


## Human Factors Case studies

### On-shore supervision of off-shore gas production

11 March 2013  
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## Content



- **HF in control centres**
  - Human Factors Engineering & ErgoS
- Control centre design – general observations
- Case studies
  - control centres – move to shore
  - move to shore & process graphics
  - remote control and CCTV
- Lessons learned & conclusion

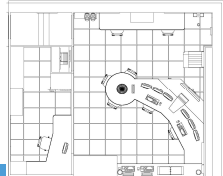

## HF & ErgoS

- ir. Ruurd Pikaar Eur.Erg.
- ErgoS Engineering & Ergonomics
  - 9 HF professionals, various backgrounds
- Control Centre Design
- Special interests
  - articles: HF case studies
  - research: CCTV-systems
  - development: Airport Ergonomics

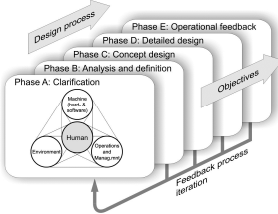
## ErgoS & off-shore

- Shell/NAM in the 90's
  - on-shore night watch for off-shore
- Off-shore control room redesign (Total K5)
- Statoil Etzel gas lager / detailed engineering
- Move to shore: GdF & Total (→ this presentation)





## HF in control centres

- Guidelines – how to ... & what ...
  - ISO 11064 – Ergonomic design of control centres
    - **you are fully aware of HF in control centres ?!**
  - Engineering contractor
    - **may not be fully aware !**
- Our View on HF Engineering
- Optimal design, productivity & reducing risks
  - not necessarily about comfort & luxury.



## Content



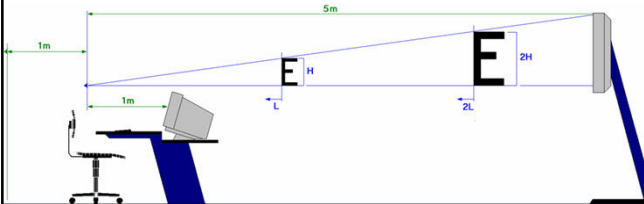
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*Note: team dynamics are "hidden" in this presentation*

### General observations

ERGOS

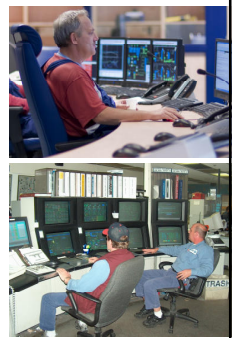
- Related topics in CR design
  - Console and control room design
  - Operator job design
  - Interaction design
    - software (HCI), shared displays, graphics
- Rule: don't work on one topic without the context of the other topics



### General observations

ERGOS

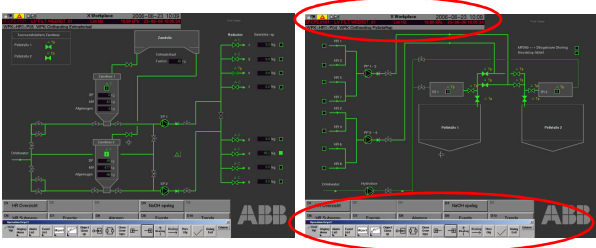
- Example – workstation design
- Large viewing distance (up to 1 m)
  - 2 working screens at a glance
  - secondary screens to left/right
  - one row for easy communication
  - readability: 4 mm character size (rule= 1000 : 250 = 4 mm)
- Short viewing distance (600 mm)
  - work at 1 screen position at a time
  - sitting (very) close together
  - limited overview
  - tiled screens / obstructed view



### General observations

ERGOS

- Interaction software
- Requires space on screen (menu)
- Repeated data on each screen




### General observations

ERGOS

- Remote control
  - can you trust the on-shore guys to guard your safety ?
  - do they really know what is going on off-shore ?
  - situation awareness ?


reliable overview ?



### Content

ERGOS

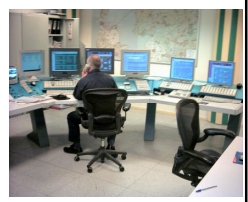
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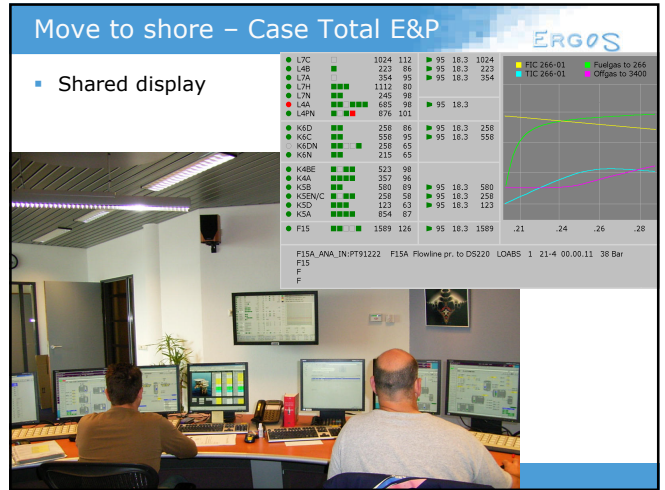
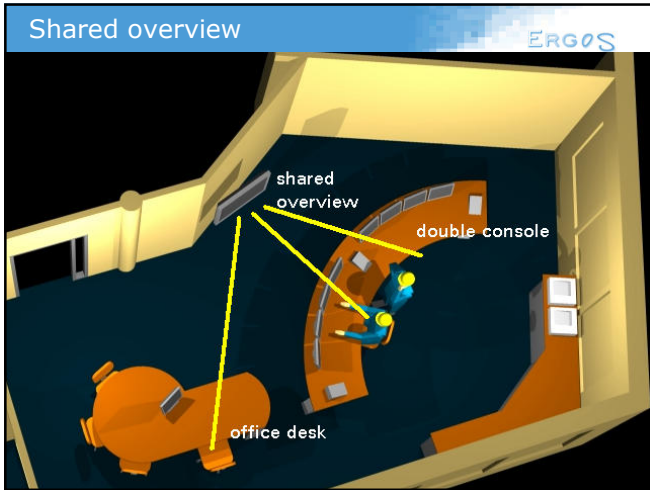


### Move to shore – case Total E&P

ERGOS

- System ergonomics procedure
  - 2003 / again in 2007
- Find out about tasks
  - existing on-shore treatment plant
  - hierarchical task analysis (HTA)
  - walk through – talk through
  - next determine: # of workplaces & instrumentation
- Some tasks move to shore (23 off-shore assets)
  - 10% alarm data transmitted to shore
  - remote desktop for satellite control
  - 1.5 job: operator + office tasks
    - therefore: shared display for production overview





### Move to shore – Case Total E&P

- Gradual development
  - contracting, production choke control
  - new operating philosophy: it is all about communication!
  - control tasks of (unmanned) satellites to shore
- Alarm management project

### Move to shore – Case Total E&P

- Alarm management project
  - limited process data available on-shore (10%)
  - hence improve quality of what you can get on-shore!
- alarm rationalization
  - same units, same signals ?
  - solve bad actors, quick wins
- HF tool: detailed HTA
  - scenario based!
- later: 100% variables on-shore
  - advanced alarm management
  - alarm overview graphic

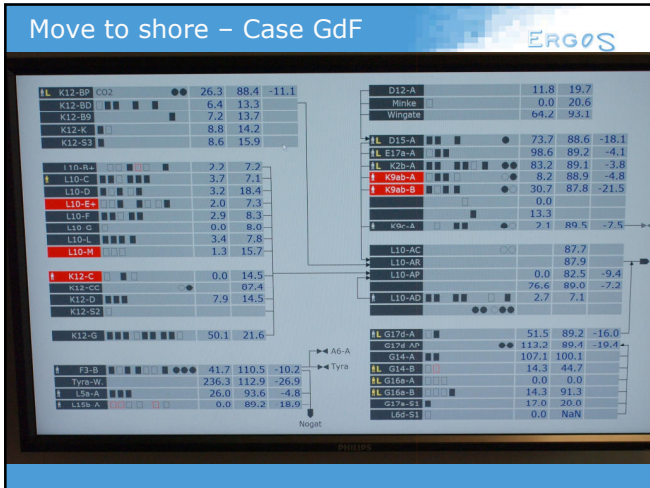
### Alarmcentrum

12:31 27-04-2010

Unit	Time	Alarm	Status	Location
L7	09:46 2704	HH-abs	✓	L7A_scrubber level
	09:31 2704	L-abs	✓	L7C_chemical flow
	08:01 2704	H-abs	✓	L7C_chemical pressure
	07:31 2704	L-abs	✓	L7A_well_s pressure
	04:17 2704	LL-abs	✓	L7B_scrubber level
	03:43 2704	HH-abs	✓	L7P_well_s pressure
K6	12:06 2704	HH-abs	✓	K6A_scrubber level
	11:51 2704	L-abs	✓	K6C_chemical flow
	10:37 2704	H-abs	✓	K6C_chemical pressure
F15	12:41 2704	HH-abs	✓	F15A_scrubber level
	11:14 2704	L-abs	✓	F15C_chemical flow
	10:21 2704	H-abs	✓	F15C_chemical pressure
	09:59 2704	L-abs	✓	F15A_well_s pressure
	05:33 2704	LL-abs	✓	F15B_scrubber level
	04:02 2704	HH-abs	✓	F15P_well_s pressure
K5	11:56 2704	HH-abs	✓	K5A_scrubber level
	09:04 2704	L-abs	✓	K5C_chemical flow
	08:21 2704	H-abs	✓	K5C_chemical pressure
	06:12 2704	L-abs	✓	K5A_well_s pressure

### Move to shore – Case GdF

- On shore control room for off shore production
  - same tasks & situations assumed (by GdF)
  - task analysis not needed (!?)
- > 40 assets; 2 x 24/7 off-shore control rooms
  - estimated 2-3 operator consoles –on shore– needed
- Gradual introduction: tasks move to shore.



- ### Move to shore – summary
- Control room design not different from any other control centre project
    - remote is "more remote"
    - operators used to work off-shore
  - Requirement
    - explicit design of communication tasks
    - operating philosophy / who is in charge?
  - Overview essential
    - situation awareness
    - process graphics / overview graphic
  - Suggest: as build analysis (CRIOP?)

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- ### Move to shore – Case GdF
- Off shore
    - 3 DCS vendors – 1800 graphics – limited content
    - expected problem: navigation & situation awareness
  - Graphics redesign – Instrumentation upgrade
- 

- ### DCS upgrade
- Observation
    - new screens, new operator workplaces
    - 1:1 conversion of old graphics ?**
    - 1280 x 1024 → wide screen High Resolution
  - This section
    - HF Guidelines
    - Case material
- 

- ### The problem.....
- More screens and graphics ... leading to a better process overview ?
  - We observed
    - 24 open windows
    - production loss
    - operator mistakes
    - workload issues
    - we want more & and larger screens
-

### Guidelines – process graphics

ERGOS

- Design rule**
  - Keep it simple
  - Simplify as much as possible
- Content rule**
  - Task related information only
- Develop style guide
  - Vendor related
  - Company or type of industry related
  - User/operator input
- More: AMS, EEMUA, Icoco-2010 (& Pikaar, 2010; 2012)

### Guidelines – process graphics

ERGOS

- Guidelines differ regarding “simple”
- old graphic
  - P&ID - based
- ASM-guideline
- ErgoS

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### Example – Well heads

ERGOS

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ERGOS

- 3 Well head & line up summarized in one table

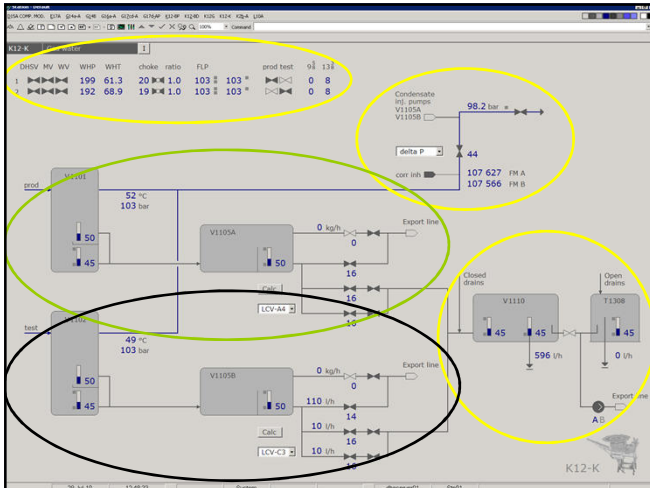
	DHSV	MV	WV	WHP	WHT	choke	ratio	prod	test	9 <sup>5</sup>	13 <sup>3</sup>	Max choke
1	▶▶▶▶▶			265	63.6	42 ▶▶▶	1.0	▶▶▶▶		9	2	
2	▶▶▶▶▶			211	83.7	56 ▶▶▶	1.0	▶▶▶▶		9	2	
3	▶▶▶▶▶			294	81.5	7 ▶▶▶	1.0	▶▶▶▶		9	2	

- table to be part of another process graphic
- detailed task analysis:
  - operators know exactly what they need
  - uncover obsolete variables (after 15 years...)

### Example – Case GdF

ERGOS

- Platform: 5 graphics
  - well head
  - test separator
  - production separator
  - gas export
  - drains



### Roadmap to Power Graphics

ERGOS

- Operating philosophy
  - specify tasks, instrumentation, shared displays
- Start: existing graphics or P&ID's
  - reduce data on controlled variables to one value only
  - for other data (set-point, alarm limits, etc) use a pop-up, tool tip or overlay
  - remove redundant symbols, edges, (crossing) lines
  - show functional relationships (not actual piping)
- Simplify symbols
- Check: is graphic self explanatory ?

### Road map to Power Graphics

ERGOS

- Remove content not needed *by operator*
- after simplifying
  - more data fits on window
  - less graphics needed ...
  - ... which simplifies interaction/navigation
- finishing touch
  - replace large on-screen touch buttons, menus and logos
  - introduce permanent process overview
  - again less data presented in process graphics ...
- result: limited number of very powerful graphics.

### Conclusion – graphics design

ERGOS

- situation analysis (basic ergonomics tool)
  - reveals ill structured information display
- simplify old technology graphics
  - 50 – 80 % reduction
  - leading to easier navigation
  - and a reduction of operator workload
- add powerful overview display
  - on the basis of an approved Operating Philosophy
- do not copy 15 year old graphics / no 1:1 conversion

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### Remote control and CCTV

ERGOS

- CCTV-operator tasks
  - traffic, surveillance, security
  - object control (locks, bridges)
  - process control / process installations
- What should operator be able to see, detect, or read reliably on CCTV-images?
  - HF guidelines ?
    - largely missing .....
    - not evidence based

## Remote control and CCTV

ERGOS

- Pooled funded research
  - 13 project partners (incl. process industries)
  - workshops – active participation, knowledge exchange
- Phase 1 – HF Literature
  - limited to traffic and surveillance (USA, UK)
- Phase 2 – 8 Case studies
- Phase 3 – Pilot experiments
  - test charts & -procedures
- Phase 4 – Draft Guidelines
  - structure of ISO 11064



## Remote control and CCTV

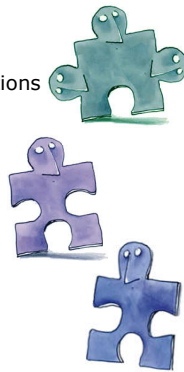
ERGOS

- Draft Guidelines – April 2013
- Open ends
  - contradictions between case studies and literature
  - image complexity / cognitive complexity
  - operator workload (# images per operator)
  - task complexity
  - elaborate new concept "scene": logical and meaningful set of visual information, monitored with a specific aim
- Project is open for participation
  - in-company workshop for new participants
  - detailed proposal available.

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## Lessons learned

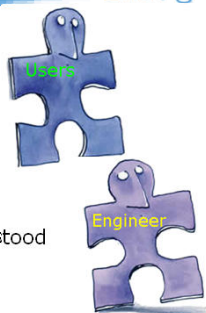
ERGOS

- Control room design – traditional results
- Process control - new tasks require full overview
  - 100 % process data transmission
  - process supervision on-shore (... if not local...)
  - new tasks: dispatching, production volume control
- Off-shore tasks also change !
  - more emphasis on maintenance
  - communication – strict rules
  - who's responsible (local vs central) ?
- Context information & situation awareness
  - you may need a detailed task analysis & task allocation ...

## My personal last observation

ERGOS

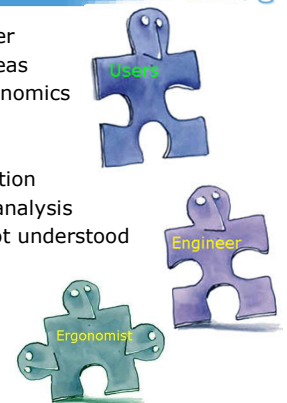
- user input is needed, however
- users do not develop new ideas
- user participation is not ergonomics
- engineers need field information
- engineers hesitate to do an analysis
- tasks & work organization not understood



## My personal last observation

ERGOS


- user input is needed, however
- users do not develop new ideas
- user participation is not ergonomics
- engineers need field information
- engineers hesitate to do an analysis
- tasks & work organization not understood
- HF Engineer
  - speaks both languages



### Move to shore

ERGOS

- Integrate Ergonomics in Engineering Projects !



The image shows three interlocking puzzle pieces. The left piece is purple and labeled 'Engineer'. The middle piece is green and labeled 'Ergonomist'. The right piece is blue and labeled 'user'. The pieces are arranged in a row, with the green piece in the center and the purple and blue pieces on either side, all interlocking.

### ERGOS

### More information

ERGOS

- [www.control-centre-design.com](http://www.control-centre-design.com)  
download papers
  - Pikaar (2012, IEA), *HMI Conventions for process graphics*
  - Pikaar (2012, Leeds), *On shore supervision of off-shore gas production – Human Factors Challenges*.
  - and others
- [www.ergos.eu](http://www.ergos.eu)
- [www.maritime-ergonomics.com](http://www.maritime-ergonomics.com)
- [www.airport-ergonomics.com](http://www.airport-ergonomics.com)