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Nordisk kjernesikkerhetsforskning
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A summary of the Nordic-group Conference on safety management Lund, Sweden, October 28-29, 2004

Coordinators: Ilkka Salo* and Ola Svenson **

* Lund University, Sweden
** Stockholm University, Sweden

April 2005

Abstract

The report summarizes the Nordic-group conference on safety management, which took place in Lund, Sweden on October 28-29, 2004. The theme-group was originally created by researchers who had a common interest in cooperation, sharing their results, and discuss topics focusing on safety management and safety culture in nuclear power production, but also in other technologies involving risks. The research has, so far, basically been related to the areas of MTO, partly from a psychological perspective, but also from other perspectives. Today, the group consists primarily of members from Sweden, Finland and Norway. During the last three years the group has gathered twice a year.

Key words

Safety management, safety culture, man-technology-organization, Nordic-group

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Electronic report, April 2005

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A summary of the Nordic-group conference on safety management

Lund, Sweden
October 28-29 2004

Coordinators:
Ilkka Salo, Lund University and
Ola Svenson, Stockholm University

LUND UNIVERSITY
Department of Psychology

[1]*Introduction and background*

This document summarizes the Nordic-group conference on safety management, which took place at Hotel Concordia in Lund, Sweden on October 28-29 2004.
The theme-group was originally created by researchers who had a common interest in cooperation, sharing their results, and discuss topics focusing on safety management and safety culture in nuclear power production, but also in other technologies involving risks. The research has, so far, basically been related to the areas of man-technology-organization (MTO), partly from a psychological perspective, but also from other perspectives. One ongoing project in the group is to write a book on the general theme "Safety management from a system perspective". The book will consist of individual chapters from the group members' research, but also from other invited participants.
Today, the group consists primarily of members from Sweden, Finland, and Norway. During the last three years the group has gathered twice a year.

Participants

The participants were Ann Britt Skjerve, and Svein Nilsen from Halden Reactor Project in Norway. The Finnish participants were Pia Oedewald and Teemu Reiman from VTT in Finland. Ilkka Salo, from the Department of Psychology Lund University represented Sweden. He also arranged and coordinated the meeting.

Presentations

The individual presentations are presented in brief below. Slides from the individual presentations are collected in the appendix.

"Bookproject"
Ilkka Salo presented the status of the ongoing book project. The project is currently in an initial review phase. So far, seven authors have submitted full manuscripts, and another three authors have submitted abstracts and/or drafts to manuscripts. The timeline for the book project was adjusted according to the prevailing circumstances. It was decided that the final chapters would be settled at the next group meeting in the end of April 2005. With the following review, editing, and publishing processes, it was calculated that the final manuscripts would be sent to printing in October 2006.

"Safety management from a system perspective"
Ilkka Salo presented his and Ola Svenson's ongoing project on the theme safety management from a system perspective. The focus of the presentation was on a general system theoretical model for analyzing safety management. The model emphasizes structure, process, and feedback for safe operations of a system. Several applications of the model in non-nuclear contexts were presented.

"Cultural features of safety critical organizations"
Pia Oedewald presented hers and Teemu Reiman's work on several important cultural features of safety critical organizations, found in a number of individual studies. Among the features the social construction of risks and safety, organizational structures and processes used as technical safety systems, and ways of coping with uncertainty was discussed.

[1] The activities in the Nordic group 2004 was partly financed with a grant from the Swedish Nuclear Power Inspectorate, SKI, to Ilkka Salo, and partly from Nordic nuclear safety research, NKS, to Ola Svenson.

"Safety management in view of general knowledge management with examples from the oil industry"
Svein Nilsens presentation attempted to define the concept of knowledge management in safety relevant contexts, and to relate it to the concept of safety management. The need for improved knowledge management and methods for achievement was illustrated with practical examples from the oil industry, particularly in relation to the procedures of drilling. Ways in which knowledge management could be considered a part of safety management was discussed. A possible contribution to our book project around these matters was also discussed.

"Employees' use of safety mechanisms at Norwegian petroleum installations"
Ann Britt Skjerve presented a study that explored the types of organizational factors that may affect the employees' willingness to apply so called safety mechanisms at Norwegian petroleum installations. The overall results of the study showed first, that the factors that affect safety mechanism use may differ depending on whether the object of the safety mechanism is the employee him or herself or other persons. Second, safety-mechanism use will generally be more markedly affected by factors at the group level than by factors at the individual and organizational level. And third, that higher level of familiarity with the local work environment seems generally to promote safety mechanism use at Norwegian petroleum installations.

"Social construction of safety in industrial organizations"
Teemu Reimans presentation focused on the social construction of safety in relation to the organizational culture and the core task of the organization. A model for the assessment of a culture and the theoretical considerations behind that model was discussed. The presentation is a part of the project presented by Pia Oedewald, above.

"Presentation of the Work and Organizational psychology division at the Department of Psychology, Lund University"
A recurring event at the previous group meetings has been a presentation of arranging department's current practice and research. This time, Professor Curt R Johansson, head of the Work and Organizational psychology division at the Department of Psychology, Lund University, gave a presentation of the work at the division. The different ongoing projects reflect the broadness of the scope of work and organizational psychology. Small company organizations, flight control room operations, are two examples of areas that have been analyzed recently.

Continuation

The meeting in Lund gave the participants a unique opportunity to share and to discuss current ideas concerning the topic of safety management. The size and format of the group meeting allows much more time to a critical discussions for each one of the presentations, compared to a traditional conference format, hence allowing a much higher degree of creativity in the group process. It was decided that we would continue to meet twice a year, and the time and place for the next meeting was settled to April 28-29 in Halden Norway.

Participants at the safety management group meeting in Lund October 28-29 2004.

Left to right, Ilkka Salo, Svein Nilsen

Left to right, Ann Britt Skjerve, Pia Oedewald, and Teemu Reiman

Appendixes

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LUNDS UNIVERSITET

Institutionen för psykologi

Itinerary – Nordic group meeting, Lund, October 28-29, 2004.

Thursday, October 28

09:00-09:30 Welcome reception

09:30-10:20 Information book project, current status etc.
Ilkka Salo

10:20-10:30 *Coffee*

10:30-11:50 Participant presentations
Ilkka Salo
"Safety management from a system perspective"

12:00-13:00 *Lunch*

13:00-13:50 Participant presentations
Pia Oedewald
"Organizational culture and the social construction of safety and efficiency"

13:50-14:40 Participant presentations
Svein Nilsen
"Knowledge management: applications in the petroleum industry"

14:40-14:50 *Coffee*

14:50-15:40 Participant presentations
Ann Britt Skjerve
"The employees as general safety systems: factors influencing safety mechanisms (functions)"

15:40-16:00 Rounding up

16:00-19:00 *Leisure time, etc.*

19:00 -- Dinner

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Friday, October 29

09:00-09:10 Meeting starts

09:10-10:00 Participant presentations
Teemu Reiman
"Challenges to NPP safety management in five European countries: model and data treatment"

10:00-10:50 Book project: Discussion on the continuation of the book project etc.

10:50-11:00 *Coffee*

11:00-11:50 Presentation of the Work and organizational psychology division at the Department of Psychology, Lund university
prof. Curt R Johansson
"Current themes and research"

12:00-13:00 *Lunch*

13:00-14:00 Rounding up, and discussion.

14:00 Meeting closes

Tentative title:

”Nordic perspectives on safety management in high reliability organizations: Theory and applications ”

Current status:
15 (13) chapters / contributions …*

1. Safety management: introduction, 1 ch.
2. Theoretical aspects of safety management, 4 ch.
3. Methodological aspects of safety management, 1 ch.
4. Applications: Case studies, 8 ch. (6ch.)
5. Conclusions, 1 ch.

To integrate the individual chapters...

- What is new with my chapter?
- What does it contribute to our knowledge in terms of
  - (a) Theory,
  - (b) Methods,
  - (c) General / specific data results,
  - (d) Applications,
  - (e) Results of general applicability. (one or more)
- Relevant issues* to address that will relate your manuscripts to a systems perspective.

Format

- 6000-7000 words
- “numbered sections”
- “APA-style”?!
- Final format depending on publisher...

Timeline

26/3-2004	Receive proposals from participants on general themes to chapters.
27-28/5	Discussion on themes at the group meeting in Stockholm.
28-29/10	Discussion on themes at the group meeting in Lund.
Apr 2005	The final chapters are settled at the group
(Nov 2004)	meeting.
Jun 2005	Receive final manuscripts! - Review starts.
(Jan 2005)	
Sept	Review ends. - Editing starts
(April)	Publishing process.
Oct 2006	Final manuscript to print.
(Jan 2006)	

General aims and disposition of the research project

To…

- develop a theoretical framework for studying safety management
- study safety management in various non-nuclear contexts (applications of the framework)
- study safety management in a nuclear context (applications of the framework)
- Transfer and utilize experiences and solutions from non-nuclear contexts to a nuclear context

"The framework"

- A system perspective on safety management
- General enough to enable application on various contexts and technologies
- Allow sufficient specification in details of the system studied

Important concepts related to systems

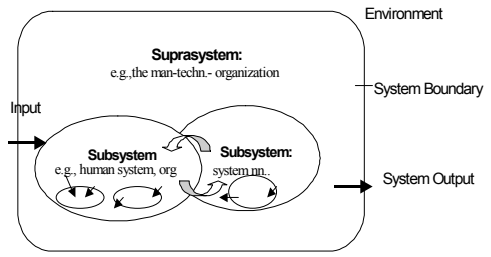
- *suprasystem* vs. *subsystems*
- *living* vs. *non-living* (sub)systems
- *information* (stock and flow)
- *structures* and *processes*

Important principles related to systems

- *to study a process, we have to define a structure including the primitives (smallest units) that we want to use*
- *a process is always observed through changes in structure*
- *we cannot describe a structure without a process of mapping the structure*

Important principles related to systems, cont.

- *Systems often form hierarchies with suprasystems containing subsystems*
- *The subsystems interact to keep themselves and the suprasystem in a steady state performing what the suprasystem is intended to produce (e.g., electricity)*.



A schematic illustration of the structure of suprasystem and subsystems with process arrows of information flow, matter and energy. The small ellipses represent subsystems at lower levels.

Adjustment processes which regulates the steady state rely on negative feedback

(1) *internal feedback* with a feedback loop that never crosses the boundary of the system

(2*) external feedback*, which goes outside the boundaries of the system receiving input from other systems (e.g., legal action against a system).

…(3*) output feedback*, (4) *input signal feedback* (5*) passive adjustment feedback,* …

10 examples of organizational concepts and their relation to system concepts

Management	**Systems**
1. Description of human-technology organization	System description with boundaries **Structure**
2. Information or matter stream from the outside treated by the organization	Flow **Process**
3. Information or matter that is contained in the organization at a given time	Stock **Structure**
4. Goals	Goals **Structure**
5. Organizational behavior	The external output and internal reactions of a system, often at the macro level **Process**
6. Long term survival of organization	Resilience of system **Process: Long time perspective**
7. Maintenance and health care	Repair **Process**
8. Power	Power **Structure**
9. Leadership	The way power is executed by the decider at different levels (individuals and groups of individuals) **Process**
10. Attitudes	Characteristics of the subsystem of individuals assumed to affect the output of the subsystems **Structure**

From theory to empirical studies

- **Issues to address: Safety of organizations related to a system perspective…**

Empirical studies:
safety management from a system perspective in non-nuclear contexts

Finished studies, manuscript(s) in progress:
- A Swedish road tunnel project
- The Swedish Civil Aviation Authority
- A Swedish Airline company
- A Swedish car manufacturer
- The Norwegian Petroleum Directorate

Ongoing studies:
- The "Swedish Railway Inspectorate"
- A Swedish railway company

Main methods

- *Document analysis, examples:*
  - *Business activity plans*
  - *Rules and regulations*
  - *Sectors accounts*
  - *Documents on event reports…etc.*
- *Interviews*

Typical analyses:

exemplified by the Swedish Civil Aviation Safety Authority

- *The total air transportation and corresponding ground activities*
- *Regulatory activities**
- *The structure of the Swedish Civil Aviation Safety Authority (Reorganization)**
- *Threats to safety*
- *Information system feedback*

Examples of results:

1. Regulatory activities - safety strategy and goals

- *…despite these strategies and goals, the five perspectives that the SCASA currently considers the most important areas of focus do not mention safety. One explanation for this might be that the areas of focus are considered to be related to the SCASA's 'pure' business plan in their work towards their customers. One may argue though, that if the systems approach is to permeate all levels of the organisation, safety should defiantly constitute a part of all processes.*

Examples of results:

2. The structure of the SCASA

- *It was noticed by some of the interviewed that one major disadvantage of the structure is the present location of the surveillance section, Sollentuna, located 2 hours from the head office in Norrköping. This could create communication problems and distant management may always be difficult. This was also noticed by some of the interviewed.*
- *Though the distance is large between the surveillance section and the rest of the organization, the present location of the members working in SCASA in Norrköping have been improved, and managers are easier to get in contact with. This is a major advantage of the structure, as communication will thrive if, simply, it is easy to communicate. Communication is likewise most important in controlling those threats against the SCASA and the market, which may erode safety.*

Continuation of the project, 2005--

Probable themes:

- Systematization of results
  - Good and not so good practices
  - Integration of results
- Transfer of results from non nuclear to a nuclear context
- Studies of safety management in a nuclear context

Questions to discuss

- How is safety management related to safety culture?
- Are safety culture indicators sufficient enough to identify fluctuations in safety management or do we need separate indicators

Cultural features of safety critical organisations

Based on working paper O&R

Statements are based on various studies

- our previous studies
- HRO-theory
- NAT
- interviews

Cultural features of safety critical organisations

- risks and safety are socially constructed in a given organisation
  - risks are not objective, nor is it self-evident that work itself is considered as consisting of risks
  - how to communicate the risk is a question to be solved
  - assumptions about the proper means to guarantee safety
- the possibility of ”disaster” is experienced as a motivating factor among the personnel
  - work is meaningful, it can have dire consequences
  - personal safety risks has negative effect on commitment, however
  - one has to deal with the issues of responsibility and accountability
- Attempt to anticipate the functioning of the organisation
  - Multiple and conflicting approaches lead to multiple and conflicting results
  - Anticipation should lead to numerical estimates => assumption?
  - Unantipated events are considered as deviations => cause must be found

Cultural features of safety critical organisations

- training is emphasised
  - personnel competence and personnel “fit”
  - Cultural fit to the system (right kind of personnel) is emphasised
- organisational structures and processes are used as technical safety systems
  - separation of ”thinkers” and ”doers”
  - collection of information and analytical approach is emphasised, and the role is allocated to certain personnel => reflecting is separated from conducting (cf. auditing) => questioning and innovation are separated from the front line to research institutes or headquarters
  - redundancies and independent safety systems
  - emphasis on instructions and procedures

Cultural features of safety critical organisations

- Coping with the uncertainty inherent in the system
  - Personnel have to have some coping mechanisms in order to get by (one cannot dwell on the risks)
  - Paradox in a sense that consequences should be anticipated
- Responsibility and accountability are distributed in an extremely complex way (intentionally)
  - responsibility is complicated by procedures, hierarchy, external auditing, regulators
  - Collective responsibility is emphasised, except in incidents (tendency to look for the cause, the guilty one)
- The role of rules and instructions in every practices
  - Rules and instructions are used to control activities not to support them
  - It is not possible to have a rule for every course of action => what is the role of individual initiative and personal expertise in work
  - Rules are used to avoid taking personal responsibility
  - Rules are used in order to cope with subjective feelings of uncertainty

Safety Management in View of General Knowledge Management with Examples from the Oil Industry

by
Svein Nilsen, OECD Halden Reactor Project

What is Knowledge Management?

- Notoriously ill-defined.
- One of the competing definitions: ”Knowledge Management enables the creation, distribution, and exploitation of knowledge to create and retain greater value from core business competencies”.
- Knowledge management always going on, but may be unsatisfactory.
- Knowledge management refer to recent methods, tools and efforts supposed to *improve* (not implement) knowledge management.

Why is improved KM needed?

- Increased competition in markets
  - Increased awareness of technological trends and market dynamics.
  - Increased awareness of internal competence. High-value knowledge.
- Increased complexity of products and production processes.
  - Multi-disciplinary planning, design and implementation needed.
  - Safety must be more carefully considered, contingency planning.

KM as a technological enterprise.

- The technological optimism of the ’90s.
- KM tools/techniques
  - Knowledge acquisition techniques
  - Ontology construction
  - Semantic web
  - Data/Web mining
  - Data warehousing
  - Document management
- At the end of the KM first generation era reports on failures seeped in.

Viewpoints emerging from the crisis

- Knowledge is not really the asset, but the people owning the knowledge and able to exploit it are the asset.
- Knowledge is not only explicit, but also implicit and tacit, actually it could happen that the most valuable knowledge is tacit and so people started to suggest that an important part of knowledge could never be codified.
- Knowledge is extremely dynamic, technology often ended in creating repositories difficult to update.
- Instead of managing knowledge it is necessary to look at the knowledge process.

M&O Issues I

- Managerial mal-practise.
  - Ignorance about the true nature of KM (inappropriate split of development costs).
  - Failure to recognize high-value knowledge.
  - Inadequate support of KM.
- Knowledge related problems
  - Poor quality knowledge
  - Unavailable knowledge
  - Walk-out of key personnel
  - Knowledge hoarding
  - Inadequate unlearning

M&O Issues II

- Failure to counteract effects of formal organization on knowledge flow
  - Internal meetings with no agenda, effects of the water cooler, cafeteria etc.
- Failure to relate to main business goals such as Economy and Safety

2005-02-22

The responsibilities of the management

- Stimulate knowledge trading
- Buyers, sellers and brokers.
- What is the currency?
  - Reciprocity
  - Repute
  - Altruism
- Trust affects knowledge trading.

2005-02-22

Safety relevant KM efforts

- The Tokaimura accident – lessons learned
  - Inadequate risk awareness by top management
  - 'Kaizen' and knowledge management
- TEPCO – learning introspection
  - 'Gaming' exercises
  - Lack of openness

2005-02-22

Issues common to KM and Safety Management.

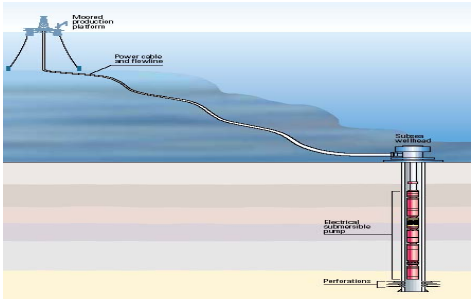
- Depends on appropriate knowledge preservation and dissemination – in parts the same pievce of knowledge need to be handled.
- Must be planned for by multi-disciplinary groups.
- Depends on appropriate involvement by the management (on several levels).
- Depends on the willingness and motivation by each individual in the organization.

2005-02-22

Economy as a driver for improved KM.

2005-02-22

Drilling



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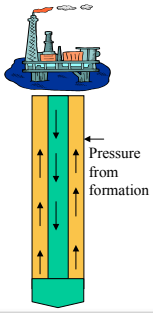
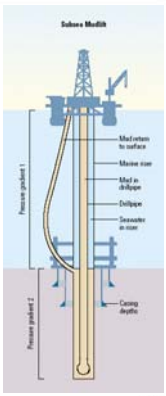
Uncertainties of drilling operation

•Topology only partially known based on seismic investigations and nearby drilling holes.

•Formation pressure only partially known. Deviation from expected conditions may cause:

- •collapse of walls of drilling hole
- •well kick
- •a reduced rate of penetration
- •escalation of costs due to delays in drilling plan





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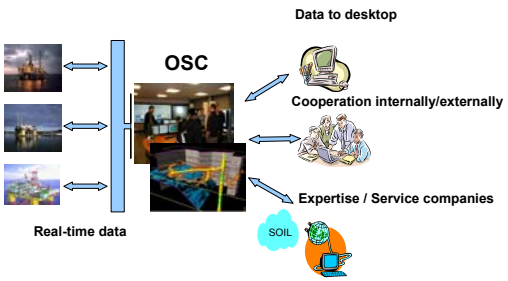
Main work processess

- Targeting remaining oil (for a given oil field)
- Recommendations to perform operations for a given target in the oil field (recommendation to drill)
- Detailed planning (down to 15 minutes interval, scheduling with contractors)
- Perform operations.
- Lessons learned and reporting.

2005-02-22

The Onshore Support Center



2005-02-22

OSC Infrastructure.

2005-02-22

Safety Relevant Aspects of Oil Drilling

- High complexity, high uncertainty, dire consequences
- Re-use of past experiences of high potential importance.
- Good cooperation when planning and implementation important
  - openness
  - safety relevant information must not be lost
  - sensitivity to other peoples opinions
  - managerial attentiveness to safety thinking

2005-02-22

WORK TITLE:

Employees' Use of Safety Mechanisms at Norwegian Petroleum Installations

Ann Britt Skjerve (IFE) and
Øyvind Lauridsen (PTIL)

Overall Purpose

Purpose: To obtain knowledge about how employees at Norwegian petroleum installations may contribute to system reliability by application of safety promoting work practices (safety mechanisms).

Background

- Improving the reliability of socio-technical systems
- Focus: Technical components
  - Humans are unreliable components
  - *Minimize* (automate) and *control* (proceduralise) human performance to the extent possible
- Humans may also contribute positively to safety!
- Cognitive ergonomics, and the influence of contextual factors on human cognition

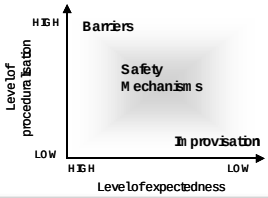
→ How can humans be supported to increase the likelihood that they will contribute positively to the reliability of socio-technical systems reliability?

Barriers, Safety Mechanisms, and Improvisation

Barriers: Means to prevent a set of predefined unwarranted events from occurring and/or to reduce their consequences.

Safety Mechanisms: Discrete general safety promoting work practices that may prevent the initiation of unwanted but not explicitly predefined event sequences and/or interrupt such sequences.

Improvisation



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Safety Mechanisms

Examples:

- If you observe a person in danger, you should warn the person.
- An employee may be allocated the role as watchman ("Hawk's eye"), i.e., to warn his or her colleagues about potential dangers associated with their task performance process.
- When faced with safety-critical or potentially safety-critical situations you should "Take Two" (minutes) to think through the situation before acting.
- If you realize that your performance may have safety-critical consequences for you or your colleagues, you should stop.

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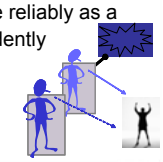
Relationship with Earlier Research

- Socio-technical system's safety
- Studies directed at *high-reliability organizations*

→ How work contexts should be organized to support human contributions to system reliability

→ Organizational redundancy: patterns of co-working in an organization that allows it to perform more reliably as a whole than when employees act independently

→ The four-eye principle



6

Safety-Mechanism Use

- The extent to which safety mechanisms *in practice* are used will be affected by at least three overall factors:
  - The employees' education and skills, i.e. their familiarity with and their ability to apply safety mechanisms
  - The employees' possibility for applying safety mechanisms
  - The employees' willingness to apply safety mechanisms (attitudes and additional motivational factors)

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Specific Purpose

To explore what type of organizational factors that may affect employees' *willingness* to apply safety-mechanisms at Norwegian petroleum installations.

→ The outcome of the study could be used to inform the safety management practices at the installations.

The study is based on the assumption that safety mechanism use is beneficial to system safety. This assumption is not explicitly tested in the study.

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The Risk Level at the Norwegian Shelf

- Based on data obtained in a questionnaire survey performed by the Norwegian Petroleum Directorate in year 2001:
  - Part 1: Demographic data
  - Part 2: 49 items related to work place safety
  - Part 3: Evaluation of the risk for six major accidents
  - Part 4: 31 items that related to work environment and recreational facilities offshore
  - Part 5: 17 items related to state of health

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Items on Safety-Mechanism Use

- Three items on the respondent's use of safety mechanisms:
  - Item 27: I stop working if I find that continuing could imply a danger to myself or to others
  - Item 35: I ask my colleagues to stop working, if I find that they perform their activities in a manner that threatens safety.
  - Item 38: If I observe dangerous situations, I report on these
- On item on the respondent's evaluation of his or her colleagues' application of a particular safety mechanism:
  - Item 31: My colleagues will stop me if I work in a risky manner

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Respondents

In all: 2928 questionnaires (≈55%)

Work Area:	**Number of respondents**
Process	523
Drilling	762
Well service	205
Catering	319
Construction/Modification	215
Maintenance	904

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Dataset Characteristics and Analysis Approach

Item Analysis (RNNS, part 2: 49 items)

- Mean score, average: 3,708.
- STD, average: 1,133
- The dataset held a *high level of homogeneity*

→ the correlation coefficients will assumedly be low, and the strength uncovered between variables might not necessarily be representative.

Focus on *patterns of results* rather than on results associated with individual items:

- Individual, Group, Organization.
- At what organizational level will interventions be most efficient?

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Classification of Variables

Individual Level

- **Age** (item)
- **Time in job position offshore** (item)
- **Overall health state** (item)
- **Personal View on One's Capability to Deal with Safety-Related Issues** (index)

Group Level

- **Local work environment** (index)
- **The psychological work environment** (Index)
- **Managers' attitude to HSE** (Index)
- **Colleagues' use of safety mechanisms** (item)

Organizational Level

- **Overall work environment** (Index)
- **The physical work environment** (Index)
- **Spare-time and rest facilities** (Index)
- **Perceived risk level** (Index)

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Results, Overall Dataset 1:3

Item 27: I stop working if I find that continuing could imply a danger to myself or to others

Item 35: I ask my colleagues to stop working, if I find that they perform their activities in a manner that threatens safety.

Item 38: If I observe dangerous situations, I report on these

Items	Item 35	Item 38
Item 27	r = ,2972 p=0,00*	r = ,2610 p=0,00*
Item 35		r =,4619 p=0,00*

Interpretation:
The results could suggest that the factors, which affect the employees. willingness to use safety mechanisms directed at *other persons* (item 35 and item 38), might be partly of a similar kind, while the factors, which affect the employees. willingness to use safety mechanisms directed at his or her *own activity* (item 27), might largely be of a different kind.

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Results, Overall Dataset 2:3

Factors at the *group level* demonstrated markedly stronger relationships with the employees' willingness to use safety mechanisms than factors at the other levels.

- This was more pronounced for items 35 and 38, than for item 27

Group-Level Variables

- Local work environment
- [The psychological work environment]
- Managers' attitude to HSE
- Colleagues' use of safety mechanisms

Interpretation:

- The outcome of the analyses could suggest that factors at the group level more markedly affect employees. willingness to use safety mechanisms, than factors at the individual and organizational level.
- Again, this interpretation is stronger for safety mechanisms directed at *other* persons, than safety mechanisms directed at the person *him or her self.*

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Results, Overall Dataset 3:3

Item 38: If I observe dangerous situations, I report on these

Regression Summary for Dependent Variable: Item 38. N=2435. R= .48 R^2= .23. Adjusted R^2= .23 F(10,2424)=71.85 p<0.0000 Std. Error of estimate: .55

	Beta	Std.Err. of Beta	B	Std.Err. of B	t(2424)	p-level
Intercept			2.49	0.12	20.63	0.0000
Age	0.07	0.02	0.05	0.01	3.97	0.0001
Colleagues' use of safety mechanisms	0.12	0.02	0.08	0.01	5.44	0.0000
Managers' attitude to HSE	0.15	0.03	0.13	0.02	5.61	0.0000
Local work environment	0.31	0.03	0.34	0.03	11.94	0.0000

Interpretation:

- The outcomes of the multiple regression analyses again suggest that group level factors more markedly influence employees' willingness to use safety mechanisms, than factors at the individual and organizational level.
- The *relative* difference between the amounts of variation explained again suggests that safety mechanisms, which involve other persons, could be influenced by different factors than the use of safety mechanisms, which only involve the employee him or herself.

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Analyses of the Six Work Areas (extracts)

The influence of work area characteristics:
To what extent are employees' willingness to use safety mechanisms different in the six work areas?

- Kruskal-Wallis One-Way ANOVA by Ranks test and the Median test

Work areas:
Process
Drilling
Well service
Catering
Construction/ Modification
Maintenance

Outcome:

. When significant differences are found they tend to involve the work areas *process* or *drilling*

. These work areas contain staff that tends to work on a given installation for longer periods of time, who can be expected to hold a *high level of familiarity with their local work environment.*

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Comparing Drilling and Well Service

***- using the* Mann-Whitney U test**

Results:

The scores obtained in the work area *well service* were significantly lower with respect to all the group level factors than the scores obtained in the work area *drilling*.

- *Local work environment* (P = 0.00, Mann-Whitney U test)
- *Psychological work environment* (P = 0.01, Mann-Whitney U test)
- *Managers' attitude to HSE* (P = 0.00, Mann-Whitney U test)
- *Colleagues use of safety mechanisms* (P = 0.00, Mann-Whitney U test).

Interpretation:

- A higher level of familiarity with the local work environment positively affects employees' willingness to apply safety mechanisms, as higher scores on the group level factors have previously been associated with a higher level of willingness to apply safety mechanisms.
- NOTE: This interpretation implies the assumption that safety in general *is* being adequately dealt with *in terms of safety mechanism use* in the local work area on Norwegian petroleum installations.

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Overall Results

- The factors that affect safety mechanism use may differ depending on whether the *object of the safety mechanism* is the employee him or herself or other persons.
- Safety-mechanism use will generally be more markedly affected by factors at the *group level* (i.e., the local work environment) than by factors at the individual and organizational level.

- ➢ Higher levels of *familiarity with the local work environment* seem generally to promote safety mechanism use *at Norwegian petroleum installations*.
- ➢ Initiatives directed at increasing employees' willingness to use safety mechanisms should be directed at the group level, i.e., the local work environment.

Safety-mechanism use seems to be affected by group norms:

- ➢ Employees' willingness to use safety mechanisms might change when they are transferred to a different 'local work environment' and special attention should be given to safety-mechanism use in these situations.
- ➢ Introduction of significant changes in the local environment, e.g., in terms of the physical layout, the human-machine interface, or the work procedures, might temporarily reduce employees' willingness to use safety mechanisms

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Limitations and Conclusions

- The RNNS questionnaire was not designed with the current research question in mind.
- There is a risk that the respondents may systematically differ from employees that did not respond to the RNNS questionnaire, as the response rate only reached 50-55%
- the respondents' level of *self-reported* safety-mechanism use might not necessarily reflect their *actual* use of safety mechanisms. The respondents' scores may most likely be biased by various heuristics.
- the definition of organizational factors to be contained in the present study and the localisation of factors that the analysis levels was based on the subjective judgements of authors and in addition constrained by the items contained in the RNNS questionnaire.
- the outlining of characteristic associated with the work areas drilling and well service.

- Still, the patterns of results obtained are coherent, and the results seem not implausible, as they correspond to the results obtained in earlier studies.

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What is New?

- Pointing out the necessity of safety promoting work practices as a supplement to safety barriers in complex high-risk organizations…
- Focus on safety promoting work practices at Norwegian petroleum installations
  - Not how the organizational context should be organized (as in HRO)
  - Stressing the employees' perception/evaluation of the state of the organizational factors.
- A specific manifest aspect of safety culture?

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Social construction of safety in industrial organisations

R&O

Based on: Reiman, T. & Oedewald, P. (Submitted). Assessment of Complex Sociotechnical Systems – Methodological issues concerning the use of organizational culture concept.

Statements about the organisational culture

- A culture is a *learned way* of responding to the *perceived* core task demands
  - *Learned* means that the culture has formed over times and thus it's foundations are partly unconscious
  - *Perceived* means that the core task demands i.e. the goals of the culture are socially constructed and may be "wrong"
- The culture includes or (manifests itself in) the artefacts i.e. the concrete, visible matters in the organisation e.g. the tools, technology, policy, procedures, practices
- Culture also includes the individuals attitudes and perceptions concerning their organisation and their own work
- The essence of the culture is the interplay between these two "worlds". *The meanings* concerning the object and the objective of the work are created in this "sense making process".

The concepts of "culture" and "core task"

- Organisational culture is a learned way of responding to the demands set by the core task

  => Ongoing process: learning happens all the time (personnel changes, changes in demands)

  => Practices and norms may develop into "wrong" direction

- Difficulty: What are the demands of the organisation's core task?
  - They are not obvious (conflicting goals, routines of the workday, difficulties in comprehending the effects of changes)

  => Conception of demands of the core task is a *product of culture* in a same way as are the solutions (norms, attitudes) generated

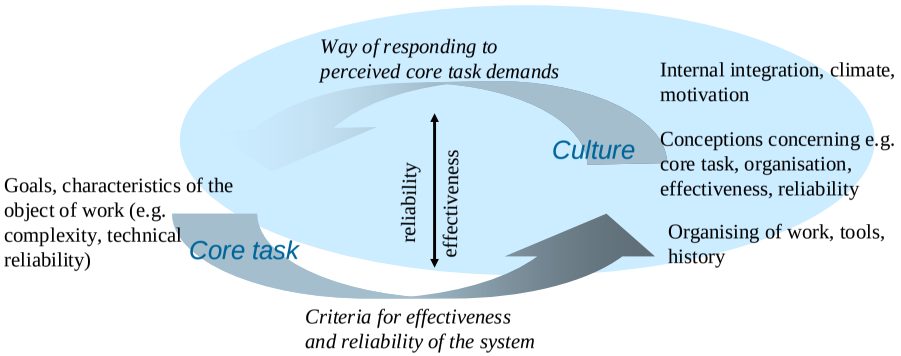
  => It is difficult the change the solutions, if the conception about the core task does not change!

organisational core task (OCT)

- OCT refers to the collective motive of the activity of the organisation.
- OCT is composed of four analytical components: the object of the activity, the objective of the activity, constraints and requirements of the activity.
- The object of the work (e.g. particular power plant, manufacturing plant or offshore platform) and the environment (e.g. deregulated electricity market) set constraints and requirements for the fulfilment of the organisational core task.
- OCT frames the motive of the activity and the shared constraints and requirements that all the workers have to take into account in all their tasks.

FROM: Reiman, T. & Oedewald, P. (Submitted). Assessment of Complex Sociotechnical Systems – Methodological issues concerning the use of organizational culture concept.

Assessment of the culture



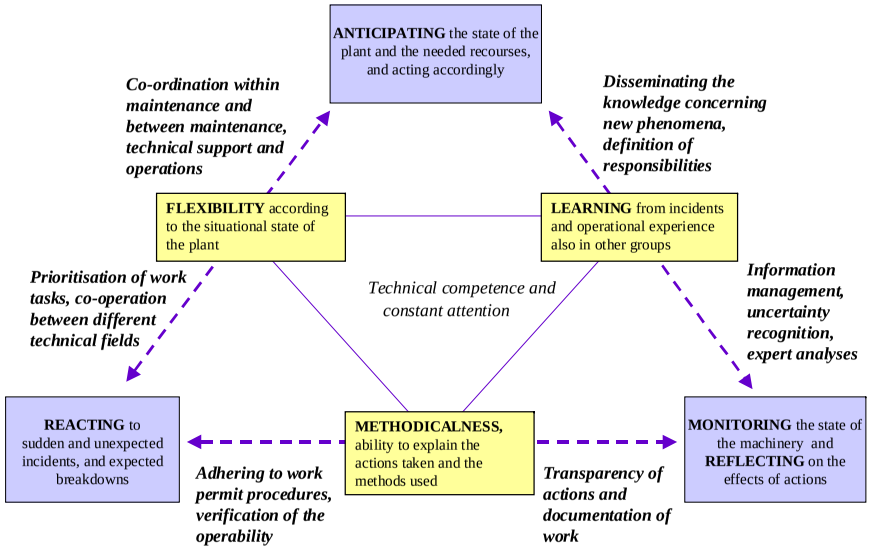
Questions:
- Does the organisation see the demands of the core task clearly?
- Does it work accordingly?
- Is it able to change if the core task demands change?

Methods:
- -interviews
- -document analysis
- -group working (domain experts)
- -CULTURE - questionnaire
- -seminars

Data:
- - characterisation of the physical object of work
- - description of organisational structure, procedures and work routines
- - conceptions of core task demands
- - perceived workplace values
- - job motivation and job satisfaction
- -targets for development
- -other manifestations of culture e.g. comments in seminars

Model of "objective" core task demands constructed by researches

Characteristics of the culture:
- - core task conceptions and differences in them
- -shared norms
- -working climate
- -psychological job characteristics
- -workplace values
- -subcultures



FROM: Reiman, T., Oedewald, P. & Rollenhagen, C. (In press). Characteristics of organizational culture at the maintenance units of two Nordic nuclear power plants. *Reliability Engineering and System Safety*.

Cultural features of safety critical organisations

Based on working paper O&R

Statements are based on various studies

- our previous studies
- HRO-theory
- NAT
- interviews

Cultural features of safety critical organisations

- risks and safety are socially constructed in a given organisation
  - risks are not objective, nor is it self-evident that work itself is considered as consisting of risks
  - how to communicate the risk is a question to be solved
  - assumptions about the proper means to guarantee safety
- the possibility of ”disaster” is experienced as a motivating factor among the personnel
  - work is meaningful, it can have dire consequences
  - personal safety risks has negative effect on commitment, however
  - one has to deal with the issues of responsibility and accountability
- Attempt to anticipate the functioning of the organisation
  - Multiple and conflicting approaches lead to multiple and conflicting results
  - Anticipation should lead to numerical estimates => assumption?
  - Unantipated events are considered as deviations => cause must be found

Cultural features of safety critical organisations

- training is emphasised
  - personnel competence and personnel “fit”
  - Cultural fit to the system (right kind of personnel) is emphasised
- organisational structures and processes are used as technical safety systems
  - separation of ”thinkers” and ”doers”
  - collection of information and analytical approach is emphasised, and the role is allocated to certain personnel => reflecting is separated from conducting (cf. auditing) => questioning and innovation are separated from the front line to research institutes or headquarters
  - redundancies and independent safety systems
  - emphasis on instructions and procedures

Cultural features of safety critical organisations

- Coping with the uncertainty inherent in the system
  - Personnel have to have some coping mechanisms in order to get by (one cannot dwell on the risks)
  - Paradox in a sense that consequences should be anticipated
- Responsibility and accountability are distributed in an extremely complex way (intentionally)
  - responsibility is complicated by procedures, hierarchy, external auditing, regulators
  - Collective responsibility is emphasised, except in incidents (tendency to look for the cause, the guilty one)
- The role of rules and instructions in every practices
  - Rules and instructions are used to control activities not to support them
  - It is not possible to have a rule for every course of action => what is the role of individual initiative and personal expertise in work
  - Rules are used to avoid taking personal responsibility
  - Rules are used in order to cope with subjective feelings of uncertainty

Bibliographic Data Sheet **NKS-106**

Title	A summary of the Nordic-group conference on safety management, Lund, Sweden, October 28-29, 2004.
Author(s)	Coordinators: Ilkka Salo* and Ola Svenson **
Affiliation(s)	* Lund University, Sweden ** Stockholm University, Sweden
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Abstract	The report summarizes the Nordic-group conference on safety management, which took place in Lund, Sweden on October 28-29, 2004. The theme-group was originally created by researchers who had a common interest in cooperation, sharing their results, and discuss topics focusing on safety management and safety culture in nuclear power production, but also in other technologies involving risks. The research has, so far, basically been related to the areas of MTO, partly from a psychological perspective, but also from other perspectives. Today, the group consists primarily of members from Sweden, Finland and Norway. During the last three years the group has gathered twice a year.
Key words	Safety management, safety culture, man-technology-organization, Nordic-group

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