn
Tel: 93087720 Fax: 73592896

AGENDA

HFC Møte

21 til 22 oktober 2009

Samhandling i distribuerte team

Trondheim, Prinsen Hotell, Kongens gate 30

Dag 1	Foredrag med spørsmål etter foredragene;	Ansvar/Beskrivelse
11:30-12:30	Registrering og lunsj	Ingrid Aalberg
12:30-13:00	Velkommen til møtet – presentasjon av møtedeltakere	HFC
13:00-13:30	Setter scenen – situational awareness, team cognition..	G. Hauland/DNV
13:30-13:45	Diskusjon	
13:45-14:00	Kaffe/Pause	
14:00-15:00	"Distributed team cognition "	M.Rosen - E.Salas/ Univ. of Central Florida
15:00-15:30	Diskusjon	
15:30-15:45	Kaffe og noe å bite i/Pause	
15:45-16:45	Theory and methods to analyse and design distributed situational awareness	Prof. N.Stanton/Brunel Univ.
16:45-17:15	Discussion	
17:15-18:00	Integrerte operasjoner og betydning for HMS nivået	A.Ringstad/StatoilHydro P.Næsje Coldevin/DnV
18:30	Middag i Studentersamfundet	HFC
20:30	Ukerevy i Studentersamfundet	Billetter ved registrering
Dag 2	Foredrag med spørsmål etter foredragene;	
08:30-10:00	Besøk Fremtidens Operasjons Rom (FOR) – Hovedinngangen til St. Olavs hospital	Prof T.A.N. Hernes
10-10:30	Transport tilbake& Kaffe/Pause	
10:30-11:15	Challenges related to distributed collaboration across organizational borders	C. Tveiten/NTNU/SINTEF
11:15-11:45	Distributed team communion - reusable fighter jock experiences	A.Arntzen/Weatherford Petroleum Consultants AS
11:45-12:15	Collaboration Training in Distributed Virtual Reality Environments	E.Nystad/ IFE
12:15-13:00	Lunsj	
13:00-14:45	Workshop – Distribuert samhandling – Praktiske metoder og verktøy for sikkerhet og kvalitet. (N.Stanton, M.Rosen/ E.Salas)	HFC deltakere

Neste møte i HFC forum blir i April og Oktober 2010

Vær vennlig og returner registreringen innen 14.oktober 2009 til:
Ingrid.Aalberg@sintef.no Sintef Teknologi og samfunn
Tel: 93087720 Fax: 73592896

REGISTRERING

Human Factors in Control

21. til 22.oktober
2 0 0 9

Prinsen Hotell, Kongens gate 30, Trondheim

Samhandling i distribuerte team

Ja, jeg vil gjerne delta:

Navn: __ ________________________________

Tittel / stilling: ____ ______________________________

Organisasjon: ___ ______________________________

Adresse: __ ________________________________

Kryss av for:

__Lunsj 21/10, __Middag 21/10, __UKE revy 21/10, __ Bestiller hotell 21/10 __ Lunsj 22/10

Tlf. : __________ Fax: ___________

E-post: _______________

For å være med må man betale inn medlemsavgift eller møteavgift. Medlemsavgiften er pr år:

- 25.000 for bedrifter med mer enn 15 ansatte (dekker 3 deltakere)
- 12.500 for mindre enn 15 ansatte (dekker 2 deltakere)
- 6.500 kr pr møte for ikke medlemmer (og overskytende deltakere)

Medlemsavtale, informasjon og publikasjoner om HFC kan finnes på WEB-siden: http://www.hfc.sintef.no

Vær vennlig og returner registreringen innen 14.oktober 2009 til:

Ingrid.Aalberg@sintef.no Sintef Teknologi og samfunn
Tel: 93087720 Fax: 73592896

SWEDISH NETWORK FOR HUMAN FACTORS

INBJUDAN till CRM-seminarium 2009-11-18 – 19

Datum: 2009-11-18 – 2009-11-19
Plats: First Hotel, Linköping
Deltagaravgift: 3 st deltagare från HFC deltar utan avgift. Därefter är avgiften 3900 SEK exkl moms.
Sista dag för anmälan: 9 november 2009

Årets CRM-seminarium har som övergripande tema Non-Technical Skills (NOTECHS). I enlighet med gällande regelverk (EU OPS 1 och JAR-OPS 3) ska besättningars CRM-färdigheter vara föremål för evaluering. NOTECHS-projektet startade 1996 då ett konsortium bildades bestående av DLR (D), IMASSA (F), NLR (NL) och University of Aberdeen (GB). I ett senare skede deltog även ett antal europeiska flygbolag.
Den föreslagna metodiken är i enlighet med ICAO Annex 6 och dess krav på evaluering av Non Technical Skills. Metodiken har validerats genom ett forskningsprojekt benämnt Joint Aviation Requirements – Translation Elaboration Legislation (JAR-TEL). Det får anses vara angeläget för samtliga som dagsläget är aktiva och har intresse för CRM-problematiken att delta i detta seminarium.
NOTECHS kommer att bli föremål för en workshop och kommer att ledas av Lucio Polo, som har synnerligen goda kunskaper i ämnet genom sitt aktiva deltagande i JAR-TEL. Lucio Polo har en bakgrund som kapten i Alitalia och arbetar idag som flyginspektör för den italienska luftfartsmyndigheten.
NOTECHS-delen av seminariet har följande delmoment:

From NOTECHS study to the assessment of NTS
- JARTEL study and the validation of NOTECHS as one of NTS behavioral markers system
- NTS assessment in practice
- “A game to be played by professional examiners"
- What are your answers to some popular questions about NTS assessment?
- NTS Methodology
- Authorities responsibilities and tools for NTS assessment
- The Future regulation: NPA 17& 22 and Part FCL an OPS
- Final questions and closing

Ytterligare moment som kommer att ingå i seminariet är bland annat "Situational awareness" i grupper som presenteras av Jens Alfredson från Saab Aero Systems samt ett inslag om Naturalistic Decision Making

samt

Vuxen pedagogik/didaktik
Vad säger forskningen om vuxnas lärande? Hur kan vi som utbildare främja lärandet på våra kurser? Exempel på pedagogiska metoder för CRM - kurser och annan utbildning inom flygbranschen. Presenteras av Karin Persson, Stockholms Universitet/Braathens Training.

(Med reservation för eventuella ändringar)

Anmälan sker på HFNs hemsida http://www.humanfactorsnetwork.se/ gå in under "courses".

VÄLKOMNA!