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Change & Transition Methods and Tools, Best Practices, Case Studies, Reference and Guidance Material Available in the Safety Related and High Reliability Organisation Environment

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2007

EUROPEAN ORGANISATION
FOR THE SAFETY OF AIR NAVIGATION

EUROCONTROL

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Edition Number	:	0.1
Edition Date	:	15. Feb. 07
Status	:	Working Draft
Intended for	:	General Public

EUROPEAN AIR TRAFFIC MANAGEMENT PROGRAMME

DOCUMENT CHARACTERISTICS

TITLE		
Change & Transition Methods and Tools, Best Practices, Case Studies, Reference and Guidance Material Available in the Safety Related and High Reliability Organisation Environment		
	EATMP Infocentre Reference:	
Document Identifier	**Edition Number:**	0.1
	Edition Date:	15. Feb. 07.

Abstract

This document contains the description of relevant material for a compendium of methods & tools, best practices, case studies, reference and guidance material for change & transition available in the safety related industry. The findings from this study cover about 40 different methods, tools, case studies, etc. from the nuclear, petroleum, chemical/technical and maritime domains. The collected material include change management models and guidelines; rules and regulations; review checklists and guidelines; Human Factors in design considerations; transition guidelines for union representatives; verification and validation techniques; workshop findings; in addition to various case studies.

Keywords

High Reliability Organisations	Change	Transition	Change Management
Safety domains	Case studies	Methods	Tools
Nuclear	Oil	Petroleum	Chemical
Technical	Maritime	Guidelines	

Contact Person(s)	Tel	Unit

STATUS, AUDIENCE AND ACCESSIBILITY					
Status		**Intended for**		**Accessible via**	
Working Draft	☑	General Public	☑	Intranet	☐
Draft	☐	EATMP Stakeholders	☐	Extranet	☐
Proposed Issue	☐	Restricted Audience	☐	Internet (www.eurocontrol.int)	☐
Released Issue	☐	*Printed & electronic copies of the document can be obtained from the EATMP Infocentre (see page iii)*			

ELECTRONIC SOURCE		
Path:		
Host System	Software	Size
Windows XP	Microsoft Office Word 2003	562 Kb

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Open on 08:00 - 15:00 UTC from Monday to Thursday, incl.

DOCUMENT APPROVAL

The following table identifies all management authorities who have successively approved the present issue of this document.

AUTHORITY	NAME AND SIGNATURE	DATE
Please make sure that the EATMP Infocentre Reference is present on page ii.		

DOCUMENT CHANGE RECORD

The following table records the complete history of the successive editions of the present document.

EDITION NUMBER	EDITION DATE	INFOCENTRE REFERENCE	REASON FOR CHANGE	PAGES AFFECTED

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EXECUTIVE SUMMARY

This document contains the description of relevant material for a compendium of methods & tools, best practices, case studies, reference and guidance material for change & transition available in the safety related industry. The document is part of EUROCONTROL's SENSE WP5 on 'Methods for Human Factors Impact Analysis in Operational Change & Transition' and focuses on the High Reliability Organisations (HRO) outside ATM. This document is one of three related deliverables of SENSE WP5 that all collect material on change & transition for the development of a compendium, although from different domains (WP2 ATM; WP3 this document; WP4 non-ATM/HRO). The HRO domains selected for data collection in this work package are the petroleum domain, the nuclear domain, the chemical/technical domain, and the maritime domain.

The document is organised in four main chapters. Chapter 1 contains a background and introductory description of the task. Chapter 2 presents the four steps of the data collection method and process (Step 1. Domain selection – Step 2. Identification of data sources – Step 3. Data collection – Step 4. Evaluation and reporting). Chapter 3 presents a description of the results of the data collection. The results are also presented in Appendix C, through the use of a scoring template for each of the identified methods and tools. The summary and conclusion can be found in Chapter 4. Appendix A and B contains two different scoring templates. Appendix A is the "CTTF method and tool description and classification template", and Appendix B is the "CTTF method and tool classification overview".

The findings from this study cover about 40 different methods, tools, case studies, etc. from the four different domains. The collected material include change management models and guidelines; rules and regulations; review checklists and guidelines; Human Factors in design considerations; transition guidelines for union representatives; verification and validation techniques; workshop findings; in addition to various case studies.

Some of the findings have generic value and can be applied outside the domain in which it originates. Other material can probably be modified or developed in order to fit ATM, whereas other material probably is too specific or requires too much effort for applicability within ATM.

1. INTRODUCTION

The ATM sector will be stressed by many and large changes in the coming years. New technology and competition are amongst the driving forces. Changes, as imposed by the Single European Sky (SES) concept, imply possibilities but also risks. Strong requirements on safety, efficiency, capacity and economy exist and need to be maintained during the change and transition (C&T) period. There is strong evidence from literature on C&T, that many change processes are not successful.

In order to be prepared for the transitions associated with changes effective methods and approaches are needed. This document presents methods and tools from the domains nuclear, oil, chemical/technical and maritime that are candidate for a C&T compendium relevant for Air Traffic Management (ATM).

Addressing C&T can be done from both an organisational and an individual perspective. Organisational change in ATM can be driven by the pressure to reduce costs, and meet performance and safety targets. The aspect of human performance in making or responding to these changes is important. Managing organisational change proactively in a timely and effective way is important in order to obtain a positive outcome and success of the change.

Examples of changes are institutional or corporate changes, introduction of operational or technological improvements or completely new major technical systems, the merging of ATC Units or whole ACCs, and changes in airspace to gain operational or economic benefits. At the same time, it is required that ATM maintains or enhances safety levels, improves efficiency and capacity and reduces costs.

- Efforts needed to respond to the changes at an organisational level could concern:
- Identification of key requirements, challenges, opportunities and difficulties
- Assessment of change impacts
- Aligning organisational and individual needs in the change process
- Change communication
- Building the skills and competencies to meet the change.

The changes towards the future ATM system in Europe will have impact on the jobs, roles and responsibilities and subsequent impacts on required skills and abilities, attitudes, motivation, and finally performance of individual staff. It is vital to take into account change impacts on the individual as a person and as a professional and group or team member. A co-ordinated and proactive approach is needed to anticipate and assess these impacts, to communicate it in a correct and helpful way, develop solutions and anticipate and mitigate possible negative repercussions which might run counter to the efforts made at organisational level to manage change and transition. Some of the changes will have knock-on effects on the way personnel is selected and trained, how they perform in the job and on that person's career and professional work perspective. Examples for changes in roles and responsibilities in the job are organisational changes and changes in the working methods and the introduction of automated tools. Efforts needed to respond to the changes at an individual level could be:

- Identifying and describing future roles, tasks and responsibilities of staff in OPS.
- Adopting a systematic and objective way of examining and assessing the effects of new technologies and organisation change on peoples' jobs and required skills.
- Putting appropriate selection, training and change strategies into place at an early stage.
- Developing alternative ways of motivating staff and managing resistance to change.
- Developing appropriate means for the transition of current / more senior operational staff.

1.1 Objective of the Work

The objective of the work presented in this document is to collect, compile and describe relevant material for a compendium of methods & tools, best practices, case studies, reference and guidance material for change & transition available in the safety related environment industry being a basis for further work in the SENSE Work Package 5 on Organisational and Individual Change and Transition in ATM. The compendium shall entail

- A collection of available general methods & tools, best practices, case studies, reference and guidance material for HF Experts and Management on Change & Transition;
- Available communication and dialogue methods & tools, best practices, case studies, reference and guidance material for HF Experts and Management vis a vis staff;
- Available methods & tools, best practices, case studies, reference and guidance material on Leadership, including concrete topics like change vision and mission;
- Available methods & tools, best practices, case studies, reference and guidance material for HF experts on how to assist and support management through the change process;
- Available methods & tools, best practices, case studies, reference and guidance material for HF experts on how to conduct the change process.
- The HF Expert work should be seen as a managerial support function.

- A list of available European & national legislation to be taken into account when conducting change processes.

- A list of available methods & tools, best practices, case studies, reference and guidance material for the employees.

2. DATA COLLECTION METHOD AND PROCESS

The data collection method and process includes four steps in order to produce the compendium of tools and methods in HRO:

1. Domain selection

2. Identification of data sources

3. Data collection

4. Evaluation & reporting

Each of the steps is described below.

2.1 Step 1. Domain selection

2.1.1 Candidate domain descriptions

2.1.1.1 Oil

The Norwegian oil export is the third biggest in the world (wikipedia.org) following Saudi Arabia and Russia. Most of the oil production takes place under rough condition in the North Sea and Norwegian Sea, and large installations are located offshore in order to deliver oil and gas to onshore refineries. The personnel on board the installations are conducting manual work guided by a number of safety routines and rules.

Different companies have been given license to operate the oil fields, and these companies are accompanied by governmental regulators and inspectorates, as well as different unions and interest organisations. The petroleum industry also relies on research and development and a lot of consultants and research institutes are engaged in the petroleum activities.

During the last couple of years the Norwegian petroleum industry has been changing. Due to technological development, and a need for more cost effective oil production the concept of ‘Integrated Operation’ (IO) has been introduces. IO is the heading of a new work practice, where support centres onshore to a larger extent than earlier can provide real time support to offshore operations due to the possibilities associated with fibre optics and information exchange. IO has had impacts on organisational structures and professional roles, work practices and demand for knowledge and training. Onshore support centres have been opened, while others are planned. Administrative and planning functions have been moved from offshore to onshore, new rosters introduced, new work practices highlighting cooperation and joint multi professional teamwork introduced, along with a continuous focus on HES (Health, Environment & Safety).

2.1.1.2 Nuclear

The nuclear industry has existed for more than fifty years and experienced a number of changes (Summers, 2001). A nuclear power plant (NPP) has a limited life time, and will one day need to be decommissioned. At the same time there is an increasing need for electrical power without the negative green house effects. New power plants are being built whereas others are upgraded with new technology, and other are decommissioned. Pressure to perform economically, downsizing, mergers, privatisation, decline in research and education, staff aging, are all ongoing change issues (Summers).

Nuclear licensees are increasingly required to adapt to a more challenging commercial environment. "One of the costs that is often perceived as being amenable to control is staffing, and hence there is significant exploration of new strategies for managing staffing levels – for example, by reducing staffing levels, revising organisational structures, adopting new shift strategies or increasing the use of external contractors" (p.9, NEA, 2002)

The nuclear industry is concerned with safety. A failure to focus on safety will potentially have disastrous consequences as have been brought to the public notion by e.g. the Chernobyl accident in 1986. Central in the NPP is the control room where the human operators play a significant part at the sharp end of the process. Typically the control room is operated by a reactor operator, a turbine operator and a shift supervisor. Thus, similar to ATC, the nuclear industry relies on the performance of the human operator in the safety critical tasks.

The nuclear industry is governed by a number of different actors. The actors include the power plants, the government and regulators, the different unions, and different consultant companies, universities and research institutes, in addition to different international associations and organisations. Given the different interest and responsibilities of the actors, and the necessary high safety level, the nuclear domain appears promising regarding change relevant tools and methods.

2.1.1.3 Chemical / technical

The chemical industry has shown rapid growth for more than fifty years. In the late 1980s the global chemical industry, for the most part, comprised a number of large multinational companies with major plant sites that produced a range of diverse products on a large scale. By the end of the 1980s a transformation in the structure of the chemical industry had begun, and throughout the 1990s major changes occurred in the ownership and types of plant associated with the industry. These changes were brought about by several factors, including environmental and safety regulations and liability concerns as well as being driven by market forces (ICCA, 1996). Today the chemical industry is still going through major changes, most of which are directed towards downsizing and consolidation (ChemComm, 2002).

Toxic chemicals are a worldwide problem, and global initiatives have been taken by the International Council of Chemical Associations (ICCA) to change and improve the industry in a direction to safer, more efficient and sustainable production, also in developing countries. These are challenges on a global scale and sustainable development will call for action on the part of the people, governments, businesses and organisations around the world (ICCA, 1996).

Operations within chemical and process industry are, as in most high risk environments, surrounded by various rules and legislations. Different changes in operations within this domain have to be controlled to make sure that modifications are not causing additional, new or different risks. Control methods for ensuring safety during changes have traditionally been focusing on technical aspects, such as changes in operational processes or equipment etc. During recent years, a realization that changes in administrative routines and organizational structure also need attention have raised also within this domain. However focus is still mainly on the technical aspects rather than on social factors and change and transition management.

2.1.1.4 Maritime

The maritime industry is a global and very complex setting that is sensitive to changes in the economic situation. During the 1970s a number of years of depression in merchant shipping introduced extensive rationalisation programs with the priority to reduce the number of crew. Over the years there has been a rapid development in technical equipment and ships design. Ships today are larger and more or less specialized for carrying a certain type of cargo. (Olofsson, 1995). A ship can be owned by a shipping company, but also by banks and investors. The latter often lack experience of ship operations and usually engage a management company. These management companies provide a variety of services such as manning of ships, maintenance, etc (Jense, 1999).

Although the maritime industry has developed in many respects, it is still an industry that is stooped in traditions and old ways of thinking (strong company cultures) and that is slow on changes. Obstacles for change are: traditions; national cultures among multinational crews; limited budgets that diminishes the willingness to invest; and organisational bureaucracy.

The level of maturity concerning safety is generally increasing, but varies in different areas of the world. A lot of progress has been made in making ships technically safer, an example is the double hulls of ships. This safety increase has been realized through the efforts made by the International Maritime Organisation (IMO), consisting of 158 member states. Unfortunately, during the 1980s it was recognized that the number of seamen and passengers that were victims in accidents at sea was not diminishing. The investigation of a number of severe accidents led to the increased awareness that human and organisational factors often were the fundamental weaknesses causing the accidents. Today a number of mandatory standards and conventions given by the IMO exist, which are intended to improve the safety of international shipping and to reduce pollution from ships by impacting on the way shipping companies are managed and operated.

2.1.2 C&T Framework Safety Domains

The degree to which the results from the data collection are relevant and usable depends upon where and why the data are collected. The data collection described in this report is concerned with change and transition within safety domains. That is, the domains selected for data collection should qualify as both being safety related and having relevant “experience” with C&T issues. In order to have a systematic approach prior to the data collection, the candidate domains should therefore be described and evaluated on safety, and on change and transition factors. A framework is developed to illustrate the relative similarities and difference between ATM and candidate domains regarding safety and C&T.

The development and use of the framework approach is not intended as a scientific and validated effort to score and compare domains. The intension is rather to articulate possible differences and/or similarities between domains, as well as making the process of selecting domains for data collection less dependent upon intuition and possible biases. In addition, the findings from a systematic comparison of different domains on safety and C&T relevant factors, that is, identified differences and similarities, will give focus in the search for data regarding which areas are most promising and which areas are of most interest.

In order to compare the different domains different scoring variables were selected. These variables were representative of defining characteristics of safety organizations, and relevant change and transition scenarios within ATM. The selected description of safety domain characteristics was based upon the identifying characteristics of High Reliability Organisations by Fear (1993):

- Costly to operate
- When it fails, the consequences are disastrous
- Accountability in terms of owning and solving problems
- Standard operating procedures for normal operation
- Hierarchy and bureaucracy are prevalent
- Tightly coupled system
- Redundancy is essential
- Monitoring takes place horizontally and vertically
- Training is consistent and compulsory
- The level of technology is high and kept in good working order

The change and transition defining characteristics were based upon the ATM change scenarios as identified in the C&T task force and are the possible changes with which any ANSP might be confronted. The 13 clusters of changes were distilled from 58 examples identified by the participants at a workshop April 21. 2006 at the premises of DFS in Langen:

1. More competition through market liberalisation and necessary certification of ANSPs; privatisation of ANSPs.

2. Consolidation of ACCs, mergers of ACCs; centralisation/ integration of services; change of location of unit; centralisation of functions, e.g. technical maintenance and remote operations;

3. Implementation of international working structures in regard to Functional Airspace Blocks (FAB).

4. More integrated ATM processes through collaborative decision making (CDM).

5. Increased demand for mobility of Air Traffic Controllers (ATCOs); different workplaces during career; integration of foreign staff in multinational teams; integration of foreign ATCOs and *ab initio* trainees in national culture.

6. Paradigm shift in ATM, e.g. through new allocation of responsibilities between air and ground.

7. New rostering schemes driven by efficiency concerns; introduction of new shift cycles.

8. New organisational structures of ANSPs.

9. New ATM systems, e.g. very advanced systems, increased automation and tool support; paper stripless systems; introduction of controller pilot data link communication (CPDLC); new equipment.

10. New ATM procedures, e.g. through advanced ATM systems and automation support in decision making; implementation of FABs, changing working roles when introducing the multi sector planner concept; altering communication when using CPDLC.

11. Implementation of Eurocontrol Safety Regulatory Requirements (ESARR); Europe wide licensing of ATCOs or maintenance staff; new laws and legislation; implementation of international regulations.

12. New working roles; emergence of new occupations; new team roles (e.g. multi sector planner).

13. Change of incident reporting; safety culture.

The ATM specific concepts were removed or made more generic in order to make scoring and comparison possible (as can be seen in the framework below).

2.1.3 Framework Scoring

The scoring of the table was done in the following matter: First each of the domains was scored individually. This was done by adding a value between -3 and +3 (7 point scale) as defined by the anchors. Each score represented the degree to which the variable was representative to the domain. The scoring of each domain was done by a SME (subject matter expert).

When scoring the domains the SME was asked to focus mainly on the sharp end of the organisation. The sharp end refers to the part of the organisation handling the main tasks, for example the ATCOs for ATM, the workers on the oil rig, the nuclear power plant operators, etc. The SMEs were also asked to consider the every day support functions serving the sharp end, like assistants, supervisors etc.

Once all the domains were scored the comparison to ATM was made by scoring how much the non ATM domains deviated from ATM (e.g. ATM score = 2, non ATM = 3, difference = 1) with a possible maximum deviation of 6. These new scores for each of the domains representing similarity or difference to ATM were reported as the output of the comparison exercise.

The ATM column was scored by a recent employee at Avinor, where he used to work as a Safety Advisor in the Safety Team. He had also a background and experience from ATC as an Aerodrome Flight Information Officer, and is now working at IFE.

The Oil column was scored by IFE's oil domain coordinator. The domain coordinator has experience from various consultant and R&D work for different actors within the oil domain, particularly in relation to the large changes associated with Integrated Operations.

The Nuclear column was scored by a previous employee of a Swedish NPP, now employed as a senior engineer at IFE. He has 15 years of experience from NPPs, including positions as turbine operator, reactor operator, and shift supervisor.

The Chemical column was scored by a lecturer at the Department of Fire Safety Engineering, Lund University. He has 35 years of experience of the petro-chemical domain working both as a consultant in safety matters, and being a national and international safety surveyor. He belongs to an Expert Group under the auspices of the Working Group on Chemical Accidents that manages the OECD Programme on Chemical Accidents. Being a member of this group he has made a contributing part in the new Guidance on Safety Performance Indicators.

The Maritime column was scored by a lecturer/researcher at the World Maritime University (WMU) in Malmö, Sweden. The WMU operates under the auspices of the International Maritime Organization (IMO), a specialized agency of the United Nations. The scorer has a vast experience of the international maritime domain and has worked e.g. both in the US Navy and as a lieutenant commander in the Philippine Coast Guard.

2.1.4 Results Framework Scoring

2.1.4.1 ATM

The ATM scores were high (+2 or +3) on both the High Reliability Organisation (HRO) identifying characteristics, and on the presence of the different change scenarios. The change scenarios were developed as descriptions of possible ATM scenarios making the result rather obvious, but the scorings on the HRO variables indicate that ATM match Fear's (1993) different identifying HRO characteristics.

2.1.4.2 *Oil*

The results regarding the oil domain confirm that it is a safety domain, and that the domain is experiencing or facing many of the same C&T scenarios as ATM. The most noteworthy differences from ATM are that the (Norwegian) oil industry is less hierarchical and bureaucratic, and that there are fewer changes following implementations of international laws and legislation or work practices, and that the data collection is not likely to find much information on these particular issues.

2.1.4.3 *Nuclear*

The results regarding the nuclear domain suggest it to be a safety domain as the scores are high on the High Reliability Organisation (HRO) identifying characteristics, whereas there are less C&T scenarios foreseen than what is the case for ATM and the oil domains. Still, the nuclear domain should be relevant for data collection as a number of C&T scenarios match those of ATM. The most promising areas for data collection appear to be in relation to changes to organisational structures, new technical systems and automation, and the related changes to work procedures including integrated work processes and implementation of international working practices.

2.1.4.4 *Chemical/technical*

Even though the chemical/technical domain have less characteristics as a High Reliability Organization compared to the other domains in this study, the scores are still high and confirms it as a safety domain. The chemical/technical domain also shares some of the same change scenarios as ATM in terms of more competition, consolidation and mergers, implementation of international working practices and laws as well as new systems and procedures. The most apparent differences in relation to ATM seem to be related to demands for mobility of workers, paradigm shifts and new rostering schemes.

2.1.4.5 *Maritime*

The scores for the maritime domain were high on the High Reliability Organization identifying characteristics, but by comparison, are not as tightly coupled as the ATM domain. Although it is a safety domain, the scores concerning the presence of the different change scenarios were low. The most noteworthy differences from ATM were that the maritime domain are not facing many changes concerning new procedures, new systems, organizational structures or work processes, and that the data collection is not likely to find much information on these issues. We are more likely to find information about implementation of international regulations.

2.2 Step 2. Identification of data sources

For each of the four domains the first step in identifying data sources was to identify the “actors” of the domain. The actors are the different organizations representing different responsibilities, concerns, focus, etc., in a C&T context. The different actors are likely to produce different methods and tools regarding C&T. For example, in the oil industry the identified actors are categorized as:

- Oil companies

- Government
- Unions
- Universities/ R&D/Consultants
- Oil industry associations

The next step was then to identify and contact the different data sources under each of these categories. E.g. the different oil companies and their contact persons and published material. The different actors in the four domains are seen in the table below.

2.3 Step 3. Data collection

The third step was the collecting of relevant data for the C&T compendium. Data was obtainable either from publications, the web, or following direct contact with key personnel. The aim of the data collection was simply to get as much descriptive information as possible. The table below lists the methods and tools that were available from different organisation representing different actors in the different domains. This list thus represents the data available for evaluation, being candidates for the compendium, rather than the compendium itself.

Domain	Actor	Organisation	Candidate method/tool etc.
Oil	Oil companies	Statoil	• Model for organisation development and change
		Hydro	• How to Change (H2C) • Change scenario description
	Government	Petroleum Safety Authority Norway	• Rules and regulations • Review checklists
		Ministry of Labour and Social Inclusion	• HES in the petroleum sector
		Ministry of Petroleum and Energy	• On the Petroleum Activity • Human Factors in Control Rooms
	Unions	NOPEF (Norsk Olje- og Petrokjemisk Fagforbund)	• Minutes – transition conference
		Lederne (Leaders)	• Case study
		YS	• Transition guideline
	Universities/ R&D/Consultants	IFE (Institutt for Energi Technikk)	• CORD MTO Method
		Sintef (Foundation for Scientific and Industrial Research)	• 'Smarter Together' (Project) • Criop – A Scenario method for Crisis Intervention and Operability analysis
		Studio Apertura	• The Pentagon model
	Oil industry associations	The Norwegian Oil Industry Association	• Integrated Operation and HES (Health, Safety, Environment)

Nuclear	Regulators	The UK Nuclear Regulator	• The UK Nuclear Regulator's view of external influences on safety
		Radiation and Nuclear Safety Authority	• Management Of Safety Requirements In Subcontracting During the OLKILUOTO 3 Nuclear Power Plant Construction Phase
		Swedish Nuclear Power Inspectorate	• Control room changes at Swedish nuclear power plants
		US Nuclear Regulatory Commission	• Human Factors Engineering Program Review Model
	International organisations for cooperation	Nuclear Energy Agency Organisation For Economic Co-Operation And Development	• The Regulatory Challenges of Decommissioning Nuclear Reactors • Managing and Regulating Organisational Change in Nuclear Installations • Assuring future nuclear safety competencies • Report On The CSNI Workshop ON Nuclear Power Plant Transition From Operation Into Decommissioning: Human Factors And Organisation Considerations • Regulatory Aspects of management of Change Summary And Conclusions • Proceedings Of The Workshop On "Scientific Approaches To Safety Management"
		International Atomic Energy Agency	• Managing change in nuclear utilities • Human resource issues related to an expanding nuclear power programme
	Universities/ R&D/Consultants	Nordic nuclear safety research	• Management of change in the nuclear industry – Evidence from maintenance reorganizations
	Unions	World Association Of Nuclear Operators	• Changes at Kola NPP • Peer review

Chemical	Government	Swedish Work Environment Authority	• ABC for risk assessment during changes in work operations • Investigation and risk assessment in systematic work environment management – a guide • Systematic Work Environment Management – a guideline
		HSE - Health and Safety Executive UK	• Organizational change and major accident hazards • Business re-engineering and health and safety management - Best practice model • Business re-engineering and health and safety management – Case studies • Business re-engineering and health and safety management – Literature survey
		Swedish Rescue Services Agency (SRSA)	• Proactive Risk Management in a Dynamic Society
	Industry associations	European Process Safety Centre (EPSC)	• Safety issues in a dynamic business environment
		The Swedish Association of Process Safety (IPS)	• IPS – Downsizing
	Universities/ R&D/Consultants	Weibullkonsult AB	• Safe modifications in the process industry
		HE Lagerstrom AB	• SORK - Systematic risk- and consequence analysis during organizational change
	Chemical companies	AkzoNobel	• RACKETman
Maritime	Regulators	International Maritime Organisation (IMO)	• International Safety Management Code (ISM Code) • Standards of Training, Certification and Watchkeeping for Seafarers (STCW) • International Convention for the Safety of Life at Sea (SOLAS) • Voluntary IMO Member State Audit Scheme • Formal Safety Assessment (FSA)
	Government	Swedish Maritime Safety Inspectorate	• Easy to do the right thing – The art of updating a vessels' bridge (In Swedish) • Strategy for the international work 2006-2012 (In Swedish)

2.4 Step 4. Evaluation and Reporting

The compendium of HRO C&T methods and tools will consist of methods and tools that have been evaluated against relevant criteria. In addition, each method or tool listed is described according to predefined categories. The evaluation criteria and the description categories has been developed as part of the task force's work, and are specified in the report "Classification Scheme of Human Factors Methods & Tools for Impact of Change Measurement" produced by DFS (2006). In order to support the evaluation of the methods and tools two forms were developed. The first form, see Appendix A - CTTF method and tool description and classification template, is a template for description and classification of the candidate methods and tools. The scored forms are presented in Appendix C - CTTF method and tool descriptions and classifications. The second form, see Appendix B - CTTF method and tool classification overview, summarises the different tools and methods in a comparative manner. The results are presented below.

C&T Framework Safety domains	Candidate domains								
Scoring variables	***ATM***	**Oil**		**Nuclear**		**Chemical**		**Maritime**	
HRO – Identifying characteristics *(B. Fear, 1993)* – the degree to which each characteristic represents the domain.									
Costly to operate	2	3	+1	3	+1	2	0	3	+1
When it fails, the consequences are disastrous	2	2	0	3	+1	1	-1	1	-1
Accountability in terms of owning and solving problems	2	3	+1	2	0	3	+1	3	+1
Standard operating procedures for normal operation	3	2	-1	3	0	2	-1	3	0
Hierarchy and bureaucracy are prevalent	2	-1	-3	3	+1	0	-2	3	+1
Tightly coupled system	2	2	0	2	0	1	-1	-1	-3
Redundancy is essential	3	2	-1	3	0	1	-2	2	-1
Monitoring takes place horizontally and vertically	2	2	0	3	+1	2	0	3	+1
Training is consistent and compulsory	3	3	0	3	0	1	-2	3	0
The level of technology is high and kept in good working order	2	2	0	3	+1	2	0	2	0
ATM Change Scenarios – *DFS Classification scheme* – the degree each variable is a foreseen change driver or consequence.									
More competition	2	2	0	-3	-5	2	0	0	-2
Consolidation and mergers; centralisation/ integration of services; change of location	3	3	0	-2*	-5	3	0	0	-3
Implementation of international working practices, New laws and legislation; implementation of international regulations.	3	0	-3	3	0	2	-1	3	0
More integrated work processes	3	3	0	2	-1	1	-2	1	-2
Increased demand for mobility of workers; different workplaces during career; integration of foreign staff	3	1	-2	-1	-4	0	-3	3	0
Paradigm shift, e.g. through new allocation of responsibilities	2	2	0	2	0	-1	-3	2	0
New rostering schemes driven by efficiency concerns; introduction of new shift cycles.	2	2	0	-2	-4	0	-2	2	0
New organisational structures.	2	2	0	2	0	1	-1	1	-1
New systems, e.g. very advanced systems, increased automation and tool support; new equipment.	3	3	0	2	-1	2	-1	1	-2
New procedures, e.g. systems and automation support in decision making;	3	3	0	2	-1	2	-1	1	-2
New working roles; new occupations; new team roles; changing working roles	2	2	0	-1	-3	1	-1	2	0
Safety culture.	2	2	0	3	+1	2	0	3	+1

* exemption Bärsebeck/Ringhals political reasons – infrastructure

Scoring	**Not at all**		**Seldom / not very much**		**Some times / to some extent**		**Always / to a very large extent**
Raw	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**
Relative	**6**	**5**	**4**	**3**	**2**	**1**	**0**

3. RESULTS

The text below gives a short description of the different methods and tools collected. Each method or tool is also described and classified according to the Template (see Appendix A - CTTF method and tool description and classification template) developed for this purpose. Some of the tools and/or methods identified during the data collection are, however, not described in the template as they, for different reasons, are not relevant for the C&T project. Some methods or tools are too general, not available in full text, or not overlapping enough with this study's interest area. These are therefore left out, but included in the data collection table above (appears in grey text).

3.1 Oil

3.1.1 Statoil – Model for organisation development and change

From the document introduction: "PROMOD is Statoil's model for the organisational development projects – based on Statoil's general project model – PROMIS. The model reflects best practice in Statoil. PROMOD is designed for major, overall organisational development projects, but can also be used as a guideline and a checklist for more limited projects. When adjusted to the individual organisational project's special challenges, PROMOD may prevent complications and delays and contribute to goal attainment." (p.6, Statoil, 2006).

The PROMOD document contains lists of challenges, checklists, diagrams, suggestions of tasks and actions, and descriptions of relevant issues in relation to the six phases of the model. The document provides high level descriptions, but does not offer references or go in detail on every issue covered. Still, the PROMOD model is a method for the whole change process and is built on best practices.

3.1.2 Petroleum Safety Authority Norway – Rules and regulations

A number of laws and acts are relevant for change processes in the Norwegian oil industry. In general there are three different categories of requirements in which the different laws and regulations are organized regarding guiding the change process. These are:

- Direction requirements
- HSE requirements
- Documentation requirements

Direction requirements are relevant for the implementation of the change process, and concerns important principles, aims, measurements, decision basis, consequence evaluations, verification, validation and continuous improvements. Direction is a tool to achieve an acceptable HES level.

HES requirements will through the direction requirements result in a HSE level. The HSE level has to be documented and is therefore connected with the documentation requirements. HES requirements specify the required HSE level on both the technical and organizational issues.

Documentation requirements concern the fact that both direction and the HSE level have to be documented.

A change process consists of a number of activities, phases, etc., and each of these is matched by relevant direction, HSE and documentation requirements. The following activities are met by different requirements on each of these three requirement categories:

- Planning
- Work processes
- Manning and competence
- Information
- Goal and strategies
- Internal demands
- Parameters and indicators
- Decision basis
- Collection, processing and use of data
- Continuation
- Improvement

The direction, HSE and documentation requirements for each of the activities listed above are found in different laws and regulations. These laws and regulations are[1]:

- The petroleum law
- The work environment law – concerns all change processes
- The frame regulation – concerns all change processes
- The direction regulation – concerns all change processes

[1] Direct translation from Norwegian – other formal English terms might apply

- The activity regulation – concerns processes leading to changes in activities

- The appliance regulation – concerns technical changes on appliance

The rules and regulations discussed above have not been classified in the “method and tool description and classification template” (see Appendix A - CTTF method and tool description and classification template) as they as they are on a too high level, but is still included here as a result due to the general approach they represent regarding changes.

3.1.3 Petroleum Safety Authority Norway – Review checklists

The Petroleum Safety Authority of Norway is responsible for conduction reviews following the introduction of Integrated Operations (IO). For this purpose they have developed checklist in order to assure that the licensees have been meeting the relevant laws and regulations. Different checklists have been developed for different purposes and different levels, ranging from company level to the individual employee.

The checklists are restricted concerning its details, but available regarding the more generic aspects. That is, the approach is available as long as the specific questions and items are revealed. The content of the checklist are developed to meet Norwegian laws and regulations and the specific questions are linked to relevant regulations, still, the approach and the main themes should have generic value for other domains and nations.

3.1.4 Ministry of Petroleum and Energy – Human Factors in Control Rooms

The “Human Factors in Control Rooms” is a validation and verification tool developed for the Norwegian Ministry of Petroleum and Energy meant to be used in the review of the process of integrating HF in the design and the operation of control rooms, and the results of that process. The guideline is a review, and not a design guideline. The guideline consists of two parts. The first part describes the relevant background (regulation), and is the introduction to the second part, which consists of lists of questions.

The tool is developed for reviewing design processes rather than organizational change and transitional issues from an individuals’ perspective. Furthermore, it is made in relation to relevant Norwegian laws and regulations. Still, due to the level of detail and its foundation in international standards and guidelines the tool is likely to have generic value to other domains and nations.

3.1.5 The Confederation of Vocational Unions – Transition guideline

The transition guideline of The Confederation of Vocational Unions (YS), is providing basic guidance on how to meet transition. The guideline is developed with the union representative in mind and describes a number of issues and suggestions on how to address these issues, with corresponding checklists and tasks. The guideline is not domain specific, but also applies to the oil domain. As the document is developed for the union representative, it has a different focus than change and transition models made for the management as it focuses on the individual employee's needs and rights.

3.1.6 CORD MTO Method

From the abstract: "This document provides guidance for performing and reviewing the MTO (Man – Technology – Organisation) activities in early design phases for construction or refurbishment projects where allocation between human, machine and/or different physical locations of personnel are of concern. The purpose of these activities is to ensure that the human factors principles are followed and that requirements for allocation of functions, design considerations and organisational structure are systematically analysed and evaluated." (p.2, CORD, 2006).

The CORD method is currently unavailable to the public, but this is likely to change shortly following the establishment of the IO centre where the key actors behind the CORD method (along with others) have come together in order to develop new knowledge, methods, and tools for the future development of IO. The CORD method has proven effective in handling the MTO perspective in a number of organisational restructuring projects, and the methodology should be generic enough to apply to other domains. Even if the CORD methodology is not developed explicitly to deal with transition issues, it is expressed that each organisation applying the method should use their change management approach in parallel. The application of CORD in several projects has shown, however, that the method effectively includes transition issues as the potentially affected employees are directly involved in the data collection and analyses, and where employee representatives are involved and present during data collection and regular meetings.

3.1.7 'Smarter Together'

The 'Smarter together' process is a multidisciplinary approach that: "focuses on operational development processes in an HTO-perspective (Human, Technology, Organization), across interfaces through co-operation and commitment from employees and management. The department is surveying and analysing challenges, in order to develop and implement smart solutions in close cooperation with the customer. Our aim is to help our customers make the most of their human, organizational and technological resources, and by doing so increase safety and efficiency." (http://www.sintef.no). The uniqueness of the approach has been described to be based upon three variables. The first variable is a bottom-up design, the second is the focus on the working teams that are made across the companies' structures, and the third, the arenas and processes which encourage trust, playfulness and confidence.

The “Smarter together” process is guided by consultants and not described in detail by available literature. It is not available as a free standing method, but the general principles of the method are described in various publications. The approach was developed in 2000, and even it is described in context to the petroleum domain, but due to its generic methodology and principles it could probably be applied in other domains.

3.1.8 CRIOP – A Scenario method for Crisis Intervention and Operability analysis

From the abstract: “CRIOP® is a methodology used to verify and validate the ability of a control centre to safely and efficiently handle all modes of operations including start up, normal operations, maintenance and revision maintenance, process disturbances, safety critical situations and shut down. The methodology can be applied to central control rooms, drillers' cabins, cranes and other types of cabins, onshore, offshore and emergency control-rooms. The key elements of CRIOP® are checklists covering relevant areas in design of a Control Centre (CC), Scenario Analysis of key scenarios and a learning arena where the workforce with operating experience, designers and management can meet and evaluate the optimal CC. A CRIOP® analysis is initiated by a preparation and organisation phase, to identify stakeholders, gather necessary documentation, establish analysis group and decide when the CRIOP® analysis should be performed.” (p.i, SINTEF, 2004). “One of the most important principles of the CRIOP method is to verify that a focus is kept on important human factors, in relation to operation and handling of abnormal situations in offshore control centres, and to validate solutions and results.” (p.3, SINTEF, 2004).

The CRIOP methodology is focused on the HF aspects of change, rather than on transitional issues concerning the individual. The methodology is described in large detail and is built on a number of standards and guidelines, and is regularly updated. It has also been used outside the petroleum domain, for example in the transport domain. Given a focus on the operational HF aspects of control room, it is likely that the CRIOP methodology should have value for ATM.

3.1.9 Studio Apertura – The Pentagon model

The pentagon model is developed by Studio Apertura. The model: “illustrates how safety-critical behavior can be analyzed from a constructivist perspective, taking as its starting point the fact that people engaged in these kinds of activities always interpret their situation and the tasks to be performed, and choose their actions based on their understanding and evaluation of a set of internal and external factors. This kind of reasoning is based on action-oriented sociological theory, where we try to take “the actor’s point of view”. It is also influenced by phenomenological thinking: people construct their own reality, based on how they understand their own situation and surroundings. It is important to bear in mind that both formal and informal factors are taken into consideration in such processes.” (p.2, Schiefloe & Vikland, 2006)

In the Pentagon model safety-critical behaviour is seen as influenced by the following organizational attributes: structural; technological; cultural; interaction and relations.

The Pentagon model has been used in order to investigate an incident at an oil platform, and to evaluate the risk level in the oil industry by providing a framework for addressing how safety critical issues relate. Although not directly used as a tool in a change and transition setting, the five factors of the model might also prove valuable in these settings.

3.1.10 The Norwegian Oil Industry Association – Integrated Operation and HES (Health, Safety, Environment)

The introduction of Integrated Operations (IO) is expected to have significant benefits including improved HES (Health, Environment & Safety). Some HES improvements will come directly as a consequence of IO, whereas others will either stay the same or event get worse. The Norwegian Oil Industry Association wanted to address IO and HES, and arranged a workshop series where the major actors in the oil industry were invited aiming to find the HES challenges and solution (to the challenges). The document describes this work.

A number of concerns at the individual's level regarding C&T are included in HES (e.g. psychosocial work environment), and the process of identifying the problems and solutions has generic value. The biggest value is probably not so much the specific problems and solutions identified, as the methodology and approach taken to identify these issues bringing together the different actors of the domain.

3.2 Nuclear

3.2.1 The UK Nuclear Regulator's view of external influences on safety

The UK Nuclear Installations Inspectorate (NII) is more than fifty years old and has experienced a lot of changes within the nuclear field. The paper "The UK Nuclear Regulator's view of external influences on safety" (2001) is a relatively short paper summarizing the most resent changes in the UK and NII's response to these changes from their regulatory perspective. The paper introduces the LC36, a licence condition where the licensee must make arrangements to control changes from a safety perspective, without describing the contents of the license condition. The description of relevant change issues in this document thus serves as a high level case study.

3.2.2 Radiation and Nuclear Safety Authority – Management Of Safety Requirements In Subcontracting During the OLKILUOTO 3 Nuclear Power Plant Construction Phase

The document is an investigation report following the construction phase of a nuclear power plant in Finland. The background described was that: “The Radiation and Nuclear Safety Authority (STUK) concluded in connection with the construction of the Olkiluoto 3 nuclear power plant that the performance of the organisations involved in the project and the interaction between the organisations did not in all respects meet the expectations that STUK has on good safety culture during the construction phase of a power plant.” (p.2, STUK, 2006). An investigation team was established in order to address the safety culture performance of the organisations.

The investigation report describes a concern with safety culture, an investigation conducted, and the applied approach. The case studies are not directly concerned with the individual’s perspective on change or transition, but describe concerns residing at the organisational level. The generic aspect of the report is the approach taken towards a practical safety culture problem through the description of a case study, as well as the importance of safety management in sub-contracting during the construction phase of a plant.

3.2.3 Swedish Nuclear Power Inspectorate – Control room changes at Swedish nuclear power plants

The document describes a project that aimed to make a review of the changes in control room design implemented in the Swedish nuclear power plants and describe how the MTO (Man, Technology, Organisation) and MMI (Man - Machine Interface) issues have been integrated in the process in order to get knowledge of the change management process and the management of MTO issues in these projects (Kecklund, 2005).

The report includes a comprehensive description of standards and requirements and the different methods and tools that the different NPPs have applied as part of their change management. The report focuses on the different NPPs change management from an organisational perspective, not really including the transition issues from an individual’s perspective.

3.2.4 U.S. Nuclear Regulatory Commission – Human Factors Engineering Program Review Model

The U.S. Nuclear Regulatory Commission (NRC) produces a large number of guidelines in what is known as the NUREG series (http://www.nrc.gov). The NUREG series contains “Reports or brochures on regulatory decisions, results of research, results of incident investigations, and other technical and administrative information.” One of the NUREGs is the 0711, the “Human Factors Engineering Program Review Model” (2002). From the abstract: “This document is used by the staff of the Nuclear Regulatory Commission to review the human factors engineering (HFE) programs of applicants for construction permits, operating licenses, standard design certifications, combined operating licenses, and for license amendments. The purpose of these reviews is to verify that accepted HFE practices and guidelines are incorporated into the applicant's HFE program. The review methodology provides a basis for performing reviews that address the twelve elements of an HFE program: HFE Program Management, Operating Experience Review; Functional Requirements Analysis and Function Allocation, Task Analysis, Staffing, Human Reliability Analysis, Human-System Interface Design, Procedure Development, Training Program Development, Human Factors Verification and Validation, Design Implementation, and Human Performance Monitoring. Each review element is divided into four sections: Background, Objective, Applicant Submittals, and Review Criteria. References to sources of additional information are also provided for each element." (http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0711/index.html).

The NUREG 0711 is concerned with a broad selection of HF topics associated with change, and provides detailed lists of review criteria from a top down perspective. The focus of the review model is therefore not directly on the individual worker or transition issues. Still, the NUREG 0711 should be a valuable resource and checklist whenever changes affect HF issues.

3.2.5 Nuclear Energy Agency OECD – Managing and Regulating Organisational Change in Nuclear Installations

The paper "Managing and Regulating Organisational Change in Nuclear Installations" (NEA, 2004): "represents the consensus of specialists in human and organisational factors in the NEA member countries on the current state of the art in regulatory approaches to dealing with licensees' organisational change. The objective is to present an opinion to decision makers in the nuclear community on approaches which regulatory bodies may consider taking when dealing with organisational change. As such, the intended audience is primarily nuclear safety regulators. Government authorities, nuclear plant operators, industry leaders, researchers and the general public may also be interested." (p.9, NEA, 2004).

The paper introduces a number of elements relevant for regulators when addressing organisational change. Each identified issue is then described in a few paragraphs. The different elements are:

- A structured review process
- Licensee management of change process
    - Baseline assessment
    - Statement of proposed change
    - Categorisation of proposed change
    - Analysis and review of change proposal

- Implementation programme
- Review of change

- Other issues:
  - Communication between regulator and licensee
  - Impact of regulatory actions
  - Regulator awareness and assessment of licensee approach to contractorisation
  - Succession management and corporate memory
  - Licensee approach to morale and safety culture
  - Licensee management of unplanned changes

Even if the paper does not go in very detail on each of the element presented above, the presented approach will probably have generic value as factors to take into account when going through organisational changes.

3.2.6 Nuclear Energy Agency OECD – Report on the CSNI Workshop on Nuclear Power Plant Transition from Operation into Decommissioning: Human Factors and Organisation Considerations

The document presents the findings from a workshop focusing on the impact of decommissioning on organizational and human factors. The workshop identified eight key issues and the potential risks. The potential risks were discussed focusing on information and questions that need further research in order to improve understanding and successful implementation of the transition from operations to decommissioning. Eight issues and high priority needs were identified (NEA, 2000):

- Creating a system to share international experience
- Organisational memory and competence
- Organisational functions and management skills during transition from operations to decommissioning
- Safety culture and morale
- Contractor reliance
- Multiunit sites
- Delayed dismantlement

- Reconciling differing regulatory and government policies and requirements

For each of the eight issues listed above four sub-issues was addressed. These sub-issues concerns: risk of failure to address issue; experience and knowledge; gaps in knowledge and understanding, and; conclusions and suggestions.

The report describes a number of relevant issues concerning decommissioning. Even if the decommissioning described here is specific for the nuclear industry there are generic issues. Firstly, the workshop approach to identify the risk factors, the current knowledge and the gaps can be applied to other domains. In addition, a number of factors concerning decommissioning and how there factors are addressed will be relevant to other domains, e.g. staff uncertainty and safety culture.

3.2.7 Nuclear Energy Agency OECD – Regulatory Aspects of management of Change Summary and Conclusions

The report is the results of a workshop addressing regulatory aspects of management of change. The background for the workshop is the potential safety issues associated with organisational changes and the regulators' roles and tasks. The results of the workshop are the identification of major risks and the regulators challenges. As described in the summary: "The workshop noted that effective regulation of organisational change has many elements, requires constructive and early dialogue between regulator and licensee and must take account of the drivers for the specific change. Areas warranting further research and development were identified." (p.6. NEA, 2002).

There are two possible contributions of the report. The first is the workshop methodology used to address the issue of organisational change. The second potential contribution is the concrete findings from the workshop. The findings from this NEA workshop consist mainly of safety concerns and challenges, and are to a large extent describing areas of discussion regarding the roles and responsibilities of licensees and the regulator.

3.2.8 International Atomic Energy Agency – Managing change in nuclear utilities

The objective of the document "Managing change in nuclear utilities" is: "to provide a description of the basic principles for managing change in nuclear utilities that is based on the practices being used in many Member States by senior management and regulators to implement effective change whilst remaining focused on safe and reliable nuclear operation. This publication gives practical guidance for senior management to manage changes effectively in their utility." (p.1, IAEA, 2001).

The guideline proposes a change process model and describes the different steps. The descriptions include background information and principles, as well as tasks, checklist, flow charts, and different example forms and content descriptions. As such, the guideline comes through as detailed and comprehensive.

3.2.9 International Atomic Energy Agency – Human resource issues related to an expanding nuclear power programme

The described document is a guideline on human resource management (including staffing) and training/education programmes for new nuclear power plant (NPP) designs. The background is that future NPPs may have needs in this area that should be met by guidelines. The report consists of two main sections, where the first addresses human resource issues like staffing and organization, recruitment and retention, training and education, and work force planning. The other section describes critical influencing factors that have an impact on the human resource issues. In addition are case studies included, describing the human resource management challenges and the way these challenges are met.

The guideline is developed for the nuclear domain and focuses on nuclear specific conditions and issues regarding human resources management. Still, a lot of the considerations raised contains generic aspects and could be used as checklists in other domains.

3.2.10 Nordic Nuclear Safety Research – Management of change in the nuclear industry – Evidence from maintenance reorganizations

From the abstract: "The nuclear industry and especially the maintenance activities have been under various restructuring initiatives in addition to continuous incremental change due to e.g. new technologies, ageing plants, deregulation and the change of generation. These changes have been experienced as causing stress and uncertainty among the workers. Also, changes have lead to e.g. lowered sense of control, goal unclarity and lowered sense of personal responsibility over one's work. Organizational changes clearly are issues that have potential effects on safety. Both positive and negative cases on safety effects of organizational changes exist, and various accidents have been pinpointed to organizational changes in the company. In this report the challenges of management of change at nuclear power plants are considered mainly from organizational culture -perspective." (…) "The report is based on four case studies of reorganizing in NPP maintenance units and on a literature review of change management at various other safety critical organizations. The report presents a framework for considering organizational changes and their safety consequences." (p. ii, Reiman et al., 2006).

The report discusses different theoretical approaches (including the "International Atomic Energy Agency – Managing change in nuclear utilities" described ovan) to change management in light of four case studies within the nuclear industry. In this way, different strengths and weaknesses are evaluated and new practices introduced. The report might be an interesting reference for change management within ATM.

3.3 Chemical / technical

3.3.1 The Swedish Work Environment Authority - ABC for risk assessment during changes in work operations

Short checklist and advices concerning risks and how to prevent them when planning changes in organizational structures or work operations.

3.3.2 The Swedish Work Environment Authority - Investigation and risk assessment in systematic work environment management – a guide

Guideline that describes how employers and employees can consciously investigate working conditions, identify risk sources and assess risks. Examples are given of methods of investigation and risk assessment, and the guide also instances measures which can prevent employees being injured or otherwise being harmed.

3.3.3 The Swedish Work Environment Authority - Systematic Work Environment Management – a guideline

Guideline that describes the basic elements of work environment management. That management needs to be adapted to their particular operation

3.3.4 HSE - Health and Safety Executive UK - Business re-engineering and health and safety management - Best practice model

Best practice model that has been prepared to give practical advice to directors, managers and health and safety professionals involved in the conception, planning, assessment and implementation of changes in business organisation and management which have the potential to impact health and safety.

3.3.5 HSE - Health and Safety Executive UK - Business re-engineering and health and safety management – Case studies

Report that provides a summary of how a sample of organisations approached the management of the health and safety aspects of major organisational change.

3.3.6 HSE - Health and Safety Executive UK - Business re-engineering and health and safety management – Literature survey

Report that summarises the findings of a survey of a cross section of current publicly available literature on: the scale and form of business reengineering in the UK; the effect that business reengineering has on health and safety standards; the health and safety issues pitfalls and opportunities associated with business

3.3.7 HSE - Health and Safety Executive UK - Organisational change and major accident hazards

Guideline that provides guidance for employers responsible for major hazards on how to manage the impact of organisational change on their control of the hazards.

3.3.8 Swedish Rescue Services Agency - Proactive Risk Management in a Dynamic Society

Study with the objective to better understand the mechanisms of major accidents in the present dynamic and technological society. From this understanding, guides to improved strategies for industrial risk management are sought.

3.3.9 EPSC - European Process Safety Centre - Safety issues in a dynamic business environment

Conference proceedings covering the issues of safety management with respect to companies re-organizing at both a corporate and site level; macro and micro level organisational change, challenges posed by the merging of organisations and their individual cultures.

3.3.10 IPS – The Swedish Association of Process Safety - IPS – Downsizing

Model including specific risk analysis methods to provide companies involved in downsizing some assistance in how suitable risk analyses can be conducted.

3.3.11 Weibullkonsult AB - Safe modifications in the process industry

Guideline to help organizations developing relevant and effective routines concerning modifications in their operations.

3.3.12 HE Lagerstrom AB - SORK - Systematic risk- and consequence analysis during organizational change

Systematic method/procedure for organizational change including checklists to find and prevent potential risk for work injuries in new organization settings

3.3.13 AkzoNobel – RACKETman

RACKETman is in short a checklist covering four important areas for organisational safety ability and performance. RA stands for Responsibilities and Authorities, CK stands for Competence and Knowledge, ET stands for Education and Training and finally man, stands for manpower for HSE activities.

3.4 Maritime

3.4.1 International Safety Management Code (ISM Code)

Since the 1980s the International Maritime Organization (IMO) has increasingly addressed the people involved in shipping in its work. In 1989, IMO adopted *Guidelines on management for the safe operation of ships and for pollution prevention* - the forerunner of what became the International Safety Management (ISM) Code which was made mandatory through the International Convention for the Safety of Life at Sea, 1974 (SOLAS).

The ISM Code is intended to improve the safety of international shipping and to reduce pollution from ships by impacting on the way shipping companies are managed and operated. The ISM Code establishes an international standard for the safe management and operation of ships and for the implementation of a safety management system (SMS).

Effective implementation of the ISM Code should lead to a move away from a culture of "unthinking" compliance with external rules towards a culture of "thinking" self-regulation of safety - the development of a 'safety culture'. The safety culture involves moving to a culture of self-regulation, with every individual - from the top to the bottom - feeling responsible for actions taken to improve safety and performance.

The Guidelines are based on general principles and objectives so as to promote evolution of sound management and operating practices within the industry as a whole. Every company is expected "to designate a person or persons ashore having direct access to the highest level of management".

The procedures required by the Code should be documented and compiled in a Safety Management Manual, a copy of which should be kept on board.

3.4.2 Standards of Training, Certification and Watchkeeping for Seafarers (STCW)

The 1978 STCW Convention was the first to establish basic requirements on training, certification and watchkeeping for seafarers on an international level. Previously the standards of training, certification and watchkeeping of officers and ratings were established by individual governments, usually without reference to practices in other countries. As a result standards and procedures varied widely, even though shipping is the most international of all industries.

The Convention prescribes minimum standards relating to training, certification and watchkeeping for seafarers which countries are obliged to meet or exceed.

3.4.3 International Convention for the Safety of Life at Sea (SOLAS)

The SOLAS Convention in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant ships. The first version was adopted in 1914, in response to the Titanic disaster, the second in 1929, the third in 1948, and the fourth in 1960. The 1960 Convention was the first major task for IMO after the Organization's creation and it represented a considerable step forward in modernizing regulations and in keeping pace with technical developments in the shipping industry.

The main objective of the SOLAS Convention is to specify minimum standards for the construction, equipment and operation of ships, compatible with their safety. Flag States are responsible for ensuring that ships under their flag comply with its requirements, and a number of certificates are prescribed in the Convention as proof that this has been done. Control provisions also allow Contracting Governments to inspect ships of other Contracting States if there are clear grounds for believing that the ship and its equipment do not substantially comply with the requirements of the Convention - this procedure is known as port State control. The current SOLAS Convention (1974, with numerous updating and amendment) includes Articles setting out general obligations, amendment procedure and so on.

3.4.4 Voluntary IMO Member State Audit Scheme

The Voluntary IMO Member State Audit Scheme is intended to provide an audited Member State with a comprehensive and objective assessment of how effectively it administers and implements those mandatory IMO instruments which are covered by the Scheme.

It is reasonably expected that the audit scheme will bring about many benefits, such as identifying where capacity-building activities (for example, the provision of technical assistance by IMO to Member States) would have the greatest effect. Targeting of appropriate action to improve performance would be greatly improved. The Member States themselves would receive valuable feedback, intended to assist them in improving their own capacity to put the applicable instruments into practice; and generic lessons learnt from audits could be provided to all Member States so that the benefits could be widely shared.

The scheme addresses issues such as conformance in enacting appropriate legislation for the IMO instruments to which a Member State is a Party; the administration and enforcement of the applicable laws and regulations by the Member State; the delegation of authority to recognized organizations; the related control and monitoring mechanism of the survey and certification processes by the Member States.

3.4.5 Formal Safety Assessment (FSA)

One way of ensuring that action is taken before a disaster occurs is the use of a process known as formal safety assessment (FSA). This has been described as "a rational and systematic process for assessing the risks associated with shipping activity and for evaluating the costs and benefits of IMO's options for reducing these risks." FSA - which was originally developed, partly at least, as a response to the Piper Alpha disaster of 1988, when an offshore platform exploded in the North Sea and 167 people lost their lives - is now being applied to the IMO rule making process.

FSA is a structured and systematic methodology, aimed at enhancing maritime safety, including protection of life, health, the marine environment and property, by using risk analysis and cost benefit assessment. FSA can be used as a tool to help in the evaluation of new regulations for maritime safety and protection of the marine environment or in making a comparison between existing and possibly improved regulations, with a view to achieving a balance between the various technical and operational issues, including the human element, and between maritime safety or protection of the marine environment and costs.

Application of FSA may be particularly relevant to proposals for regulatory measures that have far reaching implications in terms of costs to the maritime industry or the administrative or legislative burdens that may result. This is achieved by providing a clear justification for proposed regulatory measures and allowing comparison of different options of such measures to be made. This is in line with the basic philosophy of FSA in that it can be used as a tool to facilitate a transparent decision-making process. In addition, it provides a means of being proactive, enabling potential hazards to be considered before a serious accident occurs.

3.4.6 Easy to do the right thing – The art of updating a vessels' bridge (In Swedish)

The aim of this guidance material is to create a better working environment for people working on board smaller vessels and to increase the knowledge on how to produce this. The material focuses on a vessels' bridge, but can be applied also on other workplaces on board. The guidance material is based on the MTO-perspective, i.e. the philosophy saying that humans, their tasks and their surrounding world constitute a system were all factors interact.

3.4.7 Strategy for the international work 2006-2012 (In Swedish)

The strategy points out the agenda items that the Swedish maritime safety inspectorate should focus on the coming six year period.

4. SUMMARY & CONCLUSION

The findings from this study cover about 40 different methods, tools, case studies, etc. from four different HRO domains. The collected material include change management models and guidelines; rules and regulations; review checklists and guidelines; Human Factors in design considerations; transition guidelines for union representatives; verification and validation techniques; workshop findings; in addition to various case studies.

The reported material comes from what has been labelled different actors within four different domains. This corresponds with the fact that different material has different intentions and users. A situation of change and transition will to different degrees involve or affect the different actors, and by including and aligning methods and tools from the different actors when developing ATM specific tools and methods an important perspective is safeguarded.

Some of the findings have generic value and can be applied outside the domain in which it originates. Other material can probably be modified or developed in order to fit ATM, whereas other material probably is too specific or requires too much effort for applicability within ATM.

The methods, tools and case studies report here, together with the material identified and collected in the parallel activities of WP2 and WP4 should provide a rich material for the development of a compendium on change and transition in ATM.

5. REFERENCES

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Appendix A - CTTF method and tool description and classification template

SENSE Change & Transition Task Force

Template for description and classification of methods and tools to be collected in the course of task 2 to 4 (as agreed in CTTF 04, Hamburg)

This template shall be used to document all relevant **Methods & Tools, Best practices, Case studies, and Reference and guidance material** in the context of change & transition. For each please fill in a new sheet and save it under the name of the method/ tool etc.

Related to **which task**? Please enter an **X** in the box to the right.	
Task 2: ATM	
Task 3: Safety related and high risk environment industry	
Task 4: Other areas outside ATM and high risk environment	

Which **type of method etc.?** Please enter an **X** in the box to the right	
Methods & Tools	
Best practice	
Case study	
Reference and guidance material	

<u>Please fill in all available information where applicable.</u>

Name of method or tool, best practice, cases study, or reference and guidance material (it should correspond to that given in the Excel table "CTTF method and tool classification overview")
Name and affiliation of the **developer and source** where to obtain the method or tool
Year of development/ publication/ application, date of updates This information is necessary to identify methods or tools which might have become outdated
Language(s) in which the method/ tool etc. is available To identify whether it is easily applicable, or translation expertise is necessary and available.
Type of method or tool / Instrument type E.g. observation, questionnaire, interview, checklist, measurement instrument, etc.
Item Type(s)

These could be e.g. multiple choice, rating scales (if applicable)
Description of the **content** of the method/tool including an application guide or at least a reference to the necessary information to perform the measurement.
Description of collected **parameters** and their data format (scoring procedure, scales and items); results obtained.
Population for which method/ tool was designed (e.g. ATCOs, technical staff, pilots etc.) This information is needed to decide whether a method is specific to a certain population or if it can be used more generally.
Validity This should include the type of validation procedure, e.g. content, construct, criterion-related validity.
Reliability This should include the type of reliability and procedure, e.g. test-retest, parallel form, split half, Kuder-Richardson, etc.
Objectivity It should be documented if and how objectivity is assured.
Cost information This includes costs for obtaining tools or licenses, cost of necessary equipment, e.g. scoring devices, and any other costs, for instance training to use a method/ tool or required experts if not available.
Prerequisites for application Can a method be used at any time, any place or only in certain settings like simulations, field trials, etc.
Requirements/constraints concerning **conditions** under which the measurement shall be performed
Requirements/constraints concerning the **equipment** to be used This could range from paper and pencil up to high-fidelity real time simulators.
Requirements/constraints concerning **qualifications** of the person, i.e. the expertise of the person performing the measurement (e.g. psychologist, ergonomist, physiologist, management personnel, etc.) or training necessary for that

person
Estimate of the **effort** required to perform the measurement and analyse data (time, people, equipment, resources); this is related to usability and practicability of a method or tool
Experiences with that method or tool in the ATM context, including reference/ contact details of recent users
Advantages / disadvantages, if known, of the method or tool All positive and negative aspects concerning a method/ tool. Ideally this includes experiences of previous applications of a method or tool.
Alternative methods / tools If known, which other methods/ tools could be used instead?
Possible **combination** with other methods/ tools Are there other methods/ tools recommended to be used conjointly?

Finally, please mark with a cross X the classification criteria and ad remarks if necessary.

Phase of C&T process when method/ tool can be applied (This is the classification dimension described in chapter 3.3.2). (Please enter an **X** in the box right to the phase. Multiple answers are possible - if a method or tool is appropriate for use in different phases then all of them should be mentioned)	
Early (related to EATM phases Initiation, Planning, Feasibility)	
Middle (related to EATM phases Development, Pre-operational)	
Late (related to EATM phases Implementation, Local Implementation, Operations)	
Further remarks:	

Intended **application area** (i.e. HF Area and HF issue) This is the classification dimension described in Chapters 3.3.3 and 4.3. Please enter an **X** in the box right to the measurement object. Multiple answers are possible - if a method or tool is appropriate for use in different application areas then all of them should be mentioned	
Strategy and Planning	
Communication and involvement	
Resources	
Acceptance and Resistance	
Diversity and Flexibility	
Training and development	
Further remarks:	

Object of measurement E.g. intended for individuals, team, group, department, or company as described in Chapter . 3.3.4. Please enter an **X** in the box right to the measurement object. Multiple answers are possible - if a method or tool etc. is appropriate for different measurement objects then all of them should be mentioned	
Individual level	
Team Level	
Professional level (Occupational Group)	
Department/ unit level	
Company level	
Further remarks:	

Purpose of measurement This dimension describes the purpose for which a method or tool can be used (see Chapter 3.3.5). Please enter an **X** in the box right to the measurement object. Multiple assignments are possible.	
Diagnosis	
Prognosis	
Prevention	
Intervention	
If possible, alternatively or additionally indicate by an "x" the **level of precision** a method/ tool can fulfil (refer to Table 2 in chapter 3.3.5 in the Classification document)	
Orienting (to provide general information and obtaining information on the direction)	
Screening (i.e. to anticipate problems or identify their causes, to indicate whether intervention is necessary, to make a choice between alternative directions)	
Measurement (i.e. to obtain reliable and valid information)	
Further remarks:	

6. APPENDIX B - CTTF METHOD AND TOOL CLASSIFICATION OVERVIEW

Name of Method/ tool, Best practice, Case study, Reference and guidance material; **For each enter the name in the fields ot the rigth.** The names should correspond to those in the Word document "Description & classification sheet". **Then mark with a cross X the type.**	1	Example method	
Method/ Tool	1	**x**	
Best Practice	0		
Case Study	0		
Reference & guidance material	0		
		1	0

Phase of application **just mark with a cross X in the grey fields;** **multiple assignments are possible** (if a method or tool is appropriate for use in different phases then all of them should be mentioned)**;** **if necessary, add short remarks in this line (dark grey fields).**		only in simulation	
Early (related to the EATM phases Initiation, Planning, Feasibility)	0		
Middle (related to the EATM phases Development, Pre-Operational)	1	**x**	
Late (related to the EATM phases Implementation, Local Implementation, Operations)	1	**x**	
		2	0

Change & Transition area related to chapters 3.3.3 and 4.3 of the document "Classification Scheme of Human Factors Methods and Tools for Impact of Change Measurement" **just mark with a cross X in the grey fields;** **multiple assignments are possible;** **if necessary, add short remarks in this line (dark grey fields).**		only in simulation	
Strategy & Planning	0		
Communication & Involvement	0		
Resources	1	**x**	
Acceptance & Resistance	1	**x**	
Diversity & Flexibility	1	**x**	
Training & Development	0		
		3	0

Object of Measurement related to Hourglass Model **just mark with a cross X in the grey fields;** **multiple assignments possible;** **if necessary, add short remarks in this line (dark grey fields).**		remark	
Individual Level	0		
Team Level	0		
Occupational Level (Professional Level)	0		
Department/ Unit Level	0		
Company Level	0		

		0	0

Purpose of Measurement **just mark with a cross X in the grey fields;** **multiple assignments possible;** **if necessary, add short remarks in this line (dark grey fields).**		remark	
Diagnosis	0		
Prognosis	0		
Prevention	0		
Intervention	0		
		0	0
If possible alternatively or additionally indicate by an "x" the level of precision a method/ tool can fulfil (refer to Table 2 in chapter 3.3.5 in the Classification document)		remark	
Accurate Measurement	0		
Screening	0		
Orienting	0		
		0	0

Scenario **(**related to chapter 3.3.6 of the Classifiaction document) **Indicate possible scenario in which method/ tool is appropriate** **just mark with a cross X in the grey field right to a scenario** **multiple assignments are possible;** **if necessary, add short remarks in this line (dark grey fields).**		remark	
Generally applicable, not related to a specific scenario.	0		
More competition through market liberalisation and necessary certification of ANSPs; privatisation of ANSPs.	0		
Consolidation of ACCs, mergers of ACCs; centralisation/ integration of services; change of location of unit; centralisation of functions, eg. technical maintenance and remote operations;	0		
Implementation of international working structures in regard to Functional Airspace Blocks (FAB).	0		
More integrated ATM processes through collaborative decision making (CDM).	0		
Increased demand for mobility of Air Traffic Controllers (ATCOs); different workplaces during career; integration of foreign staff in multinational teams; integration of foreign ATCOs and ab initio trainees in national culture.	0		
Paradigm shift in ATM, e.g. through new allocation of responsibilities between air and ground.	0		
New rostering schemes driven by efficiency concerns; introduction of new shift cycles.	0		
New organisational structures of ANSPs.	0		
New ATM systems, e.g. very advanced systems, increased automation and tool support; paper stripless systems; introduction of controller pilot data link communication (CPDLC); new equipment.	1	**x**	
New ATM procedures, e.g. through advanced ATM systems and automation support in decision making; implementation of FABs, changing working roles when introducing the multi sector planner concept; altering communication when using CPDLC.	1	**x**	

Implementation of Eurocontrol Safety Regulatory Requirements (ESARR); Europe wide licensing of ATCOs or maintenance staff; new laws and legislation; implementation of international regulations.	0		
New working roles; emergence of new occupations; new team roles (e.g. multi sector planner).	0		
Change of incident reporting; safety culture.	0		
… (you may add further scenarios)	0		
		2	0

7. APPENDIX C - CTTF METHOD AND TOOL DESCRIPTIONS AND CLASSIFICATIONS