Experience transfer as a contributor to increased HSE level in Integrated Operations

Master thesis in Safety, Health and Environment

Spring 2007

Anne Kristine Solem

NTNU

Faculty of Social Sciences and Technology Management
Department of Industrial Economics and Technology Management

STATOIL

Norges teknisk-
naturvitenskapelige universitet
NTNU

Fakultet for samfunnsvitenskap
og teknologiledelse

Institutt for industriell økonomi og teknologiledelse

MASTEROPPGAVE

for

STUD.TECHN. Anne Kristine Solem

Fagområde	**Helse, Miljø og Sikkerhet** Safety, Health and Environment
Utleveringsdato	15. januar 2007
Tittel	**Erfaringsoverføring som bidragsyter til økt HMS-nivå ved Integrerte Operasjoner** Experience transfer as a contributor to increased HSE-level in Integrated Operations
Formål	Oppgaven har som formål å kartlegge bruken av HMS-relaterte erfaringsdata i tilknytning til Integrerte Operasjoner (IO). Oppgaven vil søke å belyse hvordan organisatorisk læring og erfaringsoverføring basert på slike data blir ivaretatt på en offshoreinstallasjon som har innført IO, og hvordan erfaringsoverføring mellom installasjoner ivaretas.

Hovedpunkter

- Studere og presentere relevant teori og litteratur om erfaringsoverføring
- Drøfte hvilke forutsetningers som må være tilstede for at bruk av erfaringsdata skal bidra til organisasjonslæring og økt HMS-nivå
- Samle inn data om dagens praksis for rapportering og bruk av erfaringsdata på en installasjon som har innført IO.
- Samle inn data om tiltak og virkemidler som benyttes for å fremme erfaringsoverføring mellom installasjoner
- Diskutere og foreslå tiltak for bedret erfaringsoverføring og organisatorisk læring på enkeltinstallasjoner og mellom installasjoner

Organisering

Masteroppgaven utføres for Sintef Teknologi og Samfunn
Veileder er seniorforsker Stig Ole Johnsen, Sintef Teknologi og Samfunn
Datainnsamling hos Statoil

Representant for instituttledelsen

Faglærer Jan Hovden

MASTEROPPGAVE

10 semester 2007

Student Anne Kristine Solem
Institutt for industriell økonomi og teknologiledelse

ERKLÆRING

Jeg erklærer herved på ære og samvittighet at jeg har utført ovennevnte hovedoppgave selv og uten noen som helst ulovlig hjelp

Trondheim
Sted

11.6.2007
dato

Anne Kristine Solem
Signatur

NTNU

STANDARD AGREEMENT

Agreement between student Anne Kristine Solem **date of birth** 19.02.83**,**

academic supervisor at NTNU Jan Hovden**,**

company/organization Statoil **and**

Norwegian University of Science and Technology (hereafter NTNU), represented by the Director of Faculty of Social Sciences and Technology Management

concerning the use and exploitation of the specifications and results from the thesis for the Master of Science degree in accordance with the supplementary regulations to the examination regulations for the Master of Science degree at NTNU, passed on 28 April 2003 by the Board for Engineering Studies (sivilingeniørutdanningen) at NTNU.

1. The student is to complete his/her Master's thesis at: Statoil (company/organization).

   The title of the thesis is: Experience transfer as a contributor to increased HSE level in Integrated Operations

2. The student has the intellectual property rights to his/her thesis. However, the thesis with drawings, models and software, which are included as a part of/or appended to the thesis are the property of NTNU. The thesis and any appendices to the thesis can be used by NTNU for educational and scientific purposes free for charge. The thesis and its appendices may not be used for other purposes.

3. The student has the right to publish his/her diploma thesis or parts of it, as an independent work, or as a part of a more extensive work, or in a popularized form in any publication or journal.

4. The company/organization is entitled to receive one copy of the thesis with appendices and be informed of NTNU's grading of the thesis. The company/organization is given three months from the date the thesis is delivered to NTNU for grading to determine whether the results are patentable and file a patent application for all or part of the results in the thesis. The company/organization is permitted to make use of the specifications and the results in the thesis in its own operations. If the specifications and the results in the thesis are to be exploited commercially by the company/organization, a supplementary agreement concerning financial exploitation has been entered into by the parties to this agreement. NTNU's supplementary agreement concerning financial exploitation is to be used for this purpose. The supplementary

agreement concerning financial exploitation agreement is to be signed in 4 - four - copies, where each party to the agreement is to keep one copy and comes into effect when has been approved and signed by NTNU, represented by the Director of Faculty of Social Sciences and Technology Management.

5. In special cases, the publication of the thesis in accordance with § 2 and § 3 of this agreement can be delayed for a maximum of 5 years. In this case a supplementary agreement / restriction agreement is to be made between the student, the supervisor, the company/organization and NTNU. NTNU's supplementary agreement / restriction agreement is to be used for this purpose. The supplementary agreement / restriction agreement is to be signed in 4 - four - copies, where each party to the agreement is to keep one copy and comes into effect when has been approved and signed by NTNU, Director of Faculty of Social Sciences and Technology Management.

6. This agreement takes precedence over any other agreement(s) entered into by two of the parties mentioned above.

7. Should there be any dispute relating to this agreement, it should be resolved by negotiations. If this does not lead to a solution, the parties agree to the matter being resolved by arbitration in accordance with Norwegian law. Any such dispute is to be decided by the District Stipendiary Magistrate in the City of Trondheim or whoever he/she appoints.

8. This agreement is signed in 4 - four - copies, where each party to this agreement is to keep one copy. The agreement comes into effect when has been approved and signed by NTNU, Director of Faculty of Social Sciences and Technology Management.

Trondheim .... (place)

7/6-07 .... (date)

Anne Kristine Solem .... Student

.... Supervisor at NTNU

.... ~~Manager HMST TA, Statoil~~ Discipline advisor for company/organization (signed and stamped)

Approval of the agreement:

7/6.07

NTNU
Institutt for industriell økonomi og teknologiledelse
7491 TRONDHEIM

....
Director of Faculty of Social Sciences and Technology Management, NTNU (dated, signed and stamped)

NTNU, 2005-03-07

NTNU

SUPPLEMENTARY AGREEMENT / RESTRICTION AGREEMENT

(In accordance with § 5 of the standard agreement)

Supplementary agreement between student Anne Kristine Solem
date of birth 19.02.83,

academic supervisor at NTNU Jan Hovden,

company/organization Statoil **and**

the Norwegian University of Science and Technology (hereafter NTNU), represented by the Director of Faculty of Social Sciences and Technology Management

in connection with the standard agreement that is in force about the use and exploitation of the specifications and results from the thesis for the Master of Science degree in accordance with the supplementary regulations to the examination regulations for the Master of Science degree at NTNU, passed on 28 April 2003 by the Board for Engineering Studies (sivilingeniørutdanningen) at NTNU.

1. *In accordance with § 5 of the standard agreement* that has been entered into by the above parties, the said parties have agreed that the thesis is to be kept confidential for 5 years from the time this present agreement is entered into.

2. This restriction is imposed due to consideration of the competitiveness of the company/-organization.

3. *After the thesis has been graded,* it is to be delivered to the respective Faculty at NTNU which will arrange for safekeeping in a bank vault during the confidentiality period. After this period has expired, the thesis will be returned to the department concerned.

4. This agreement is signed in 4 - four - copies, where each party to this agreement is to keep one copy. The agreement comes into effect when has been approved and signed by NTNU, represented by the Director of Faculty of Social Sciences and Technology Management.

Trondheim
(place)

7/6 - 07
(date)

Anne Kristine Solem
Student

Supervisor at NTNU

~~Manager HMST TA,~~ Statoil
Discipline advisor

Approval of the agreement:

7/6-07

NTNU
Institutt for industriell økonomi
og teknologiledelse
7491 TRONDHEIM

Director of Social Sciences and Technology Management, NTNU (dated, signed and stamped)

NTNU, 2005-03-07

Preface

This master thesis is written at the Department of Industrial Economics and Technology Management at the Norwegian University of Science and Technology (NTNU), with specialization in Safety, Health and Environment (HSE). The thesis is written in co-operation with Statoil and Sintef which have provided the necessary resources. The main objective of this thesis is to see how the HSE-level and experience transfer are influenced by Integrated Operations. The objective of the thesis is based on my own interests and issues of interests in Statoil.

Several people have been involved in this thesis with good advice, guidance and professional knowledge. I would especially thank my teaching supervisor Stig Ole Johnsen in Sintef for contributing with professional guidance, constructive feedback and motivation. I would also like to thank my supervisor in Statoil, Arne Jarl Ringstad, for organization of field work and for constructive comments, Irene Wærø in Sintef, Charlotte Zahl Kristiansen and Tore Mollan for helpful inputs and constructive feedback. I would also like to thank both Sintef, Center for Integrated Operations in the Petroleum Industry at NTNU and Statoil for economic support which made the field work possible.

Lastly I would like to thank all the informants who gave me the information needed to make this thesis possible.

Trondheim, June 11, 2007

Anne Kristine Solem

Abstract

The objective of this thesis has been to investigate how the use of Integrated Operations (IO) has influenced the HSE-level and experience transfer in the oil and gas industry. IO has several meanings, but in this thesis IO is limited to only include onshore engineering support of operations through operations room. A case is performed in Statfjord RESU in Statoil and their operations room is located at Forus Vest. Several of the findings are related to the specific conditions in Statfjord RESU, but several of them may also be general findings for the industry.

The first research question is: “How does the use of IO influence the HSE-level in Statfjord RESU?” The main objectives of implementing IO in Statfjord RESU were identified. The two most important factors were; to do the offshore support more efficiently because of a lack of engineering resources and to reduce the number of personnel offshore because of a shortage of sleeping accommodation. HSE was not an objective when IO was implemented in Statfjord RESU. During organisational changes it is important to inform the employees about the objectives of the changes. This has not been done good enough in Statfjord RESU since several of the informants did not know the objectives of the implementation of IO. Some selected criteria have been used to evaluate the HSE-level after the implementation of IO. The evaluation is made by doing a comparison between the incidents connected to the chosen criteria before and after the implementation of IO. It turned out that the frequency of the reported incidents has decreased, in addition there was a reduction in the total frequency of accidents and near-accidents. Even though the frequency of accidents has decreased, IO has not contributed to any reduction in the number of reported personnel injuries or other incidents of a high potential. Work practice is over-represented as a contributing factor of the yellow and red incidents. This may be an indication of an insufficient evaluation of the different incidents since there usually is a combination of human, organisational and technological factors affecting human behaviour and work practice.

The second research question is: “What possibilities and threats does the use of IO cause for the experience transfer in Statfjord RESU?” The three main possibilities considered as the most important ones were to improve the process for preparing and updating operational procedures, secondly better utilization of competence in the organisation because more people are involved in the planning and execution of the operations. At last a better collaboration between onshore and offshore. The three threats considered as the most important ones were firstly information-overflow. Statfjord RESU and Statoil have many systems and arenas for experience transfer which makes the amount of experience data over-complex and several of the systems are not searchable. The second main threat is a lack of priority to transfer experience. IO has resulted in other work tasks and methods use in planning and execution of operations which contribute to a higher workload on personnel both onshore and offshore. This results in less time to share and make use of experience. The third main threat is the lack of "hands-on" experience among the engineers. An important element is removed when the engineers do not travel offshore since they do not have the possibility to gain operational knowledge and experience when they are onshore. This may affect the planning and execution of operations.

In addition the face-to-face conversation between engineers and offshore personnel will also disappear. Face-to-face conversation is an arena where problems are intercepted easier. All planning is made onshore and all the plans have to be communicated through more links before they reach the personnel performing the operations offshore. This may result in communication difficulties where details can get lost.

Research question three is: "How can experience transfer in Statfjord RESU and in Statoil be improved?" The managers attitudes towards experience transfer is an important element and it is therefore important that they demonstrate to the different units in Statoil, the importance of experience transfer and organise to prevent goal conflicts. Many systems are used randomly today and several are not used in the planning and execution of operations. Therefore the management should contribute to make efficient systems. It is necessary to close the control-loop to improve the experience transfer and organisational learning in Statfjord RESU and Statoil More possibilities and threats are addressed which influence the experience transfer. It is important to continue developing the possibilities and to do corrective actions where needed. The corrective actions should involve changes of the governing variables which may contribute to organisational learning. In addition can a better and a more systematized accident investigation based on the accident database Synergi contribute to increased organisational learning. The systematisation includes both reporting and how data are used.

Sammendrag

Oppgavens formål har vært å undersøke hvordan bruk av Integrerte Operasjoner (IO) påvirker HMS-nivå og erfaringsoverføring i olje og gass industrien. IO er et vidt begrep, men i denne oppgaven er IO begrenset til at ingeniører støtter operasjoner offshore fra et operasjonsrom på land. Et case studium ble gjennomført hos Statfjord RESU i Statoil. Deres operasjonsrom ligger på Forus Vest. Flere av funnene er knyttet opp mot spesifikke forhold i Statfjord RESU, men flere kan også være generelle funn for industrien.

Det første forskningsspørsmålet lyder som følger: ” Hvordan er HMS-nivået i Statfjord RESU påvirket av innføringen av IO?” Det ble da sett på målsetningene med å innføre IO på Statfjord RESU og de to viktigste var å gjøre offshore-støtten mer effektiv på grunn av mangel på ingeniør ressurser og redusere antall personer offshore på grunn av mangel på sengeplasser. HMS var ikke et mål når IO ble innført i Statfjord RESU. Et viktig aspekt i store organisasjons endringer er at de ansatte blir informert om endringene og målsetningene med endringene Dette har ikke vært gjort på en god nok måte i Statfjord RESU da flere av de ansatte ikke kjenner til målsetningene med å innføre IO. Til å vurdere HMS-nivået etter innføringen av IO har noen utvalgte kriterier blitt benyttet. Det har blitt gjennomført en vurdering av kriteriene ved å se på utviklingen av hendelsene knyttet til disse kriteriene før og etter innføringen av IO. Det viser seg at frekvensen av rapporterte hendelser er redusert etter innføringen av IO, i tillegg er også frekvensen av ulykker og nesten-ulykker redusert. Selv om ulykkes-frekvensen er redusert, viser det seg at IO ikke har bidratt til en reduksjon i antall rapporterte personskader eller andre hendelser med høyt potensial. Arbeidspraksis er over-representert som bakenforliggende årsak til de gule og røde hendelsene. Dette viser en mangelfull vurdering av de ulike hendelsene da det som regel er sammensetning av årsaker knyttet til menneskelige, organisatoriske og tekniske faktorer som bidrar til at mennesker handler som de gjør.

Det andre forskningsspørsmålet er ”Hvilke muligheter og trusler medfører IO for erfaringsoverføringen i Statfjord RESU?” De tre mulighetene som er vurdert til å være de viktigste er forbedrede muligheter til å utarbeide og oppdatere prosedyrer, bedre utnyttelse av kompetanse i organisasjonen hvor flere er involvert i planlegging og gjennomføring av operasjoner og tettere samarbeid mellom hav og land. De tre truslene som er vurdert til å være de viktigste i forhold til erfaringsoverføring er for det første at Statfjord RESU og Statoil har

mange systemer og arenaer for erfaringsoverføring som gjør mengden erfaringsdata uoversiktlig. Flere av systemene er heller ikke er søkbare. En annen trussel er mangel på prioritering av erfaringsoverføring. Innføringen av IO har medført andre arbeidsoppgaver og metoder for planlegging og gjennomføring av operasjoner som medfører høyt arbeidspress på både personell offshore og på land. Dette resulterer i lite tid til erfaringsoverføring som involverer både deling og bruk av tidligere erfaringer. Til sist er det viktig å være klar over at man tar bort et viktig element når ingeniørene ikke reiser offshore. Når ingeniørene er offshore får de ikke mulighet til å opparbeide seg operasjonell kunnskap og erfaring. Dette kan påvirke planlegging og gjennomføring av operasjoner. I tillegg vil også den direkte dialogen mellom ingeniør og personell offshore forsvinne. Direkte dialog er en arena hvor problemer lettere kan fanges opp. Ettersom all planlegging gjøres på land, må alle planene kommuniseres gjennom flere ledd før det når det utførende ledd offshore. Dette kan medføre vanskeligheter med å få kommunisert alle detaljer.

Forskningsspørsmål tre lyder: "Hvordan kan erfaringsoverføringen på Statfjord RESU og i Statoil forbedres?" Ledelsens holdninger til erfaringsoverføring et viktig element og det er derfor viktig at de signaliserer til de ulike enhetene i Statoil at erfaringsoverføring er viktig og at det legges til rette for det for å hindre målkonflikter. Slik det er i dag er det mange systemer som brukes tilfeldig og flere blir ikke bruk i planlegging og gjennomføring av operasjoner. Ledelsen bør derfor bidra til å lage effektive systemer for erfaringsoverføring. For å bedre erfaringsoverføringen og organisasjonslæringen i Statfjord RESU og Statoil er det nødvendig å lukke styringssløyfen. Det har blitt avdekket flere muligheter og trusler som IO medfører for erfaringsoverføring. Det er derfor viktig at man fortsetter å gjøre de tingene som fungerer og videreutvikler de. I tillegg må man gjøre korrektiv tiltak der hvor det er nødvendig. Tiltakene bør være av den grad at de bidrar til endring av styrende variabler som igjen kan bidra til økt organisasjonslæring. Bedre og mer systematisert ulykkesgranskning ved bruk av ulykkes databasen Synergi, vil også kunne bidra til økt organisasjonslæring. Systematiseringen inkluderer både rapportering og bruk av data.

Table of contents

List of Figures and Tables

List of figures

List of tables

Abbreviations and Definitions

Abbreviations

ALARP	As Low As Reasonably Possible
DBR	Daglig Bore Rapport (Daily drilling report)
D&W	Drilling and Well
HSE	Health, Safety and Environment
ICT	Information and Communication Technology
IO	Integrated Operations
LTI	Lost Time Injuries
MTO	Man, Technology and Organisation
OLF	Norwegian Oil Industry Association
Ptil	Petroleumstilsynet (Petroleum Safety)
QA	Quality Assurance
QC	Quality Control
RESU	RESsurs Utnyttelse (Resource Utilization)
RQ	Research question
SJA	Safety Job Analysis

Definitions

Operations room

Operations room is an area in a building where one or more control rooms are located, and/or a collaboration room is located with accompanying external workplaces, quiet room etc. (Statoil, 2005a). A collaboration room is a meeting room with a pc connected to a projector, loudspeaking telephone, audiovisual collaboration equipment (videoconference by means of large-screen and smartboard) and individual work places with a possibility to show pictures of several sources simultaneously. A control room is the same as a collaboration room, but in addition it has fixed working places and equipment for monitoring and controlling of processing plants. It is used for 24/7 operations (Statoil, 2005a).

Barrier

Measures which reduce the probability of realizing a hazard's potential for harm and which reduces its consequences. NOTE: Barriers may be physical (materials, protective devices, shields, segregation, etc.) or non-physical (procedures, inspection, training, drills, etc.) (ISO 17776, 2002).

Red incidents

Serious HSE-incidents are unwanted incidents (also near-accidents and conditions) categorised by a potential degree of seriousness 1 and 2 (Statoil, 2006a). There are totally five degrees of seriousness in the risk matrix. The degree of seriousness 1 and 2 of personal injuries are respectively fatality and lost-time injuries.

Yellow incidents

All personal injuries resulting in absence from work and injuries resulting in transfer to another job or restricted work. This includes injuries occurring during working hours, official journeys and on the travel between heliport and platforms (Statoil, 2005a).

Green incidents

Incidents resulting in medical treatment or first-aid (Statoil, 2005a).

Virtual teams

Virtual teams are groups of geographically, temporally, and/or organizationally dispersed knowledge workers brought together across time and space by way of information and communication technologies (Piccoli, Powell & Ives, 2004). Two major characteristics set them apart from traditional organisations "they are highly networked organisations, usually relying on electronic information and communication technologies" and "individual membership in virtual organisations is temporary and the boundary of the virtual organisation is often unclear" (Zedtwitz, 2004).

HSE non-conformities

Hazard or accident situations that have resulted in, or could have resulted in, harm to persons, the environment and material assets or other financial losses based on operational accidental situations (e.g. lost production, loss of sales, loss due to defective product quality etc.) (Statoil, 2005b).

Falling objects

All incidents where an object has fallen from one level to a lower level or might fallen to a lower level under insignificant changed circumstances (Statoil, 2006a).

Condition

An unwanted HSE-condition which has not triggered an incident, but under altered trivial circumstances, could have resulted in harm or loss (Statoil, 2006a).

Near-accident

An unwanted HSE-incident which has not resulted in an accident with harm or loss, but which under altered trivial circumstances, could have resulted in harm or loss (Statoil, 2006a).

Accident

An unwanted HSE-incident which has resulted in actual harm or loss related to human, environmental or economic values (Statoil, 2006a).

"It should not be necessary for each generation to rediscover principles of process safety which the generation before discovered. We must learn from the experience of others rather than learn the hard way. We must pass on to the next generation a record of what we have learned."

~ Jesse C. Ducommun
Safety Pioneer

(Baker, Leveson, Bowman, Priest, Rosenthal, Erwin, Gorton, Tebo, Hendershot, Wigmann & Wilson, 2007)

Part 1: Introduction

1 Introduction

This chapter gives some background material where Integrated Operations (IO) and its driving force is described, also some organisational and human challenges. The chapter also present the research problem and the research question to be answered in this thesis. A description of the scope and boundary conditions are given, mainly through a case study description at the end of the chapter.

1.1 Background – IO in the oil- and gas industry

IO involves the use of new Information and Communication Technology (ICT) and new types of co-operations between onshore and offshore. IO imply better collaboration between onshore and offshore, but also between operators, service companies, suppliers and between different disciplines and functions (OLF, 2002a).

1.1.1 Definition of IO

The concept IO has several meanings in the industry and not one clear definition. In the report ”Trusler og muligheter knyttet til eDrift” (Johnsen, Lundteigen, Albrechtsen & Grøtan, 2005) they try to make an overview of the different definitions of IO:

- Imply use of ICT to change working processes to achieve better decisions, to remote control equipment and processes and to move functions and personnel onshore (Stortingsmelding 38, 2004 in Johnsen et al., 2005)
- Use of ICT and real-time data to optimise the operations on the continental shelf (OLF-rapport ”eDrift på norsk sokkel – tredje effektivitetssprang”, 2003 in Johnsen et al., 2005)
- Real-time integration of offshore-operations and onshore support with coordinated operations room (oversatt fra OG21 TTA-strategirapport ”E-Operations and maintenance, 2003 in Johnsen et al., 2005)
- What is eDrift[1]:New operational mode, ICT solutions which include (near) real-time data, integrated working processes(multidisciplinary, offshore and onshore, different organisations). To achieve: Faster and better decisions (ref OD in Johnsen et al., 2005).

[1] eDrift is another word for IO

1.1.2 New work processes

IO result in new work processes (figure 1.1).

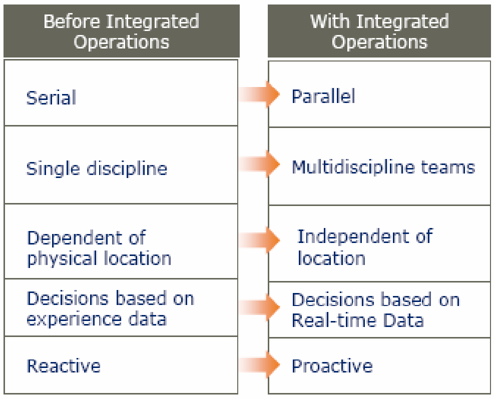

Figure 1.1: New work processes (Ringstad & Andersen, 2006)

- Parallel: ICT makes transfer of real-time data between onshore and offshore possible. This may result in better and faster communication between onshore and offshore, more efficient planning- and co-operations which traditionally have been serial and time-consuming (OLF, 2002b).

- Multidiscipline teams: As illustrated in figure 1.2, more operations rooms/control rooms are connected and have access to the same information. In addition, experts can have access to the same information at the same time. This means that a more efficient external support is possible.

- Independent of location: ICT and operations room make it possible to support the operations independent of location.
- Decisions based on Real-time data: ICT makes transfer of real-time data between onshore and offshore possible. Onshore personnel may follow the operations because of real-time data. The real-time data may be analysed onshore and decisions may be based on these data.
- Proactive: When onshore personnel have access to real-time data they may analyse data and use the results prior to the operations.

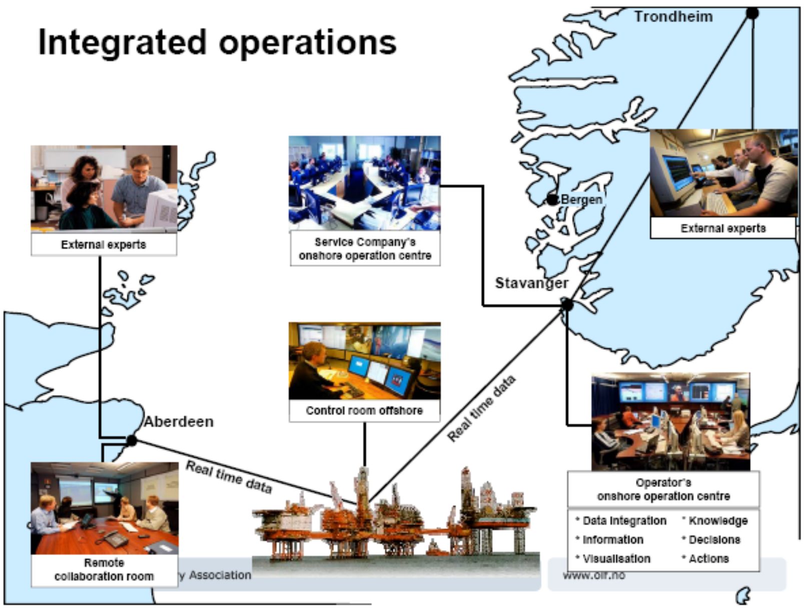

Figure 1.2: Multidiscipline teams

1.1.3 Why implement IO

There are many reasons to implement IO and different stakeholders may have different views, but according to the report "Muligheter og trusler knyttet til eDrift" (Johnsen et al., 2005) these factors are the most common ones:

- Economics
    - Increased production
    - Increased degree of extraction
    - Reduction in operation costs
    - Reduction in maintenance costs
    - More efficient decision-making processes
- Safety
    - Improved HSE
    - Reduced personnel exposure to risk because the number of offshore personnel is reduced

According to OLF (2002b) the introduction of IO will result in an "efficiency step" because of the reduced operating- and extension costs and increased extraction of oil. The potential of introducing IO is about 10% growth in production and 30% reduction in operating costs (OLF, 2003). The economic profit increases because IO contributes to a lengthening of the last phase on mature fields (OLF, 2003). In the last phase the oil production reduces and the operating- and maintenance costs need to be reduced to maintain an economic satisfactory result. In figure 1.3 the red line indicates the development of NOK per barrel oil equivalent without introduction of IO, and the blue line indicates the development if IO is implemented.

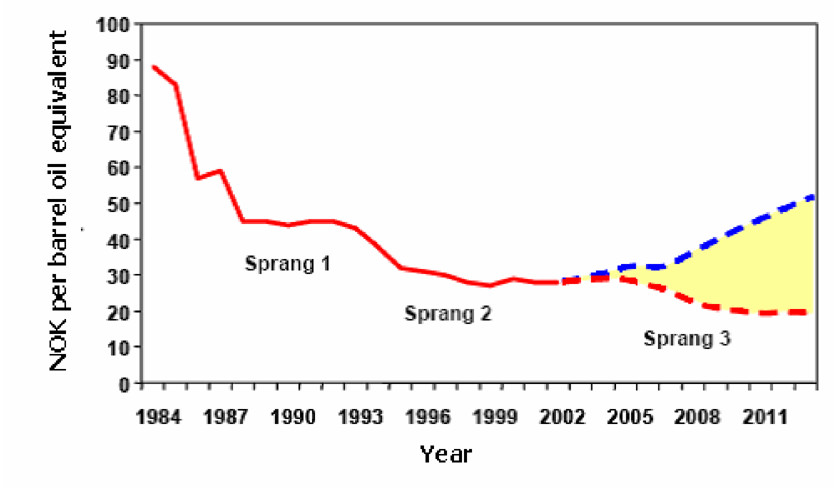

Figure 1.3: Economic development (OLF, 2002)

In addition IO will also give new possibilities to improve the safety for humans, environment and economic values (OLF, 2004). OLF assume in the report ”eDrift på norsk sokkel- Det tredje effektivitetsspranget” (OLF, 2002b), that IO in 2010 will have a positive effect on safety if the industry has taken into account the necessary changes and requirements. They assume that the control rooms onshore may give better support to the platforms in emergency situations, faster support in connection to drilling-and well operations, better emergency preparedness, earlier detection of hazardous situations and improve supervision of emission to air and water (OLF, 2002b).

Human and organisational challenges

IO is expected to increase the profit and the HSE-level, but IO may also introduce new challenges to the HSE on the platform if important aspects are not taken into account. According to Dekker (Dekker, 2002), new technology can give a system and its operators new capabilities, but inevitably brings new complexities too. He says that new technology can lead to an increase in operational demands by allowing the system to be driven faster, harder, longer, more precisely or minutely. This can also require operators to do more, do it more quickly and in more complex ways and under less favourable conditions. It can also add new vulnerabilities that did not exist before and shift the ways in which systems break down. New technology is also often ill-adapted to the way in which people do their work and it requires people to acquire more knowledge and skills to remember new facts (Dekker, 2002). IO will bring along challenges for both the organisations and the humans. The challenges will among other factors consist of new forms of co-operations, work processes, sharing of work, workload and requirements to competence and skills (OLF, 2002a).

People will often oppose to changes in the organisation because they are satisfied with the current situation. IO is dependent of ICT and therefore people may be opposed because it creates uncertainty and changes. That is why it is important to inform the employees about the changing process and let them realize the importance of the changes (OLF, 2002b). Changes in the distribution of responsibility may also be a problem in the changing process (OLF, 2002b), and therefore it is important to make it clear who is responsible in every situation. Some will experience continuous support from control room onshore as loss of responsibility, while other see the advantages (Wahlen, Landmark, Sandven, Høydalsvik & Hellebust, 2005).

Co-operation will be changed by the implementation of IO. Research fields will be closer and it is expected to be more communication between the different research fields when they are closer. This will change the requirements to expert knowledge and co-operations between personnel from different disciplines (Wahlen et al., 2005).

IO may contribute to reduce the knowledge of the systems because of increased use of ICT, e.g. when new employees start working, they will know the system through ICT and not have any personnel experience. This may contribute to a lack of perception and reduced understanding of the system. This may also result in problem-solving without “hands-on” experience, less overview of situations, bad improvisations and less transfer of tacit knowledge which may cause more deviations and errors (Johnsen et al., 2005).

The communication between onshore and offshore takes place in virtual teams. Working in virtual team can be challenging for the team. Some of the main problems of managing knowledge in virtual organisations include knowledge transfer and learning; collaboration, coordination and competition in networks; capturing and re-utilising dispersed knowledge; team organisation and team management; culture, language and behaviour in decentralised teams (Zedtwitz, 2004).

1.2 Scope and Boundary conditions

1.2.1 Scope

A specific case is chosen and focus is placed on drilling and well operations. The purpose of the case is to gain insight into how IO influences the HSE-level and experience transfer on a specific oil-field.

Case: Experience transfer in Statfjord RESU

The focus area in this thesis is the implementation of IO at Statfjord subsurface (RESU), which handles well production and reservoir management at the Statfjord field. The Statfjord field is a part of the Tampen area and started its production in 1979. The Statfjord field consists of three platforms; Statfjord A, Statfjord B and Statfjord C (figure 1.4).

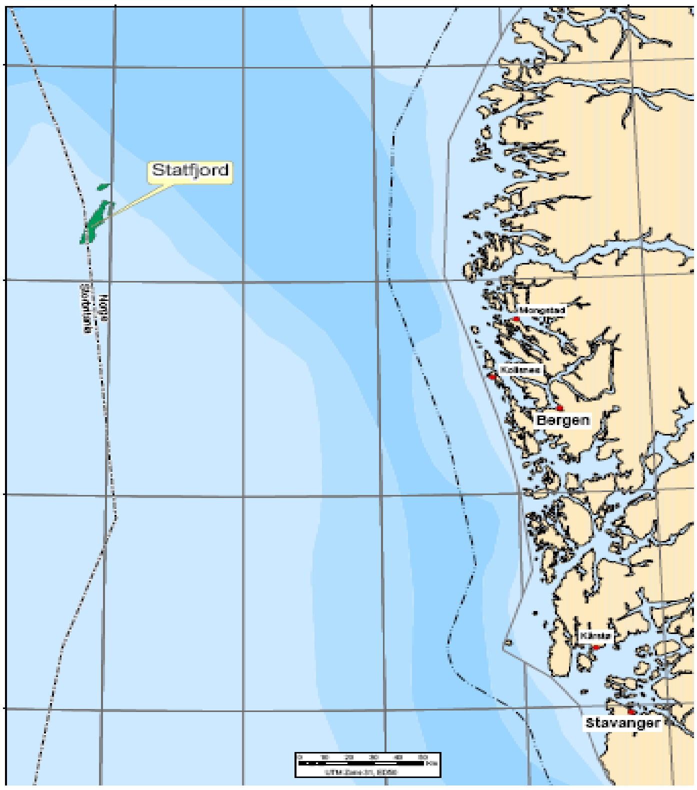

Figure 1.4: The Statfjord field. Hentet fra (Statoil, 2006b)

The Statfjord field is currently in its last phase. Improved recovery and thereby extended production life is now to be obtained by changing the drainage strategy from pressure maintenance to depressurisation, which will extend the lifetime of the Statfjord field by approximately ten years (Milter, Bergjord, Høyland & Rugland, 2006). The field has been an oil field and is now being converted to a gas field by decreasing the reservoir pressures and producing cumulated gas (Milter et al., 2006).

The implementation of IO in Statfjord RESU was a pilot project in Statoil. Prior to the implementation of IO, support to drill and well operations were given by a discipline engineer who was a member of the offshore crew. Due to ICT, which makes it possible to transfer real-time data, the engineers can follow the operations onshore. A change in the work processes was necessary to make the onshore support complete. Onshore and offshore operations rooms were established and contained videoconference equipment, a smart board, projectors, powerful computers, radio communication with the platforms and various platform work teams (Milter et al., 2006). Statfjord RESU has its onshore operations room located at Forus Vest. The onshore support started in January 2005 (Bergjord, 2005).

Transfer of real-time data from offshore to onshore enables more efficient support of drilling, well intervention and production operations (Milter et al., 2006). Real-time data makes it possible for multidisciplinary teams to remove bottlenecks and optimise the value chain and it also results in better, faster and safer decisions (Milter et al., 2006). Automatic monitoring, real time surveillance control, data storage for post examinations to learn from experience and remote interpretations were all important elements in increasing quality and reducing operation expenses (Milter et al., 2006).

1.3 Research problem

The purpose of the task, given in the project definition is:
To map the use of HSE-related experience data in Integrated Operations (IO). The task will be to enlighten how organisational learning and experience transfer based on such data is ensured on an offshoreplatform which has introduced IO, and how experience transfer between platforms are taken care of.

The task is covering the following main points:

1. Study and present relevant theory and literature about experience transfer.
2. Discuss what assumptions that are needed to make experience data contribute to organisational learning and increased HSE-level.

3. Collect data about today's practice for reporting and use of experience data on one platform which has introduced IO.
4. Collect data about measures and means which are used to promote experience transfer between platforms.
5. Discuss and suggest measures to improve experience transfer and organisational learning on a single platform and between platforms.

1.3.1 Research questions

The three research questions (RQ) to be elaborated are:

1. How does the use of IO influence the HSE-level in Statfjord RESU?
2. What possibilities and threats does the use of IO cause for the experience transfer in Statfjord RESU?
3. How can experience transfer in Statfjord RESU and in Statoil be improved?

Some main points to be covered in the report were given in the previous section. These points are covered by the three research questions in the following way: Point 1: *"Study and present relevant theory and literature about experience transfer"* and point 2: *"Discuss what assumptions that are needed to make experience data contribute to organisational learning and increased HSE-level"* are covered in chapter 3: Theory. Point 3: *"Collect data about today's practice for reporting and use of experience data on one platform which has introduced IO"* is covered in chapter 2: Objectives and systems, RQ 1 and RQ 2. Point 4: "*Collect data about measures and means which are used to promote experience transfer between platforms"* is covered in chapter 2: Objectives and systems and in RQ 2. Point 5: "*Discuss and suggest measures to improve experience transfer and organisational learning on a single platform and between platforms"* is covered in RQ 3.

The thesis will try to evaluate the practice for experience transfer in Statfjord RESU, but also how experience is transferred between different platforms in Statoil (figure 1.4). Only three platforms are drawn in figure 1.5 to illustrate that different platforms in Statoil are involved in the experience transfer. But in reality, all the platforms in Statoil are involved.

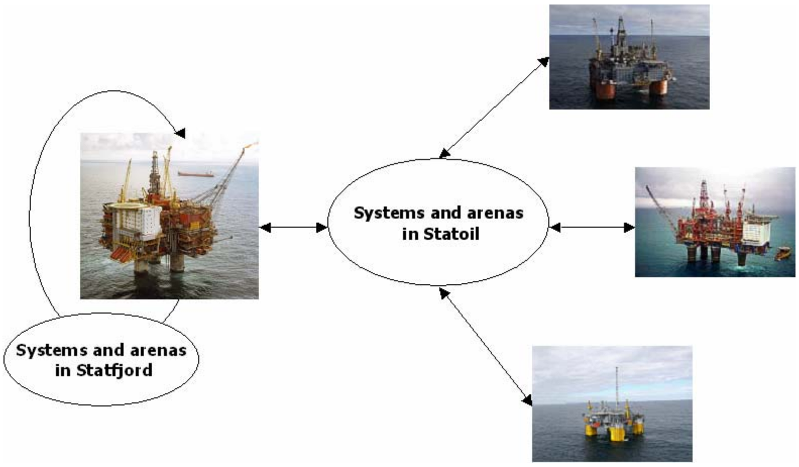

Figure 1.5: Experience transfer in Statfjord RESU and between different platforms in Statoil

2 Objectives and supporting systems

This chapter describes the objective of implementing IO in Statfjord RESU. Systems and arenas for experience transfer in Statfjord RESU will also be presented. This is mainly results from the interviews, but it is considered more convenient to present these result in this chapter to give the reader some background information about the objectives of implementing IO in Statfjord RESU and the systems and arenas for experience transfer.

2.1 The objective of implementing IO in Statfjord RESU

The management at the Statfjord field and in the Tampen area decided to implement IO in Statfjord RESU. The objectives were informed to relevant personnel through public meetings and the labor union was involved.

The main goal for IO in Statfjord RESU was to support all operations in Statfjord RESU onshore (Bergjord, 2006). IO enables the Statfjord late-life project in the fields late phase which includes modification of old platforms, and modification is considerably cheaper than building new platforms (Statoil, 2005c). The Statfjord late-life project will result in an increased degree of extraction and income, also in an increased activity on the field and create possibilities for additional business developments (Statoil, 2005c).

The objectives for implementation of IO in Statfjord RESU was according to one of the informants to:

1. Increase the efficiency of offshore support because of the lack of engineering resources
2. Release sleeping accommodations because this was a limited resource in the realisation of the Statfjord late-life-project
3. Reduce operating costs
4. Reduce offshore exposure on personnel

Different activities were performed to realise the IO project:

1. Facilities: Operations room with video conference equipment, smart board, projectors, powerful computer, radio communication with the platforms and various platform work teams (Milter et al., 2006)

2. Duty schemes: It was prepared duty schemes for the onshore personnel and compensatory arrangement because of the reduction of income when the offshore-increment was removed.
3. A plan for training: It was a need for training of both new and experienced personnel in the new systems.

2.2 Actors in the experience transfer in Statfjord RESU

Many actors are involved in the experience transfer in the drilling and well operations in Statfjord RESU. An overview of the different actors onshore and offshore is given in figure 2.1. Most likely more personnel are involved in the experience transfer, but the actors described are the ones focused on in this thesis.

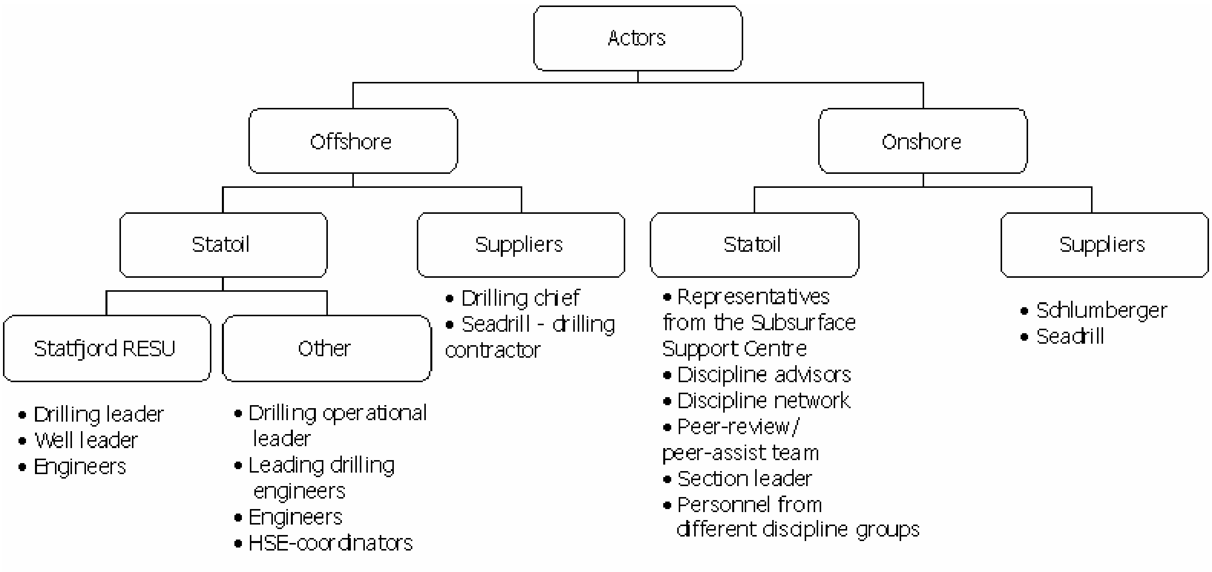

Figure 2.1: Actors involved in experience transfer in Statfjord RESU

To distinguish between some of the positions onshore and offshore, a description of the position are given in table 2.1.

Table 2.1: Description of different positions

Position	Description
Drilling leader	The drilling leader is responsible for drilling of the well according to drilling plans and procedures.
Drilling chief	The drilling chief is the topmost leader of the main contractor (in this case Seadrill) and has a lot of responsibility according to the contract between Statoil and Seadrill. This involves running of drilling machinery, equipment and maintenance.
Drilling operational leader	The drilling operational leader is responsible for the drilling operations, the execution of the drilling program. He has the personnel responsibility for the drilling leader.
Leading drilling engineer	The leading drilling engineer is responsible for planning and quality assurance of drilling plans and to support the engineers in the operations.

2.3 Systems and arenas for experience transfer in Statfjord RESU and Statoil

Statfjord RESU and Statoil have many systems and arenas for reporting both HSE- and operational related incidents. This chapter contains an overview of the different systems and arenas Statfjord RESU uses for experience transfer and how they are related (figure 2.2). In the green square in figure 2.2, the systems and arenas in Statfjord RESU are presented. In the blue square, the systems and arenas in Statoil are presented. The overview is based on results from the interviews and governing documents. The overview is most likely not complete, but this thesis only concentrates on the systems and arenas mentioned by the informants. The dotted arrows indicate requirements in governing documents (Statoil, 2005d), but the interviews showed deviations between governing documents and practice. A short description of the different systems is also given. Governing documents are used as a supplement to the result from the interviews in the description.

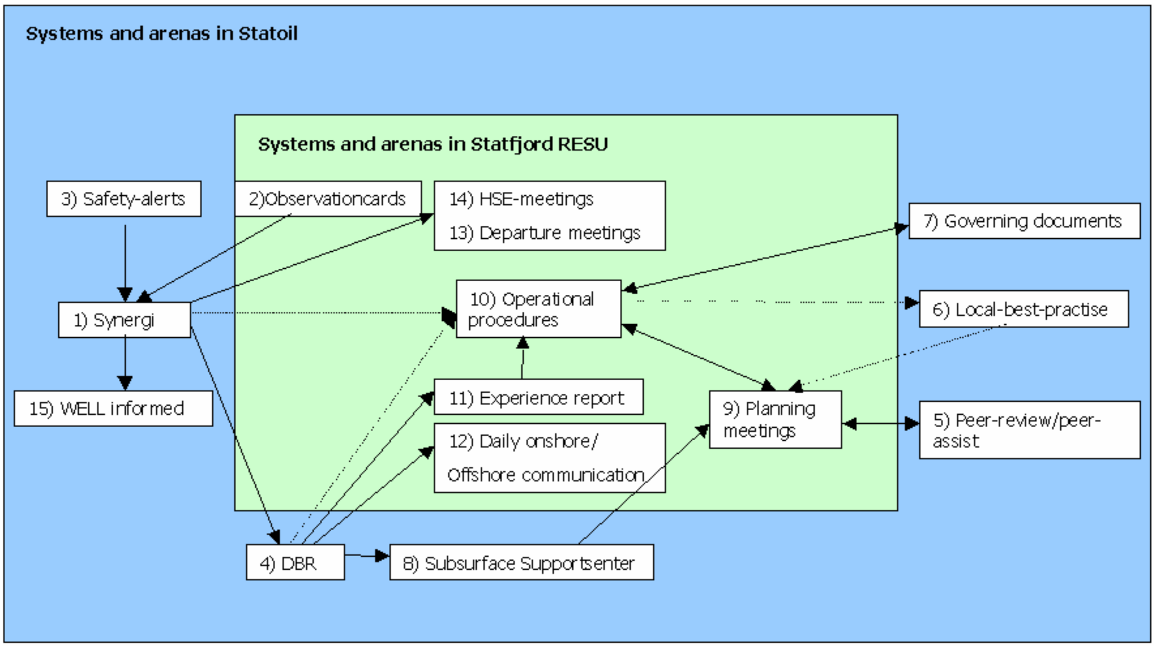

Figure 2.2: Systems and arenas for experience transfer in Statfjord RESU and in Statoil

2.3.1 Description of the different systems and areas for experience transfer

1) Synergi

Synergi is a database of reported accidents and incidents. It contributes to systematic follow-up of unwanted incidents and is an important instrument for experience transfer and learning. Synergi is used both as an internal system in Statfjord RESU, but also between different platforms in Statoil. Both HSE and economic experience and/or observations are reported in Synergi. The onshore engineers should use Synergi in the planning of new operations (Statoil, 2005d). The drilling leader/well leader is responsible for ensuring that Synergi is used to systematize unwanted incidents and to get useful reports before an operation (Statoil, 2005e). Actors involved: All actors.

2) Observation cards

The observation cards are used to report small incidents. The degree of seriousness of the incidents are evaluated and those incidents of importance are reported in Synergi. This is to prevent reporting of unimportant incidents. This system is not implemented on all platforms in Statfjord RESU. Actors involved: All actors offshore

3) Safety-alerts

A contact point at the main office receives safety messages from the industry and sends the message to all relevant companies and personnel. This messages may include information about errors in equipment used offshore. The safety-alert may be reported in Synergi, and the messages relevance to the platforms are checked. The message is only relevant if the platform uses any equipment mentioned in the message. Then the problem needs to be fixed. Actors involved: All actors.

4) DBR

DBR is the most important system which is the most used onshore. DBR is used both as an internal system in Statfjord RESU, but also between different platforms in Statoil. The platforms give a status report from the last 24-hours every day. The report include both HSE- and operational factors. Incidents reported in Synergi have a reference number which is used to link the incidents to DBR, then a summary of the relevant incidents emerge in the HSE-field in DBR. In that way the same incidents are reported both in Synergi and DBR, but they do not overlap. It is an experience part in DBR where important experience can be written. The drilling leader/well leader is responsible for the reporting. The onshore engineers should use DBR in the planning of new operations (Statoil, 2005d). Actors involved: All actors offshore, engineers, leading drilling engineers, operation leaders and Subsurface Support Centre

5) Peer-review/peer-assist

In both a peer-review/peer-assist there is a team of five to ten persons put together, where they go through the plans of different operations. The team consist of e.g. discipline advisors, leading drilling engineers, experienced engineers from different platforms and other persons with knowledge and experience with the operations. Peer-review and peer-assist contributes to experience transfer between different platforms in Statoil. New technology, problems in operations and difficult operations require peer-review or peer-assist. Peer-assist is easier than a peer-review, and is a form of brainstorming early in the planning phase. The peer-review is more comprehensive and is used when the program/procedures are 80-90% complete.

6)Local-best-practice

Local-best-practice is a system stored in Statoils intranet where all the oil fields may store updated procedures for different operations. When other platforms are going to do a similar operation they may search in Local-best-practise and find information about others best-practise. The onshore engineers should use Local-best-practice in the planning of new operations and update their own Local-best-practice after the operation (Statoil, 2005d).

7) Governing documents

Statoil have governing documents on different layers in the organisation. The platforms are committed to follow the governing documents in all activities.

8) Subsurface Support Centre

The Subsurface Support Centre's main objective is to transfer experience between different platforms in Statoil. They may follow all operations and give support when needed. They utilize the knowledge and experience in the Subsurface Support Centre, but also in the discipline networks when solving problems. They analyse real-time data, use DBR and the tacit knowledge in the team when making decisions. They do not focus mainly on HSE-problems, but they take HSE indirectly into consideration when they solve operational problems.

9) Planning meeting

There are one or more meetings before all the operations, where elements in the operations are discussed, e.g. methods and main equipments. In the beginning of the planning of a new well, two operations leaders have to participate to transfer experience. The reason why the operation leaders have to participate, is because they often have more experience than the engineers and may give good advice in the detail and principle level. Representatives from the Subsurface Support Centre and peer-review/peer-assist teams are also involved in the planning of operations when it is necessary with external support. Actors involved: Engineers, leading drilling engineer, drilling operation leaders, suppliers and section leader.

10) Operational procedures

A drilling program is prepared for each well, and a detailed procedure is made for each operation. Both the leading drilling engineers and the drilling engineers are responsible for the planning and the quality assurance of the program. The detailed procedure is tailored to the operation, based on a master procedure which already exists for each of the operation. The written detailed procedure is discussed in the operations room where both onshore- and offshore workers participate. The communication happens through videoconference and net meetings were they can see each other and the procedure on two big screens in each room. Corrections in the procedure are done if necessary. The procedure is then transferred to the offshore workers.

If the drilling leader, during the operation, do not want to follow the procedure punctual, he has to contact the operation leader onshore and they can discuss the changes. After the operation, the drilling leader writes an as-run-procedure were he may add new elements of risk in the operation or suggest more optimal ways of doing the operation. The changes will then be considered and if it is experience which is also relevant for the later operations, corrections in the master procedure will be done. One person is responsible for each of the procedures and also for the updating. By doing this, experience will be transferred to future operations. This way of working with the procedure is now easier because of the technology in the operations room. Actors involved: All actors offshore, engineers, leading drilling engineers, suppliers, operation leaders and representatives from the drilling operator.

11) Experience report

An experience report/final report is written when a well is finished. The report contains a short description of the performance and results which includes both good and bad experience. The report is used in the planning of new wells to see the status of the well. The status factors are for example equipment used and length to the valves. The program engineer (the engineer who has planned the well) is responsible for writing the experience report. The onshore engineers should use experience reports as a part of the planning of operations (Statoil, 2005d). Actors involved: Engineers, leading drilling engineers, drilling leader and well leader

12) Daily onshore/offshore communication

There is a morning meeting every day, where all the Statfjord platforms participate. In these meetings they go through DBR from the last 24-hour period, but the main focus is on future operations and planning. The meeting is not only an informative meeting, but also an area to give actions and make decisions (Statoil, 2005e). In these meetings there are an enormous amount of experience transfer. Actors involved: Drilling leader, drilling chief, engineers, leading drilling engineers, drilling operations leaders, representatives from the suppliers, section leader and personnel from other discipline groups e.g. reservoir engineers, geologists and production engineers, well engineers and those controlling the logistics.

In addition to the morning meeting, there is communication between onshore and offshore when there are problems offshore and when onshore personnel see something in the operations they want to alert.

13) Offshore departure meetings

This is a meeting for all the workers travelling offshore. It is two meetings, one is for the leaders offshore where the operation leaders go through the drilling schedule for the next offshore period. The engineers responsible for the drilling program also attend these meetings. Then they go through the wells in detail which they are going to work on in that period. In addition they also go through HSE issues, e.g. the yellow and red incidents from the last period where the offshore workers were off duty, the HSE-goals and HSE-expectation at the Statfjord field. The HSE-expectations at the Statfjord field includes 100% compliance of requirements and procedures, stop when there are corrections, visible management on deck, an open culture and consequence management will be practiced when rules and requirements are not followed. The other meeting is when Seadrill has internal departure meetings with the offshore workers (the contractors) and the suppliers have meetings with their employees. One operation leader should try to attend the meeting with the suppliers. Actors involved: Drilling operation leaders, Seadrills rigleaders, drilling leader and drilling chiefs.

14) HSE-meetings

The offshore workers attend one HSE-meeting every time they are offshore. It is a meeting for both the day shift and the nightshift. All offshore workers who works for Statoil attend these meetings. It is the safety delegate and the drilling chief from Seadrill who arrange the meetings where they among other factors go through important HSE-incidents. Actors involved: Drilling leader, drilling chief, contracts from Seadrill and all representatives from the suppliers.

15) WELL informed

WELL informed is a magazine D&W in Statoil distributes. The magazine has 2500 number printed and is distributed to suppliers and Statoil-offices in Norway and abroad. WELL informed contributes to experience transfer between different platforms in Statoil. The articles are written both by personnel onshore and offshore from different fields in Statoil. The articles cover new technology, testing of new technology, research, development and statistical information of both operational and HSE performance. Each article is signed by the author(s) and makes it possible to contact the author(s) for more information about the subject if desirable.

The systems and arenas will be evaluated in more detail in chapter 6.3.

Part 2: Theoretical framework and method

3 Theory

This chapter describes the theoretical framework of the study. The theoretical aspects are chosen to suit important elements in evaluation of HSE performance, experience transfer and organisational learning.

3.1 Monitoring of HSE performance

3.1.1 Accident investigation

There are many reason why accidents or incidents should be investigated. The report "I etterpåklokskapens klarsyn: Granskning og læring av ulykker" (Hovden, Sklet & Tinmannsvik, 2004) point out five reason why accidents should be investigated. The reasons are to answer questions about 1) what and where, 2) why an accident happened, 3) organisational learning, 4) criminal proceedings and 5) compensation. The reason why companies choose to investigate an accident is because they believe they can gain better knowledge of the causes to the accident, and this knowledge can be used to prevent similar accidents in the future. In this thesis the main focus will be on why accidents happen, what can be learned from the accidents and how it can contribute to organisational learning.

In accident investigations the bow-tie model can be used as a basis (figure 3.1). In the middle there is an accidental event. On the left side is the causes to the accidental event and to the left the consequences. A system is always threaten by some hazards/threats which could lead to an accident. To prevent this from happening there are both barriers to prevent the accident (left side) and to reduce the consequences of the accident (right side). In the simplest form, a barrier is something that separates a vulnerable target from a dangerous energy source. The barriers can e.g. be physical structures, routines, safety culture, work processes and attitudes. It is therefore convenient to talk about MTO(Man, Technology, Organisation)-barriers. In an investigation the investigators try to find which barriers that should have prevented the accident from happening, whether some of the barriers did not function or if some of the barriers have been missing.

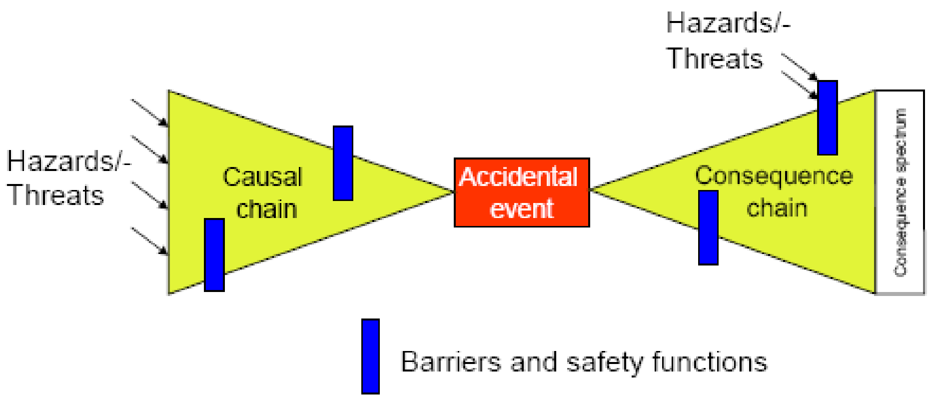

Figure 3.1: Bow-tie, an accident model

An accidental model tries to simplify complex incidents to something handy and comprehensible to ensure that the most common characteristics of an accident are taken care of. Even though every accident is different, the investigators try to find common features which can contribute to learning and improved protection (Hovden et al., 2004).

3.1.2 Root causes and contributing factors

It is often difficult to distinguish between the root causes and the contributing factors to an accident, because the causal chain can be complex. In theory, the contributing factors are described as more stable conditions at the workplace, and by changing such factors more lasting effects will be achieved (Kjellén, 2000). Root causes are the most basic cause of an accident or incident (Kjellén, 2000). The root causes are the direct causes to the accident or incident. The more latent contributing factors are also contributors to the accident or incident, but they are more indirect causes.

The causes to an accident are many and consists of both human, organisational and technological factors. In an investigation the focus is often on humans and human error (Dekker, 2004). Dekker (2004) says that we can see human error as a cause of failure (old view), or we can see human error as a symptom of failure (new view). His focus is on the new view and that human error is a symptom of trouble deeper inside the system, and that humans alone can not get the blame for an accident. An error has its root in the system surrounding it; connecting systematically to mechanical, procedural, organisational and other aspects to such an extent that the contributions from system and human begin to blur. “The deeper you dig, the more you will understand why people did what they did, based on the tools and tasks and environment that surrounded them.” (Dekker, 2002). Reason (1997) also mentions that errors are caused by problems at several different layers in the organisation; the individual and the team, the task, the workplace and the organisational processes. He also point out that human behaviour is governed by the interplay between psychological and situational factors. It is not better to use explanations such as “the operator did not follow the rules” or “the operator did not notice the signal” because they do not say anything about why the operator did what he did, these labels are the same as saying “human error”.

Human errors may therefore not be the only cause to an accident, because they will not give an answer to why the accident happened. This is because human factors are not just about humans, they are about how features of people’s tools and tasks and working environment systematically influence human performance (Dekker, 2002). According to Dekker (2002) “Human error is not the conclusion of an investigation. It is the starting point.”.

3.1.3 Risk matrix

Accidents and incidents are usually classified based on the potential consequences they can lead to and how frequently. There might be consequences to humans, material, environment, reputation etc. They are often classified in a risk matrix which tells the severity of the accident (figure 3.2).

Consequence \ Frequency	1	2	3	4	5
1	Low	Low	Low	Low	Medium
2	Low	Low	Low	Medium	High
3	Low	Low	Medium	High	High
4	Low	Medium	High	High	High
5	Medium	High	High	High	High

Figure 3.2: Risk matrix

The numbers which describe the consequence and the frequency defined based on industry and work tasks that the risk matrix is used for. The risk matrix is based on the ALARP principle, where the colours indicate which remedial actions that have to be done. The red areas indicate a risk above the acceptance criteria where action must be taken to reduce the risk. The yellow areas indicate that that risk has to be reduced as low as reasonably possible

(ALARP) and the green areas indicate that no further risk reduction is required (Kjellén, 2000).

3.1.4 LTI-rate

The lost-time injury frequency rate (LTI-rate) is the most common indicator used in HSE-performance (Kjellén, 2000). The LTI-rate is a loss-based HSE-performance indicator.

"The LTI-rate is defined as the number of lost-time injuries per one million hours of work. A lost-time injury is an injury due to an accident at work, where the injured person does not return to work on the next shift."

The LTI-rate is used to compare the HSE-performance with the pre-established safety goals and to see the development of the LTI-rate over time (Kjellén, 2000).

3.2 Organisational learning

Central actors characterize the results of experience transfer as reduced costs, better exploitation of resources, increased efficiency, better HSE and better products (Aase, 1997). Experience transfer is an enabler for organisational learning. Aase, Ringstad & Sandve (2001) try to give a definition of the two concepts experience transfer and organisational learning:
"The focus on experience transfer is mainly on the communication of information and experience, availability and transfer between different people, groups or units in the organisation.(..) The focus on organisational learning is also on communication and availability, but are more based on the assumptions that learning involves new knowledge and changing of behaviour."

3.2.1 Tacit and explicit knowledge

Experience is based on actions one person or a group in a concrete situation have experienced (Aase, 1993). Experience can be both tacit and explicit, and there exists different learning mechanisms to exchange these experience to improve the organisational learning. The original knowledge can be explicit and tacit, and the resulting knowledge can also be tacit and explicit (figure 3.3) (Kjellén, 2000).

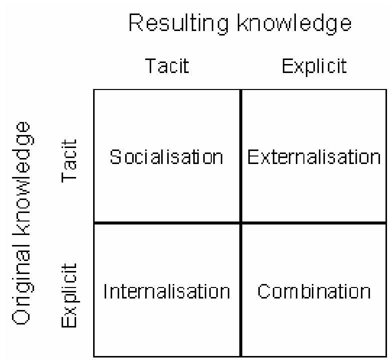

Figure 3.3: Tacit and explicit knowledge (Kjellén, 2000)

- Externalised: Tacit knowledge and experience are in this dimension made explicit through documentation, e.g. through accident investigations, HSE audits and in risk analysis.
- Socialisation: In this dimension individual tacit knowledge is exchanged to other people, e.g. in group-meetings, but the knowledge is still tacit.
- Internalise: Explicit knowledge is in this dimension made tacit, e.g. in risk analysis, where the team members will go through a learning process which will affect their unconscious mental models and skills in handling similar situations to those analysed.
- Combination: Explicit knowledge continues to be explicit.

Explicit and tacit knowledge are mutually complementary entities (Aase, 1997b). Knowledge and/or experience are crated or expanded through social interaction between explicit and tacit knowledge (Nonaka &Takeuchi, 1995 in Aase, 1997b). Experience transfer and organisational learning should therefore address both sides of the explicit/tacit dimension, using the different perspectives to create experience transfer systems with high degrees of both explicit and tacit knowledge (Aase, 1997b).

3.2.2 Accident databases

By studying incidents and accidents, organisations can learn from earlier experience and they may introduce measures to prevent the accidents from happening again. One problem is that many companies complete good investigations, but they do not implement efficient preventive measures (Hovden et al., 2004). Hovden et al. (2004) recommend an overall evaluation of the accidents/incidents in a given period, e.g. one year, rather than to see the accidents/incidents as single incidents where measures for each of the incidents are found.

3.2.3 Single- and double-loop learning

The implementation of remedial measures is often the reaction to accidents or incidents. Argyris and Schön (1996) have classified two possible outcome of the measures: single-loop learning and double-loop learning (figure 3.4). In single-loop learning an error is just corrected without any investigation of the contributing factors. In double-loop learning the investigation tries to find the fundamental causes of the incident, and the measures implemented are more thorough and can contribute to permanent improvement of the production system and the work processes (Hovden et al., 2004). Therefore, double-loop learning contribute to organisational learning, while single-loop learning do not.

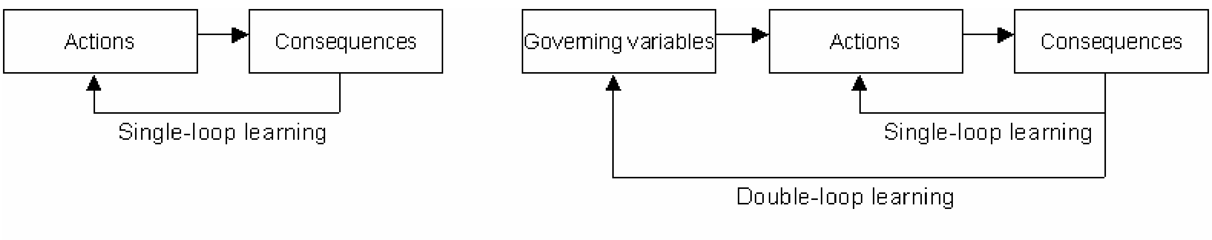

Figure 3.4: Single- and double-loop learning

A similar concept to Argyris and Schön's organisational learning is Van Court Hare's hierarchy of order of feedback. Van Court Hare distinguishes between different orders or levels of feedback control, characterizes as follows (Kjellén, 2000):

Level 0: Simple transformation without feedback. E.g. accidents are not followed up with remedial actions.
Level 1: Simple machine with direct feedback but without selective memory. E.g. corrections of deviations identified by accident investigations or safety inspections.
Level 2: Tactical systems with memory of organisation, conditional selection of pre-established plans and predictive feedback. E.g. starting a pre-planned eye-protection campaign following an increase in eye injuries.
Level 3: Strategic systems that learn from experience and have the ability to correct plans and develop new plans. E.g. change in routines, instructions, rules or design on the basis of accident experience.
Level 4: Goal-changing system that learns and consciously develops, selects and implements new plans. E.g. change of safety policy and goals on the basis of accident experience.

Van Court Hare's hierarchy of orders of feedback can be related to Argyris og Schön's organisational learning. Level zero and level one correspond to the single-loop learning, and level three and level four correspond to the double-loop learning.

3.2.4 HSE control-loop

Experience contains important knowledge, but it is often tacit and has to be transferred and translated to knowledge by the recipients (Aase, 1993). Organisational mechanisms should contribute to experience transfer. Formal systems for experience feedback, e.g. HSE-information systems, are used to prevent accidents (Kjellén,2000).

A HSE control-loop is meant to contribute to an increased HSE-level if the loop is closed (figure 3.5). The organisations overall HSE requirements are described in the organisations governing variables, which form the basis of the organisations HSE-management. The governing variables are implemented in the organisation through the HSE action plans. The organisation controls and verifies the governing variables through the reporting of accidents and near accidents, workplace inspections, control of barrier availability, risk analyses and audits (Kjellén, 2000). If the results of these controls are not in accordance with the organisations governing variables, the organisation has to make corrective actions. At this point it can be useful to adopt experience data from the HSE-information system and use experience transfer to improve the problem areas or adapt the organisations governing variables to a more realistic level. Correcting the governing variables contribute to double-loop learning (Argyris et al.,1996).

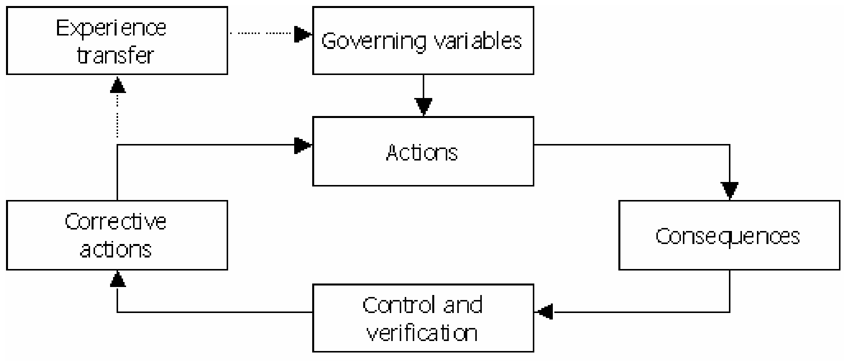

Figure 3.5: HSE control-loop (Modified Kjellén, 2000)

3.3 Communication

Communication can be defined as a social processes where a sender and a receiver exchange information (Hovden, 2003). Examples of types of information exchanged are facts, arguments, proposals and stories. The article "Risk communication" (Hovden, 2003) describes a simple communication model (figure 3.6). The information is sent from the sender to the receiver through a channel. A channel could be e.g. a telephone, a video conference or an e-mail. Before the message is sent through the channel it has to be coded, which means that the information is translated to a specific and expressed message. This is the most crucial part of all communication, because the information has to be expressed in words or other forms of signals to precisely represent the meaning the sender meant by the message. It also has to be understood the same way by the receiver in his decoding. The coding, decoding and interpretations may be disturbed by culture, language, status etc. In addition to the coding, decoding and interpretations the channel may have technical problems e.g. telephone line, or humans such in inattention, distraction etc.

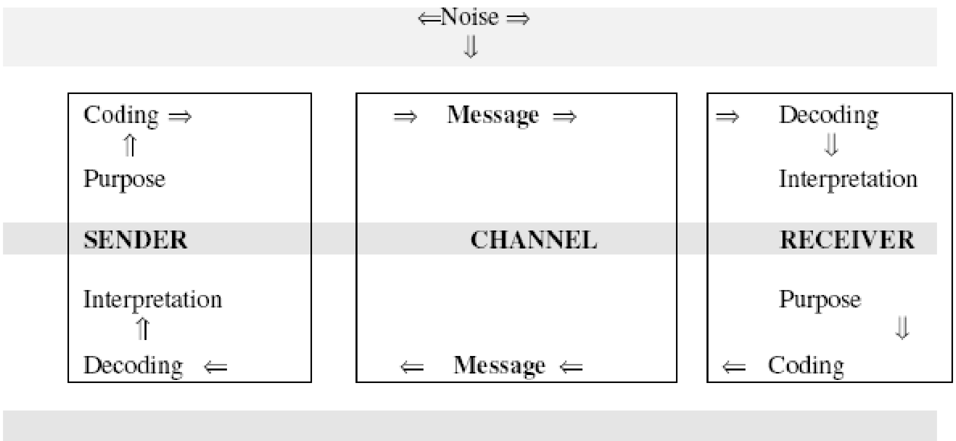

Figure 3.6: A simple communication model (Hovden, 2003)

The more links there are in the communication chain, the greater the filtration of information. This means that whether one is a first-, second- or third hand source, some impressions and impulses will not be perceived. Moreover, others will be sorted out as unimportant and not passed on (Hovden, 2003).

Face to face communication is the most effective method of communication because it is possible to receive instant feedback and it is possible for both the sender and the receiver to supply information whenever necessary. It is easier to convey urgency and hence problems will be identified more quickly (Henderson, Wright & Brazier, 2002). Moreover, face to face communication provides the ability to replace verbal information with body language.

The most critical form of communication that takes place is not between different people on the same team, but between different teams at shift handover (Henderson et al., 2002).

3.4 Barriers and enablers for experience transfer and organisational learning

There are many factors that contribute to prevent efficient experience transfer and organisational learning. Various research has been done on this theme and some of the findings are presented in this chapter.

Systems

Lack of systems is a barrier against experience transfer (Aase, 1997b), but systems for experience transfer that are too detailed, has a wrong design, is time consuming and top-down driven are also a barrier (Aase, 1997a). In addition, information overflow is a barrier (Aase, 1997b). To enable experience transfer it is recommended to update formal routines documented in requirements, procedures, hand books and standards, but there are shared opinions about these measures (Aase, 1997a; Aase et al., 2001). It is also recommended to use IT-systems and databases where organisations can store experience from reported data on incidents and make it accessible from different parts of the organisation (Aase, 1997a; Aase et al., 2001). In addition to the formal systems, it is important to encourage the employees to discuss safety related topics both in formal and informal areas. This can contribute to transfer tacit and individual knowledge to explicit and collective knowledge (Hovden et al., 2004; Aase, 1997a; Aase et al., 2001).

Organisational factors

Slowness in the organisations prevent learning because individuals and organisations stick to existing work practices (Aase et al., 2001). In the changing processes this is very relevant and especially in IO where implementation of new ICT contributes to new work practices and new systems. Mechanical organisations, which imply a passive and static perspective to an organisation, contribute to a hieratic processing of information and is only aimed to explicit knowledge (Aase et al., 2001). The operations room result in less hieratic processing between onshore and offshore in Statfjord RESU because much of the cooperation is through virtual teams where the structure is more informal and the coupling between the actors are more loose. In Statoil the structure may be more hieratic. The norms and the “language” onshore and offshore may be different because the personnel are members of two different cultures which may be a barrier (Aase, 1993). A culture is an abstract phenomenon where the members feel a connection because the other persons in the group share common interests (Bolman & Deal, 2002). Other barriers are lack of priority, resources/ capacity for sharing of information and too frequent reorganisations (Aase et al., 2001; Aase, 1997a). Homogeneity in the organisation reduce the potential for unusual ideas and views, because variety of the operators background and experience create creativity, innovation and learning (Aase et al., 2001).

Different enablers for experience transfer are mentioned by different researchers. Traditionally the focus has been on developing administrative management systems and tools, but it is also necessary to focus on the individual and organisational factors (Aase et al., 2001). The managements attitudes are crucial for the learning environment, they have to arrange an area for experience transfer (Hovden et al., 2004). It is important to integrate experience transfer in the philosophy, objectives and the HSE-methodology (the systems, organisation, communication, documentation, implementation and evaluation), and to not look at experience transfer as a goal alone (Aase, 1993). Mearns, Whitaker & Flin (2003) mention three enablers:

- “Genuine and consistent management commitment to safety, including: prioritisation of safety over production; maintaining a high profile for safety in meetings, personal attendance of managers at safety meetings and in walkabouts; face-to-face meetings with employees that feature safety as a topic; and job descriptions that include safety contracts.”
- “Communication about safety issues, including: pervasive channels of formal and informal communication and regular communication between management, supervisors and the workforce.”
- “Involvement of employees, including empowerment, delegation of responsibility for safety, and encouraging commitment to the organisation.”

Other enablers are personnel-rotation, network and informal contacts (Aase, 1997a; Aase et al., 2001). Learning histories where discussions and reflections among the employees contribute to communicate histories in the organisations, e. g. “scare” stories or success histories, is probably the most important learning source (Hovden et al., 2004).

Human/attitudes

Behaviour is triggered by a set of antecedents and followed by consequences which can be expressed as the ABC model of behaviour, Antecedents (A), Behaviour (B) and Consequences (C). “ABC analysis facilitates the identification of ways to change behaviour, by ensuring the appropriate antecedents are in place and that the consequences support the desired behaviour.” (Flemming & Lardner, 2002). Antecedents trigger the behaviour and examples of antecedents are rules and procedures, suitable tools and equipment, information, skills and knowledge, training etc. “Antecedents are <u>necessary</u> for a behaviour to occur, but are not <u>sufficient</u> to ensure the behaviour is maintained over time.” (Flemming et al., 2002).

The operators motivation and moral are key factors for safety. These factors are highly related to the respondents’ satisfaction with their company’s management system and their trust in management (Itoh, Andersen & Seki, 2004). In the article “Strategies to promote safe behaviour as part of a health and safety management system” (Flemming et al., 2002) is four main categories of critical health and safety behaviours described:

- Frontline health and safety behaviour: Behavioural Safety Programs focus on frequent operations, site rules and personal protective equipment, but it is also important to focus on infrequent operations.
- Risk control behaviour: Focus on risk assessment and compliance with operation or emergency procedures.
- Management actions: Investment in plant and equipment, training, recruitment and auditing
- Leadership and direction: Demonstrating commitment and prioritising safety

In addition is the operators working attitudes a barrier. This includes their willingness to share information, differences in what people say and what they do and that they have focus on details instead of the totality (Aase, 1997a). The operators competence is also a barrier (Aase, 1993).

Accident investigation

Accident investigation may contribute to organisational learning (Hovden et al., 2004). This is only possible if the causes of the accidents are analysed and both contributing factors and root causes are taken into consideration. There are some barriers against organisational learning during accident investigations. As mentioned earlier, human errors should not be the conclusion after an investigation (Dekker 2002; Reason 1997). This may happen when focus is on the personnel rather than the situational contributions to error, focus is on the active failures rather than latent conditions, when it is not distinguished adequately between random and systematic factors causing errors and the investigators are generally not informed by current human factors knowledge regarding error and accident causation (Reason, 1997). It is also becoming increasingly normal that operators involved in deviations get sued or charged with (criminal) offences (Dekker, 2002).

It is also important to implement preventive measures which contribute to permanent improvement (double-loop learning). Hasty safety management because of pressure to come up with findings and recommendations quickly after an accident, can lead to a superficial study of the deviations and their deeper sources (Dekker, 2002; Hovden et al., 2004). Other barriers against implementation of efficient preventive measures can be when organisations perceive that it is less costly to hide/neglect errors and deviations than implement remedial measures (Hovden et al., 2004), “”firefight” the last error rather than anticipating and preventing the next one, rely heavily on exhortations and disciplinary sanctions (Reason, 1997).

4 Method and working process

In this chapter the method and the working process are presented. The description of the chosen method is based on Ringdal (2001) and his description of a research process (figure 4.1).

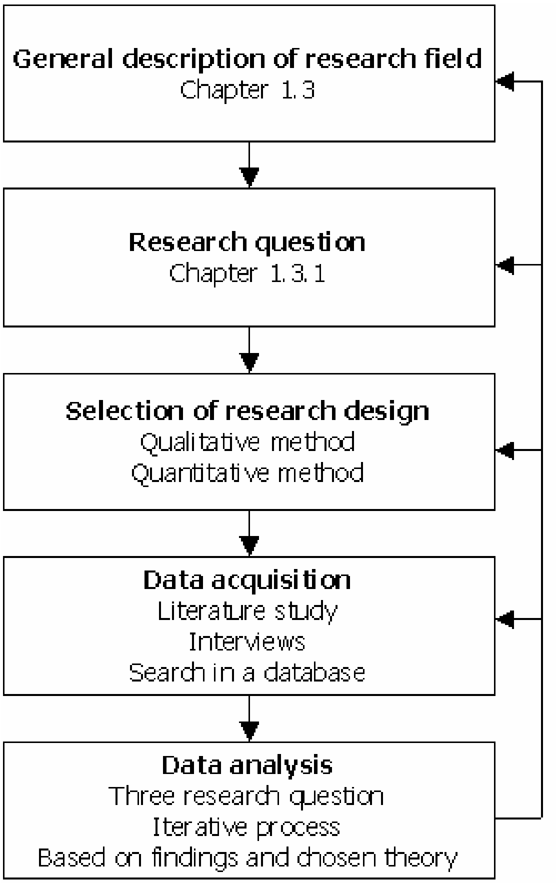

Figure 4.1: Research method (Ringdal, 2001)

4.1 General description of research field and research questions

Both the general description of the research field and the research questions are presented in chapter 1.3 and will not be repeated here. The general description is based on both own interests and interests in Statoil. The general description was changed during the first period because of findings in the data acquisition and interests in Statoil. The development of the research questions was a more iterative process where the research questions were mainly formulated after the data acquisition.

4.2 Selection of research design

In research a choice between qualitative method, quantitative method or a combination between these two must be made (Ringdal, 2001). The qualitative method is characterized by a collection of text data from small samples, in depth studies and it emphasizes nearness to the research field or objects. It seeks to understand a phenomenon. The quantitative method collects numeral data from big representative samples. It mainly tries to explain a phenomenon and has a distance to the research field (Ringdal, 2001).

In this research a choice has been made to use both the qualitative and the quantitative method. The quantitative method is used to evaluate the HSE-level where Statoil's accident database, Synergi, has been used. There has not been done an evaluation earlier on how the implementation of IO has influenced the HSE-level in Statfjord RESU, and therefore the information was limited. To find information about how the implementation of IO has influenced the experience transfer, the qualitative method was used. Much research on experience transfer and organisational learning can be found, but there is not a lot on how I has influenced experience transfer. Therefore it was necessary to do in-depth interviews with relevant personnel to gain enough information to do an evaluation.

4.3 Data acquisition

Within the qualitative and the quantitative method there are various different ways to collect data. Tjora (2006) describes three different qualitative methods; literature study, observation and interview and in this thesis literature study and interviews were used. In the quantitative study it was made statistics based on the data in Synergi. The study is mainly based on the results from the interviews and incident data from Synergi.

4.3.1 Literature study

A literature study was performed to gain knowledge about experience transfer, organisational learning and monitoring of HSE.

The sources used to find literature were internal Statoil reports, published literature and governing documents in Statoil. The literature was found by searching in internal databases in Statoil, in the literature database BIBSYS, e-journals from the University library in Trondheim and from the search engine www.google.no. The thesis supervisors at both Statoil and Sintef had a central role in suggesting important documents and where to find them.

Results from the literature study were used in several parts of the thesis. First it was used to give a background information about IO and second to answer how IO is used in Statfjord RESU. Last it was used to find the theoretical framework and to some extent to supplement the description of systems and arenas for experience transfer.

4.3.2 Interviews

According to Tjora (2006) interviews can be divided into structured-, partly structured and open. The difference is mainly to what extend the questions are fixed in advance and the flexibility during the interview. The interviews in this thesis were partly structured because they were based on an interview guide (Appendix A) to ensure that important areas were covered, but the guide was not followed punctually. The partly structured interviews give a more iterative process which gives room for changes as the interviews are carried out. In-depth interviews mean that it is possible to focus on topics especially relevant for the informant. The informants were to some extent allowed to speak freely because they could comment on issues not thought of by the interviewer in advance, but which were relevant for the thesis. Some of the question were also dedicated to some of the informants.

A tape recorder was used in all the interviews to make it easier to follow the conversation. All the interviews were transcribed afterwards which made it easier to analyse the data and to remember all the details. The interviews lasted between 45 to 70 minutes and they were used only for the purpose of this thesis and therefore deleted afterwards.

The results from the interviews were mainly used to give a description of the different systems and arenas for experience transfer in Statfjord RESU, answer RQ 2 and to some extent RQ 1 and RQ 3. Because of the lack of written information regarding how IO influences experience transfer, it was often necessary to rely on the information from the interviews. Personnel mainly involved in drilling and well operations onshore were selected as informants. The list of informants was constantly updated because of tips from informants about other relevant persons. Table 4.1 shows the final lists of informants. Names are not provided, but the list illustrates the informants position and company. The table also indicate if the interview guide was used or if it was just a conversation.

Table 4.1: Informants

Position	Company	Interview guide	Interview/ Conversation
Leading drilling engineer	Statoil	X	
Leading drilling engineer	Statoil	X	
Improvement manager (D&W)	Statoil	X	
D&W operation leader	Statoil	X	X
D&W operation leader	Statoil	X	X
Discipline advisor QA/QC	Statoil		X
Drilling operation leader	Statoil		X
Expert in drilling and well analysis	Statoil		X
Drilling operation leader	Statoil	X	
Senior engineer	Statoil		X
Previous drilling chief	Seadrill	X	
Previous drilling chief	Seadrill	X	
User support	Synergi Solutions		X
Head engineer technical work environment	Statoil		X
HSE-coordinator	Statoil	X	
Project leader Statfjord RESU	Statoil		X
Editor WELL informed	Statoil		X
Section leader Statfjord RESU	Statoil		X

4.3.3 Database

Searches in Synergi was performed to make statistics and evaluate the HSE-level. The searches were performed based on fixed criteria. The results from the searches in Synergi are mainly used to answer RQ 1.

4.4 Data analysis

Data analysis and data acquisition were not two separate stages in the research process, because during the data analysis it turned out that it was a need for more supplementing information.

Data from Synergi and to some extent data from the interviews were used to answer RQ 1. Searches based on different criteria were performed in Synergi, and in the presentation the same indicators that the different Statfjord platforms use to measure HSE-performance were used. The analyses are based on the number of incidents and incidents per one million working hours. A comparison between a period of two years before and two years after the implementing of IO was performed. Parts of the analyses are supplemented with results from the interviews.

RQ 2 was mainly answered based on results from the interviews. The interviews were analysed and categorized to find possibilities and threats according to experience transfer. Based on the results, an evaluation of the main findings were performed. Relevant literature and chosen theoretical aspects were used to discuss important issues according to experience transfer. In addition positive and negative factors of the different systems and arenas for experience transfer were adressed. Given the nature of the research questions, RQ 2 was mainly answered before RQ 3.

In RQ 3 it was made an attempt to find corrective actions to the threats and possibilities according to experience transfer addressed in RQ 2 by using relevant literature and theoretical aspects.

Part 3: Results and discussion

5 RQ 1: How does the use of IO influence the HSE-level in Statfjord RESU?

This chapter gives an evaluation of the objectives for implementing IO in Statfjord RESU. It also gives an evaluation of how IO has influenced the HSE-level.

5.1 The objectives of implementing IO in Statfjord RESU

The objectives of implementing IO in the industry (from chapter 1.1) and in Statfjord RESU (from chapter 2.1) are repeated in table 5.1.

Table 5.1: Objectives in Statfjord RESU compared to common objectives for IO in the industry

Objectives in the industry	Objectives in Statfjord RESU
➢ Economics o Increased production o Increased degree of extraction o Reduction in operation costs o Reduction in maintenance costs o More efficient decision-making processes ➢ Safety o Improved HSE o Reduced exposure to risk when number of offshore personnel is reduced	o To increase the efficiency of the offshore support because of lack of engineering resources o To release sleeping accommodations because this was a limited resource in the realisation of the Statfjord late life project o To reduce operating costs o To reduce offshore exposure on personnel

One of the main objectives for implementing IO in the industry, is due to economic profit, but that was not the driving force in Statfjord RESU. The main objective for implementing IO in Statfjord RESU was to make the offshore support more efficient because of limited engineering resources and sleeping accommodations. The only economic objective in Statfjord RESU was to reduce operating costs.

Safety is a factor that many in the industry uses as an objective to implement IO. Reduction of offshore exposure on personnel is an objective both in the industry and in Statfjord RESU, but it was not an objective to improve HSE when IO was implemented in Statfjord RESU.

Communication of the objectives

Several factors are the reason why IO results in organisational changes, and among these are new work processes, sharing of work and co-operation. To reduce the personnel's uncertainty and opposition in organizational changes, it is necessary to give the affected personnel information about the changes (OLF, 2002b). Information will let the personnel realize the importance of the changes and may prevent resistance against the changes in the organisation. This means that it is important to communicate the objectives of why they are introducing IO to the employees. In the e-operations checklist in CRIOP it is recommended that the visions and goals are communicated to the key stakeholders (Johnsen, Bjørkli, Steiro, Fartum, Haukenes, Ramberg & Skriver, 2004). The objectives were communicated in public meetings. When the informants were asked about the objectives, they could not repeat all the objectives. Only two informants mentioned efficient offshore support, based on real-time data, as an objective. One informant mentioned to reduce sleeping accommodation as an objective and another mentioned reduction of personnel offshore. It seems that the objectives have not been communicated good enough to the employees.

Effects in Statfjord RESU after implementing IO – are the objectives obtained?

IO is a strategic choice in Statoil, where IO is the way to operate in the future. Therefore Statoil has many projects on different platforms where they implement IO. Some of the projects give earnings and others do not, but Statoil sees the earning from all the projects in total. In the end, Statoil think that IO will be profitable for them, when they see all the IO projects as a whole. The IO-pilot in Statfjord RESU is a piece in the whole IO-puzzle in Statoil. Even though it will not give earnings, it will contribute to increased experience with onshore support. Earnings was not a driving force to implement IO in Statfjord RESU, but necessary because of the lack of engineers. Experience from the pilot in Statfjord RESU may be transferred to other projects and contribute to a greater use of engineering resources in total. The effects of IO in Statfjord RESU are measured based on the two first objectives; to increase the efficiency of the offshore support because of lack of engineering resources and to release sleeping accommodations.

The objectives of implementing IO in Statfjord RESU are repeated in table 5.2, and gives an overview of the obtained goals.

Table 5.2: Objective achievement

Objective	Obtained
1. To increase the efficiency of the offshore support because of lack of engineering resources. Approximately 70% of the operations have been supported from land with real time data during 2005 (Milter et al., 2006). But at the same time as IO was introduced, the Statfjord field started new operations and they still have to give offshore support on some of the operations such as completion. Analyses of real-time data onshore is done to a certain degree to day, but the potential is not utilized yet because there is not competence or resources available in Statfjord RESU.	Yes
2. To release sleeping accommodations because this was a limited resource in the realisation of the Statfjord late life project	Yes
3. To reduce operating costs.	No
4. To reduce offshore exposure on personnel.	Yes

Table 5.2 gives an overview of the objectives in Statfjord RESU, but in addition it can be useful to mention the informants feelings about the changes. Several of the informants said that they are not totally satisfied with the new work practices. They think it is better to let the engineers travel offshore where they can see the equipment and gain experience and knowledge.

"We have also experienced some difficulties with drilling and unstable structures, where we also have had engineers offshore. And that results in the fact that we eventually realize that it is more useful to have the engineers offshore, but nobody will say it out loud".

"I wish the engineers could have been offshore again on a more permanent basis."

Some said that the onshore support should have been in addition to the offshore support. But other say that they also have seen advantages to improve the communication between onshore and offshore.

The main objective by implementing IO in Statfjord RESU was to increase the efficiency of the offshore support. IO in Statfjord RESU was not driven by the possibility of increased HSE-level or profit, which are common objectives in the industry for the implementation of

IO. It seems like the objectives of implementing IO in Statfjord RESU, are not clear among the employees. Not all employees in the Statfjord organisation onshore are satisfied with IO, they mean that the engineers should travel offshore. Three out of four objectives are obtained. Even though objective one "to increase efficiency of the offshore support" is obtained, it is still room for improvement. This is because the potential in the real time data is not utilized fully yet, and some of the operations are not given onshore support because of their complexity and problems.

5.2 HSE-level

Database systems are one of the means for explicit experience transfer in the offshore-industry (Aase et al., 2001). Statoil uses the system Synergi. Experience transfer was one of Synergi's paramount objective in the beginning, and it is now mainly used to develop corrective and risk reducing measures. Reported incidents from Synergi are used to evaluate how IO has influenced the HSE-level in Statfjord RESU.

IO was introduced in January 2005. To evaluate the progress, it will be made a comparison between the incidents two years before the implementation (2003 and 2004), and two years after the implementation (2005 and 2006). There is not enough samples in this thesis to give any conclusions about a positive or negative trend (Kjellén, 2000). Therefore it is not possible to say for certain whether the results in this chapter indicate a trend or not. In the presentation, both numbers and frequency will be considered. The frequency is calculated per one million working hours. Number of working hours is given in table 5.3:

$$\frac{\text{Number of incidents * 1 000 000}}{\text{Number of working hours}}$$

Table 5.3: Number of working hours

	Statfjord A	Statfjord B	Statfjord C	Sum
2003	201 922	171 337	231 980	605 239
2004	223 878	152 565	132 599	509 042
2005	223 236	176 370	277 511	677 117
2006	193 923	254 399	157 354	605 676

In the evaluation only HSE non-conformities are considered. It is also limited by HSE non-conformities, where the three platforms Statfjord A, Statfjord B and Statfjord C in Statfjord RESU are the responsible units. An evaluation of serious HSE-incidents, personnel injuries and falling objects have been chosen as performance indicators because Statfjord RESU uses those to measure HSE.

5.2.1 Reported HSE non-conformities

Statoil use a risk matrix to categorize HSE-non conformities which include degree of seriousness and different incident categories. Both a potential and an actual consequence on each of the incidents must be registered. They do not use the dimension frequency as in figure 3.2, because it can give an unrealistic classification of the incidents. This is because of the difficulty for all persons who use Synergi to give a realistic estimate on how often the incidents will occur. Incident classified as HSE non-conformities, used in Statfjord RESU, are personal injury, oil emission, other emission, fire/explosion, oil and gas leakage and fuse failure (Statoil, 2006a). Figure 5.1 shows the number of reported HSE-non conformities, while figure 5.2 shows the frequency of reported HSE non-conformities.

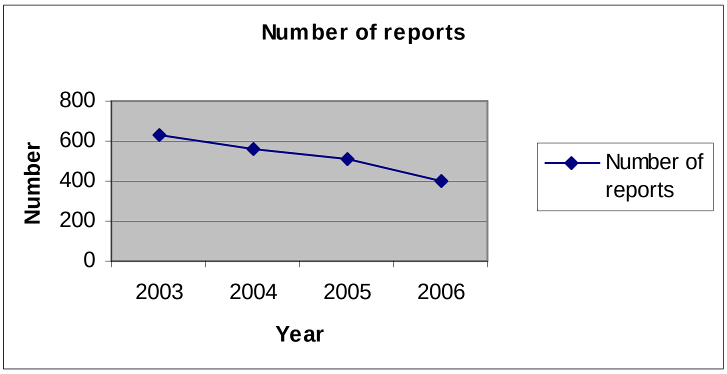

Figure 5.1: Number of reported HSE non-conformities

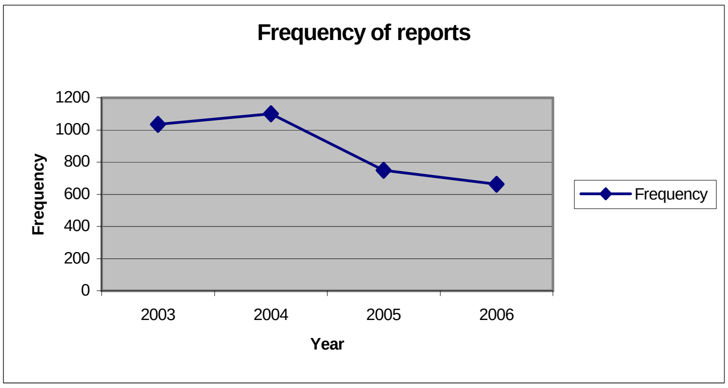

Figure 5.2: Frequency of reported HSE non-conformities

The number and the frequency of reported HSE-non conformities are reduced after the implementation of IO. The informants do not feel that the onshore support has contributed to changes in the reporting of HSE non-conformities in Synergi. A HSE-coordinator offshore said that D&W is good at reporting incidents in Synergi. One explanation on the reduced number, can be the introduction of observation cards where some of the green incidents are sorted out, but all the platforms in Statfjord RESU have not introduced this system yet.

Figure 5.3 shows the frequency of accidents, near-accidents and conditions of all the reported HSE non-conformities. The total frequency of accidents, near-accidents and condition is reduced after the implementation of IO. Both the frequency of accidents and near-accidents are reduced after the implementation of IO, but in 2005 and 2006 they have been stable.

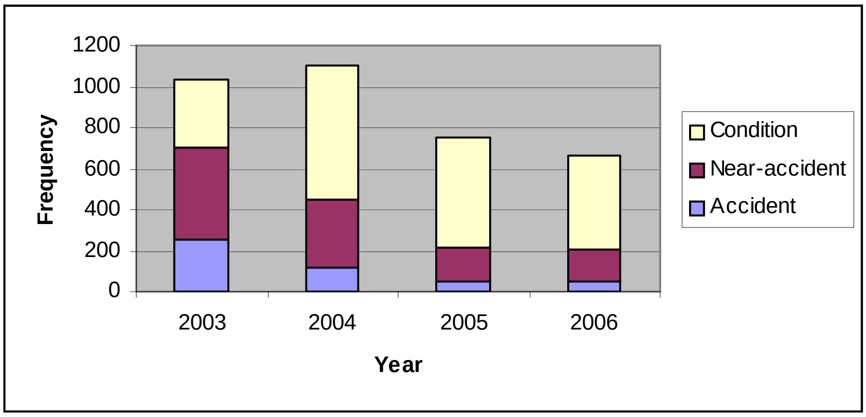

Figure 5.3: Frequency of accidents, near-accidents and conditions of reported HSE-incidents

The reporting of HSE-non conformities has decreased and the total frequency of accidents, near-accidents and condition has decreased.

5.2.2 HSE non-conformities resulted in personal injuries

Personal injuries include fatalities, lost-time injuries (LTI), injuries resulting in transfer to another job or restricted work, medical treatment and first-aid. First-aid is not taken into consideration in this evaluation, because they are not obliged to report to the concern (Statoil, 2006a). Figure 5.4 shows the number of personal injuries, while figure 5.5 shows the frequency of personal injuries.

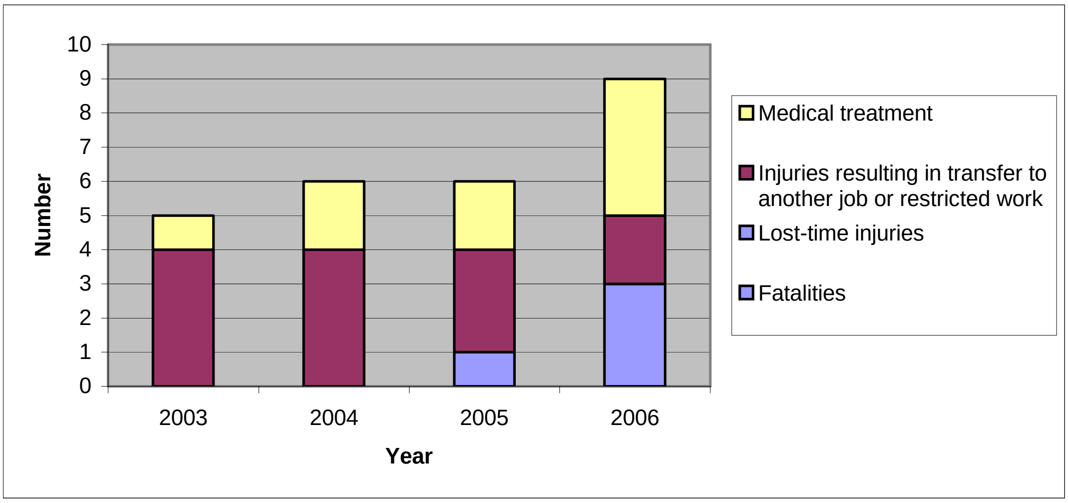

Figure 5.4: Number of personal injuries

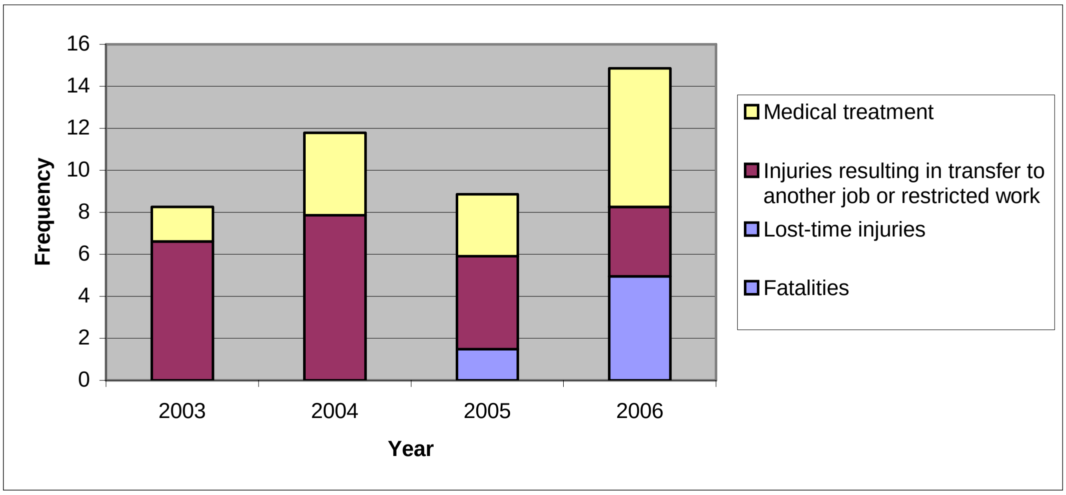

Figure 5.5: Frequency of personal injuries

The total frequency of accidents has decreased (figure 5.3), but the frequency of personal injuries has varied through the whole period from 2003 to 2006 (figure 5.5). The personal injuries decreased in 2005, but they increased in 2006. Most important are the LTI-injuries introduced in 2005 and 2006 which is the second most severe accident. There were no LTI-incidents before the implementation of IO.

LTI

Because of the introduction of LTI-incidents after the implementation of IO, it may be useful to see why these accidents occurred and if they occurred as a consequence of IO. The LTI-incidents in 2005 (table 5.4) and those in 2006 (table 5.5) have different contributing factors. The contributing factors and the root causes are identified in this thesis, but an evaluation is not performed, and should be performed to see whether it is a connection between the implementation of IO and the LTI-incidents.

Table 5.4: Contributing factors and root causes in 2005

Contributing factors, level 2	Contributing factors, level 1	Root causes
Working management	It was accepted that rules/procedures/requirements were not followed.	Equipment/tools were used incorrect
		Did not implement sufficient safeguarding of the workplace
Work practice	Insufficient self inspection before operation	Equipment/tools were used incorrect
		Did not implement sufficient safeguarding of the workplace
	Insufficient design or construction	Equipment/tools were used incorrect
		Did not implement sufficient safeguarding of the workplace

Table 5.5: Contributing factors and root causes in 2006

Contributing factors, level 2	Contributing factors, level 1	Root causes
Work practice	Wrong estimate of the hazard by the employee	Did not use correct personal protective equipment
		Error or failure in equipment/technical system
		Slippery or rough underlay
	The employee did not follow good work practices, rules, procedures and SJA (Safety-Job-Analysis)	Equipment/tools were used incorrect

The frequency of personnel injuries has varied, but is at its highest in 2006. In addition, four LTI-incidents have occurred after the implementation of IO.

5.2.3 Yellow and red incidents

HSE-non conformities are classified as either green, yellow or red incidents. In this thesis the focus is on red and yellow incidents, because they are the most severe incidents. All the LTI-injuries from chapter 5.2.2 are classified as red incidents. The rest of the personal injuries are classified as yellow incidents, except for some of the medical treatment injuries which are not classified.

Figure 5.6 shows the number of reported yellow and red incidents, while figure 5.7 shows the frequency of yellow and red incidents.

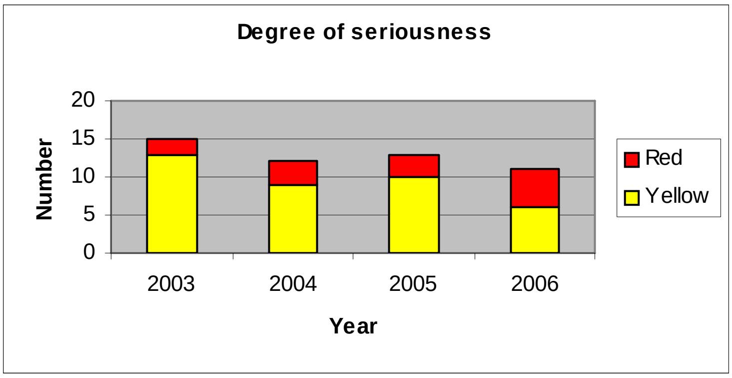

Figure 5.6: Number of reported yellow and red incidents

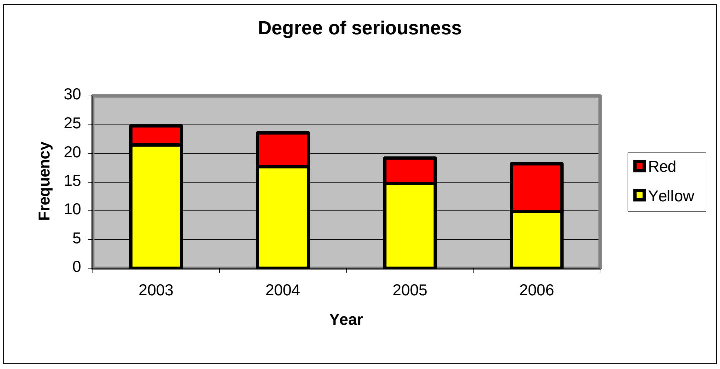

Figure 5.7: Frequency of reported yellow and red incidents

The total frequency of reported incidents in the period 2003-2006 is reduced. While the frequency of yellow incidents is reduced throughout the whole period, the frequency of red incidents has varied and is at its highest in year 2006.

The total frequency of yellow and red incidents is reduced in the whole period, but the number of red incidents has varied and is highest in 2006.

5.2.3.1 Contributing factors for the red and yellow incidents

It is a requirement in Synergi to register at least one contributing factor of the yellow and red incidents, but it is not a requirement for the green incidents. Figure 5.8 gives an overview of the contributing factors registered on the HSE-non conformities in Synergi, but most likely are these factors only connected to the yellow and red incidents. Since it is possible to report more contributing factors per incident, it is not possible to calculate the frequency of the different contributing factors and to compare the frequency between the contributing factors before and after the implementation of IO. A presentation of the number of contributing factors before and after implementation is therefore made, and then it is possible to see which factors that are dominating in the two periods.

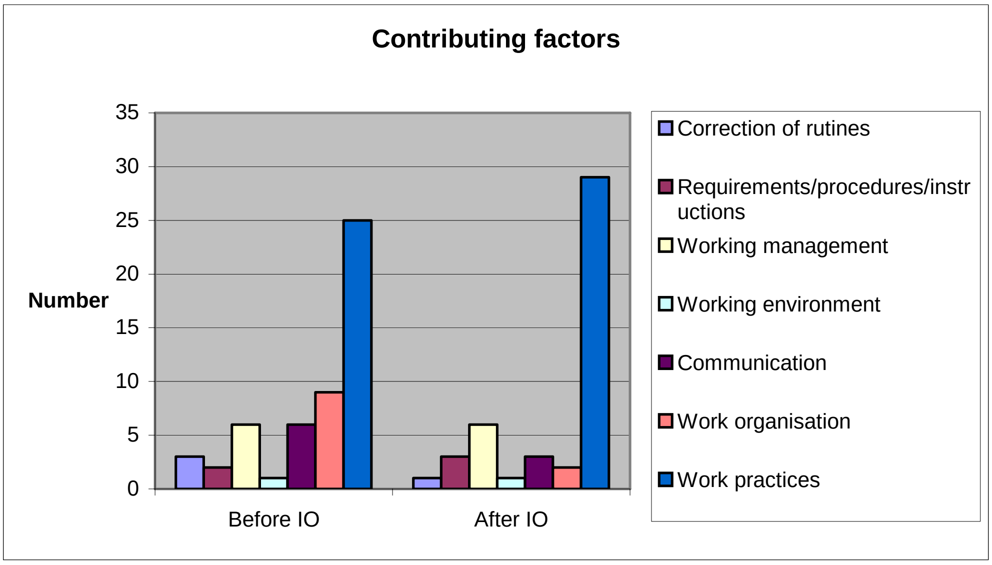

Figure 5.8: Contributing factors

An evaluation on the four most dominating contributing factors before and after the implementation of IO will be given.

Work practices

Work practices is over-represented as a contributing factor in the HSE non-conformities both before and after the implementation of IO. Contributing factors classified as work practices includes, among other factors, lack of self inspection before the operation, insufficient design or construction, wrong estimate of the hazard by the employee and that the employee did not follow good work practices, rules, procedures and SJA. According to Reason (1997), work practice is the same as saying human error. By this, he means that it is not a good explanation for the incidents, because human errors are caused by problems at different layers in the organisation. Human error is the starting point of an investigation (Dekker, 2002). It is necessary to identify why people operated in a certain way, because it might be caused by a combination of human, organisational and technological factors (Reason, 1997).

One of the main challenges in drilling and well operations is management, where the problem is that the drilling leader has a lot of administrative tasks and that he may not be on the drilling floor constantly to perform visible management (Ptil, 2005). This is also confirmed in the interviews with Statfjord RESU personnel. When the engineer was offshore he could be the leader on the drilling floor, when the drilling leader was preoccupied with other tasks the engineer could then have prevent some of the bad work practice.

"But I know of small incidents which could have resulted in consequences. I am pretty sure these incidents could have been prevented if the engineer had been offshore. It involves thoughtless acts offshore, and if an engineer had been there, he would have registered the foolish act."

Work organisation

Before IO was implemented, several incidents were caused by work organisation, but this factor is almost absent after the implementation of IO. Contributing factors classified as work organisation includes among other insufficient HSE-evaluation before operations, work planning, SJA and the installation was not sufficient prepared for operation. IO introduces new ways of co-operation and sharing of work, therefore the work organisation has to be changed. IO has contributed to more standardization in the drilling and well operations where all operations are planned in more detail. All the planning is done by the engineers onshore, where they may utilize the competence and experience in the organisation, because they are closer and they have the possibility to use videoconferences which makes it easier to contact external experts. The plans are also discussed in several meetings before the operations, where important factors are discussed and handled.

"I feel that the detail planning has contributed to better work practice, both according to efficiency and safety. If you have good plans and everything in order prior to the operations, it usually goes much better."

Since the incidents caused by the working organisation are reduced as much as they are, it seems like the new organizing with the planning works well, and it may have influenced the HSE-level in a positive way.

Communication

Before the implementation of IO, communication was the third most contributing factor and it still is. IO introduces new ways to communicate and a lot of the communication is through virtual teams. Contributing factors classified as communication includes among other factors; failures/errors in computer software, insufficient overlap by change of the guard, important information was not communicated/understood and that the work task was not discussed in advance. According to Zedtwitz (2004), problems with communication in virtual teams will include different factors like knowledge transfer and learning. Because all the planning is made onshore and the engineers are not travelling offshore, one challenge is to communicate the plans to the offshore workers. Some times it may be difficult to communicate every detail in the plans, and the most important ones are the risk factors. This could have been prevented if the engineer who prepared the plan assisted in the operation offshore, because face-to-face communication is the most efficient way to communicate (Henderson et al., 2002).

Zedtwitz (2004) also mentions co-ordination as a problem. In Statfjord RESU there are strict communication rules between onshore and offshore, where the drilling leader is the single-point-of contact offshore. The drilling leader has many tasks and he should not unnecessarily be disturbed, and he may therefore form a barrier to contact the platform. It is also rules for whom is allowed to contact the platforms. This may create problems when someone in the operations room see problems in the production, and the drilling leader will not take it seriously because it is from someone other than the people allowed to report. This has been a situation once and it resulted in economic consequences.

Collaboration is another factor which may cause trouble in virtual teams (Zedtwitz, 2004). IO gives onshore and offshore new ways to collaborate because of the operations room with among other factors, possibilities as video conferences and net meetings. By introducing IO, people onshore in Statfjord RESU feel that the collaboration and the possibility for onshore to be more involved in the operations has improved. Onshore has the possibility to follow the operations offshore and give input if necessary. The drilling leader contacts personnel onshore if he has problems, and he can get support more quickly because, onshore personnel are more involved in the operations, they have access to real-time data and knows the operation better than earlier.

Working management

Working management was the third most contributing factors before the implementation of IO, but after the implementation, incidents caused by working management have increased and is now the second most contributing factor. Working management includes among other factors, insufficient follow-up of the work and that HSE was given a low priority. This may also be associated with the fact that the drilling leader has many tasks and therefore he does not have time to follow the operations on the drilling floor constantly.

Work practice is reported as the most frequent contributing factor.

5.2.4 Falling objects

In the years of 2003-2005, all the red incidents (figure 5.6) were caused by falling objects. In 2006, two out of five red incidents were caused by falling objects. Figure 5.9 shows number of falling objects, while figure 5.10 shows the frequency of falling objects.

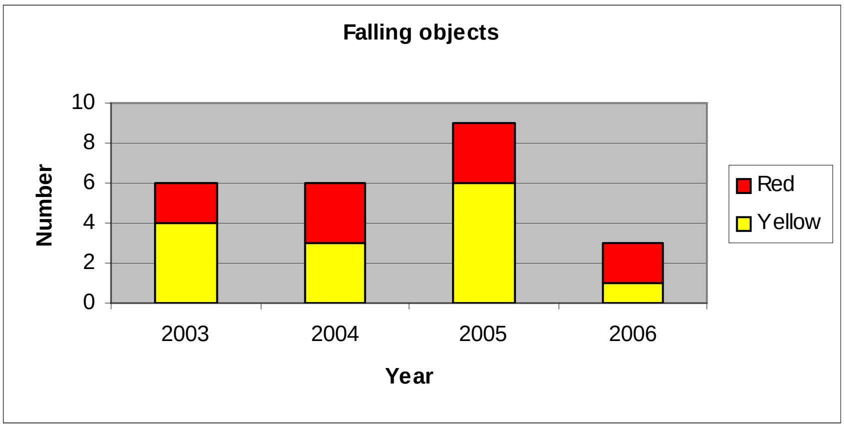

Figure 5.9: Number of falling objects classified yellow and red

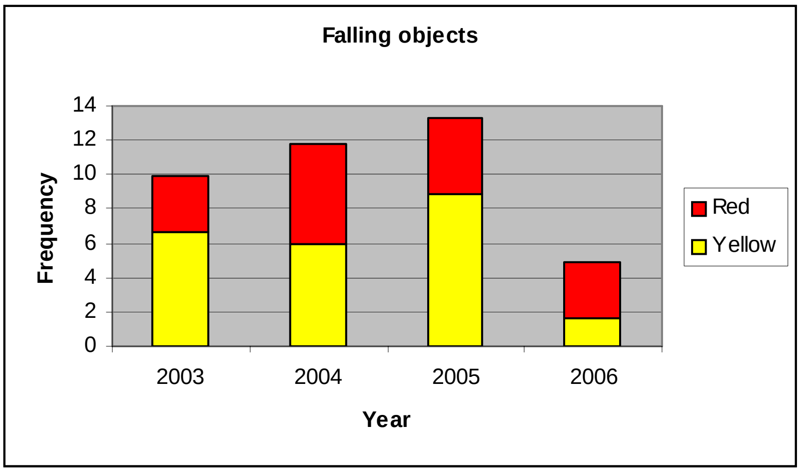

Figure 5.10: Frequency of falling objects classified yellow and red

The frequency of falling objects increased from 2003 to 2005, but in 2006 it has been a drastic reduction. One of the reasons to the reduction may be a big accident that happened in 2005 where one person almost died. Based on that accident, some preventive measures were introduced. All the informants say that falling objects are not directly associated with IO, and that an increase in falling objects most likely is not caused by the implementation of IO.

Frequency of falling objects increased in the period 2003 to 2005, but is drastically reduced in 2006. The informants are of the opinion that falling objects are not directly associated with the implementation of IO.

5.3 Summary of research question 1

The two previous chapters (5.1 and 5.2) indicates that there are two major shortages in how IO has influenced the HSE level in Statfjord RESU:

1. ***Improved HSE was not an objective.***

The main objective by implementing IO in Statfjord RESU was to increase the efficiency of the offshore support. The introduction of IO in Statfjord RESU was not driven by the possibility to improve HSE.

2. ***IO has not contributed to a reduction in the number of reported personnel injuries or other incidents of a high potential.***

The total frequency of accidents, near-accidents and conditions has decreased, and in addition the total frequency of red and yellow incidents has decreased. In spite of this, the frequency of personnel injuries and the frequency of red incidents have been varied, and they are at the highest in 2006. In addition, four LTI-incidents have occurred after the implementation of IO.

Considering the two points above, Statfjord RESU has some challenges according to HSE in IO. How IO will influence HSE in Statfjord RESU in the future, is dependent on how the two elements above are taken into consideration. In addition, work practice is reported as the most frequent cause to incidents. This may indicate incomplete investigation of the reported incidents, because work practice is affected by both human, organisational and technological factors.

6 RQ 2: What possibilities and threats does the use of IO cause for the experience transfer in Statfjord RESU?

This chapter's focus is to give an evaluation on the possibilities and threats for the experience transfer in Statfjord RESU caused by the implementation of IO. First some main findings are discussed, followed by other findings which may be of importance. At the end, some positive and negative factors according to the different systems and arenas for experience transfer in Statfjord RESU and Statoil are addressed.

Statoil and the Statfjord field have governing variables formulated in governing documents, which describe the requirements for experience transfer. To meet the requirements, there are implemented systems and arenas to make it possible to realize them. Systems and arenas in Statfjord RESU and Statoil are described in chapter 2.3. Traditionally the focus has been on developing administrative management systems and tools, but it is also necessary to focus on the individual and organisational factors (Aase et al., 2001). This means that the MTO-aspect also is important in experience transfer and organisational learning.

To achieve organisational learning it is necessary to close the control-loop in figure 6.1. The changed situation because of IO may have affected the actions for experience transfer, and resulted in both positive and negative consequences for experience transfer and organisational learning in Statfjord RESU. It is therefore important to address negative consequences and to make corrective actions, but it is also important to address positive consequences to utilize and develop these possibilities. This chapter will address the needs for corrective actions, and in chapter 7, corrective actions will be suggested.

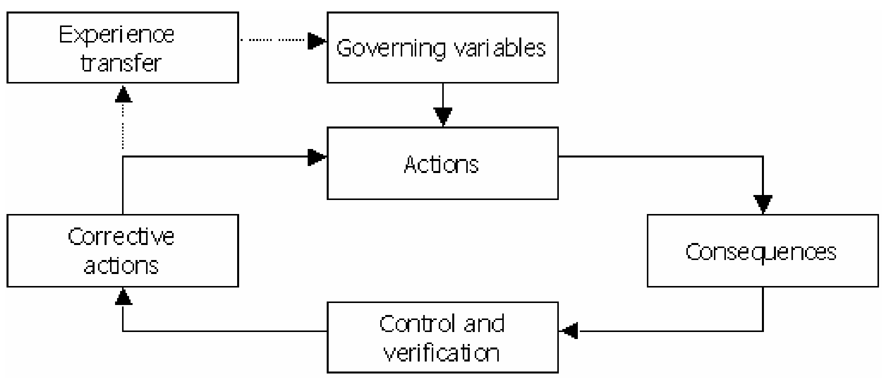

Figure 6.1: HSE-control loop (Modified Kjellén, 2000)

6.1 Main possibilities and threats influencing experience transfer

Based on the results from the interviews, three possibilities and three threats according to experience transfer are considered as the most important factors (table 6.1). The main focus is on the changed conditions caused by the implementation of IO.

Table 6.1: Possibilities and threats according to experience transfer

Possibilities	Threats
Improved operational procedures	Information overflow
Better utilization of competence in the organisation	Lack of priority to transfer experience
Better collaboration between onshore and offshore	Lack of “hands-on” experience among the engineers

6.1.1 Main possibilities

6.1.1.1 Improved operational procedures

Several informants say that the standardization of experience in the master-procedures and the work with the detail planning is one of the best results from IO.

”I feel that the biggest advantage with IO for us, is that we are closer to the operations and that we have succeeded in making a system where we manage the learning loop. We have tried many other things earlier which have not worked as well (..).”

”The biggest advantage with onshore support, is that we have gotten better detail-procedures. Everybody are at a higher level, focused on what to do at all times.”

The experience gain through operations are now collected in the master-procedures. All operations have their own master-procedure. After every operation there is written an “as-run-procedure” based on experience from the operation where recommendations to changes in the master-procedure may be suggested. If the recommendations are relevant, the master-procedure is updated. This is an example of double-loop learning because the governing variables are changed, and this can contribute to permanent improvement of the work processes (Argyris et al., 1996). According to Van Court Hare’s hierarchy of order of feedback, the work with the master-procedures is placed in level 3. Systems in level 3 are strategic systems that learn from experience and have the ability to correct plans and develop new plans, e.g. change in routines (Kjellén, 2000).

"It seems like the system is a very thorough way to ensure local experience transfer in Statfjord."

"Experience is collected through the operations offshore. An engineer is responsible for the detail-planning in an operation. He gets feedback from offshore and updates the master-procedure if it is something we should take into future consideration. The experience transfer is ensured in that way."

The detail planning may contribute to a higher HSE-level, because well planned operations will normally take place more straightforward compared to bad planned operations. As discussed in chapter 5.2.3.1, the amount of incidents caused by work organisation is reduced. The operational procedures also contribute to make a lot of the tacit knowledge in the organisation explicit through the planning meetings, where knowledge and experience are shared and discussed.

6.1.1.2 Better utilization of competence in the organisation

IO has resulted in new work processes where co-operation is independent on physical location (Ringstad et al., 2006). In Statfjord RESU this is made possible by the operations room at Forus Vest, but also from personal computers connected to the Statoil internal communications network (Milter et al., 2006). This means that both internal support from the operations room at Forus Vest and external support is possible without travelling. This gives a better utilization of competence in planning and during operation because it is easier to involve people. It is also possible for external personnel to follow the operations and therefore give support faster than earlier.

"My opinion is that it is better to have people offshore where the job is done, but of course there is more competence onshore. If there is enough capacity onshore to involve more people to evaluate the situation, that is good as long as the communication is right."

Different issues are discussed during the planning meetings and this results in experience transfer between the personnel involved. It is important to discuss issues both in formal and informal areas, because it may contribute to transfer tacit and individual knowledge to explicit and collective knowledge (Hovden et al., 2004; Aase, 1997a; Aase et al., 2001).

6.1.1.3 Better collaboration between onshore and offshore

IO has contributed to a better collaboration between onshore and offshore because of the operations room. Personnel onshore are more involved in the operations than they used to be because of real-time data and the meetings through videoconferences and net meetings. This makes it easier for offshore personnel to contact onshore and the other way round. IO may have introduced some new barriers in communication, but the collaboration between onshore and offshore in total is better.

” The communication has become much better and much more open”

Time consuming and top-down driven systems for experience transfer are barriers against experience transfer (Aase, 1997a), but the new possibility for collaboration between onshore and offshore has resulted in more efficient support and therefore better experience transfer. Tacit and informal contact for experience transfer are good systems for experience transfer (Aase 1997b; Aase et al., 2001), and IO has contributed to more tacit communication between onshore and offshore.

6.1.2 Main threats

6.1.2.1 Information overflow

Information overflow is a barrier to prevent experience transfer (Aase, 1997b). The information overflow is not directly connected to IO, but it is mentioned as one of the biggest barrier against experience transfer among the informants, and is therefore included as one of the main barriers. In Statfjord RESU the informants feel that the experience data and information available is overwhelming and therefore it is difficult to find information.

“It is the amount (….), to sort out the most important from the amount. From my point of view it is because it runs enormous amount of information between offshore and onshore, but also in the system generally. (..) And to sort out important things from the amount, I think will be a severe job.”

“Generally, the most important problem by using experience data, is what I call information overflow. We have many systems where it is stored a lot of good information. But to have the right data, or to have a system where you find the right information to the right time in a simple way. We do not have that...”

”As long as the system is not good enough for me to get information and learn things, I also loose experience.”

The main problem is the number of systems, which are too many. When this is the case, it becomes time consuming searching for information and that creates a barrier (Aase, 1997a). In Statfjord RESU, this results in a random use of experience data because they use the systems randomly. In some cases they rely on solutions where they contact people in the network they know to get experience, but often they only rely on the experience in the team. It is positive to use knowledge and experience in the network, but this becomes a problem when new engineers need help, since they do not know the network and who to ask for help (Aase, 1997b).

"It is useful to have contacts and to know people, but the organisation can not rely on that because it is a bit random."

Statfjord RESU has many systems for experience transfer, but often they create new systems which result in old systems "dying out" since they to some extent overlap. This practice may be an indication of systems where the demanded needs are not met. Systems which do not satisfy the needs, are almost the same as not having a system because the system is not used. Lack of systems is according to Aase (1997b) a barrier for experience transfer.

"(…) we had other systems for experience transfer, but people did not use them and then it is a typical thing that people start with a new without cancelling the old ones, and then the old systems lies in the background, but nobody uses them. (…) One of the problems I refer to, is that we get a lot of information on very many channels, a lot of places. My focus is therefore that a new system can not be started up, because this results in a new place to search for information. At least one system should be terminated, preferably more."

The introduction of new systems and arenas makes the system for experience transfer over-complex and this makes it more difficult to find information. It is also a problem if a new system overlaps with an old system, because information may be stored in both systems since some parts of the organisation stick to the old system. When this happens some information can be lost, because when information from only one of the systems are used, the information in the other system will not be taken into consideration. This is a problem to some extent in Statfjord RESU, because the system with the operational procedures does not take into consideration data from e.g. Synergi. When data from Synergi is not involved in the planning of new operations, the information about incidents will not be used.

Some of the systems are not searchable, e.g. experience reports, or it is difficult to searches for experience data, e.g. DBR. Some feel that there is a need for experts to perform search in the systems because of the lack of user-friendliness. When systems are not searchable, it is difficult to use experience from them, since it will be to time-consuming to go through every experience to find relevant information.

In addition to the different systems and arenas mentioned in chapter 2.3, IO has made it possible for onshore personnel to get access to real-time data. This has resulted in an enormous amount of data transfer between onshore and offshore.

6.1.2.2 Lack of priority to transfer experience

Lack of priority is according to Aase (1997b) a barrier against experience transfer. The personnel in Statfjord RESU feel that they do not have the time to share or obtain experience because they are busy doing their own tasks. Experience transfer comes in addition to their daily tasks and is often given a lower priority. Some of the informants said that they use more random solutions or do not search for experience data before operations which may indicate that it is to time consuming to search for experience.

"There is not enough time to look upon other areas which are essential for sharing of experience. Both to tell other what you have done, and to be able to find out what others have done which may be useful for you to know. Therefore I think that time is the most important factor here.., (…)"

"We will carry out a piece of work, and then we use the experience we have in our heads and in the team around us. That is what generally happens."

Both personnel onshore and offshore feel that they have a lack of time to do the required work. Onshore personnel feel that IO has resulted in a more hectic work-day with more meetings they have to attend.

"(…) the working-day has become more hectic. The governing documents have resulted in new work practices. At the planning meeting, a fixed number of persons from different categories should attend and the planning meetings take place constantly and holds up a lot of people in meetings. I think it has become an incomprehensible amount of meetings, annoying amount of meetings. And your working-day where you have time to do a piece of work is decreased considerably."

”I feel that we onshore are to occupied with meetings, we run from one meeting to another. We have to attend different meetings, working groups, problem-solving groups, discussion of detail procedures etc. We have no control of our day. Everybody else decide what we should do, therefore we have very little time left to do the task we need to work on. It is an enormous amount of meetings.”

Overlap between meetings and operations makes it necessary for the engineers to prioritise between where to participate. Usually operations are prioritised before planning meetings. This may result in loss of possibilities to gain or share experience that could have been valuable for both the engineers and the operations.

“(…) I do not think there has been made a good enough definition as to how much an engineer, if he is engaged in operations in the operations room, should work there and how much he should work with other tasks.”

”It is just about prioritising and we who are involved in the operation, we prioritise the operation of course. There should be activities almost all the time offshore. But because of that some things need to be given a lower priority. Maybe you are so involved in your own operation, that you can not attend another planning meeting which is similar to one on your own platform in x number of weeks.”

The drilling leader offshore also has a high work load which contributes to a lack of time to transfer experience and follow the operations on the drilling floor. When the engineers were offshore they could unload the drilling leader to some extent.

“(…) the drilling leader has many areas of responsibility offshore and he can not bury himself in the operation. He may do so periodically of course, but not continuously. (…) he will fail his job pretty much if he becomes absorbed in the plans and stays on the drilling deck constantly. That is actually not possible.

”The drilling leader offshore has a lot of work tasks, they involve time pressure and that he is involved in the other things happening on the platform. (…) And because he does not have the engineer offshore, makes it more bothersome."

Synergi is used to find preventive measures on single incidents which according to Hovden et al. (2004) is not optimal. The HSE-coordinators do not perform systematic searches for problems over a certain period because of the lack of time. D & W report incidents to Synergi, but they do not use much of the data in their work, e.g. the engineers do not use Synergi when they are planning new operations.

6.1.2.3 Lack of "hands-on" experience among the engineers

Competence is a barrier against experience transfer (Aase, 1997a). When the engineers were offshore they could follow the operations and see the equipment. This resulted in gained knowledge and experience. The engineers are still offshore to follow some of the operations, but now they see the operations maybe 1-2 times compared to 4-5 times earlier, and that makes a big difference in the gain of knowledge and experience. The experience can e.g. be drilling equipment, surfaces, well control, the organisation offshore and situations that requires the engineer to study special areas.

"I mean that onshore support versus the engineers travelling offshore weakens the engineers learning process, but also the experience transfer"

"The negative side is the lack of the intense close encounter, the operational experience they gain by being offshore and touching the equipment."

In discussions that may arise, it may be difficult for the engineers to imagine how things look like, e.g. between incidents, equipment and the well, and that can result in a communication problem. Generally the offshore workers and the engineers onshore have different knowledge, experience and understanding of the operation offshore.

"It is the same as the drilling engineers onshore, it has its advantages and disadvantages. As xxx mentioned, they do not actually know how the operations runs. Writing a detailed plan then, is difficult."

"(…) I see that it is a combination between onshore support and the engineers travelling offshore. If they want an engineer offshore, an engineer travels offshore. And I think it is very good for them also, the possibility to travel offshore and get a picture on how things look like, because it is easier when a discussion arise."

Because the engineers are not offshore on a regular basis, they now have to read reports, in addition to follow operations from the operations room to gain experience. It is difficult to get the right picture of how e.g. equipment and operations look like from these reports, when they do not have the operational experience. And most likely, all experience is not written down in reports. It is easier to understand the operations and the problems through personal experienced episodes, rather than reading reports. Engineers travelling offshore may be considered as a form for personnel-rotation because they can understand the situation offshore better compared to only being onshore, and personnel-rotation is considered to be more efficient than reports and procedures (Aase, 1997a; Aase et al., 2001).

“Then he has to read reports, talk on the telephone and try to learn and gain experience based on that. He can do it to a certain extent, but I think that is more difficult than from own personal experience, since he then remembers it better”

6.2 Other challenges influencing experience transfer

In addition to the main findings, some other challenging factors are discussed in this chapter.

6.2.1 Communication

The drilling leader is the single point-of-contact offshore. He is very often busy and he should not be disturbed unnecessarily. Therefore it may be difficult for the engineers onshore to get answers to their questions. If they had been offshore, they could have tried to find the answers themselves by asking people or look at the equipment, without disturbing the driller leader. Because the drilling leader is the single point-of-contact, he may be a barrier in the communication between onshore and offshore, since onshore personnel do not want to disturb him unnecessarily.

”We talk together many times every day, but the engineers have been instructed not to nag at the drilling leader more than necessary, because it is very busy offshore.”

“You are often reserved from calling the drilling leader to ask questions, because you know that the drilling leader has a busy work day and you should respect his time.”

There are strict communication rules between onshore and offshore. It is necessary since everybody can not call the drilling leader when they have a question, because then he will be too disturbed from his daily work. But sometimes it can be too strict since the drilling leader does not want to receive any other comments than from the drilling engineers, even though other in the operations room have seen problems in the operation.

When some of the functions are moved onshore, the drilling team and the analysts are split. It could have been a better system to communicate good advise, recommendations and information back offshore. Today, the communication between onshore and offshore is a bit random. They mainly contact each other when they see special problems that need to be addressed. There could be more fixed routines for when onshore should contact offshore based on e.g. time or special criteria.

”Today I do not think there is a good enough system to communicate from onshore to the platform about what they see in the well at all times. (…). But that is my claim regarding how it is functioning in RESU, the communication is not good enough. It has to be improved, but the first thing we have to improve, is that we need to have something reasonable to communicate. We need to systematize the collection and the analyses of the data.”

When the engineers are onshore, all planning of the operations is done onshore and has to be communicated to the offshore workers by the means of the operations room. The drilling plans may be perfect and take into consideration all important elements, but it may be difficult to communicate absolutely everything to the people who actually perform the drilling operations offshore. The communication goes through several links and the more links there are in the communication chain, the greater the filtration of information (Hovden, 2003). The most critical form of communication takes place between different teams at shift handover (Henderson et al., 2002). The operations room remove the possibility of face-to-face communication. Face-to-face communication makes it easier to identify problems more quickly and makes it possible to receive instant feedback during operations (Henderson et al., 2002).

”(…) I think that IO still have problems with the transferring of knowledge and information to the personnel offshore who are performing the operations. If the problem is not solved, certain areas of the IO-activity can probably be shut down.”

6.2.2 Resources

The lack of resources is a barrier against experience transfer (Aase, 1997b). There is not enough competence and resources to analyse and use all the incoming real-time data. The real-time data should be used pro-active and at the right time. This was also the intention when IO was implemented.

”(…) and I do not experience that people here are waiting to receive information that makes the basis for decisions. (…) It is not only lack of real-time communication, it is also lack of resources generally. My interpretation is that we have not the potential to use it as efficiently as many believe.”

6.2.3 Attitudes

Work norms are a barrier against experience transfer (Aase, 1997a). In many of the operations they do not consider earlier experience, because the attitude is so that parts of the operations are without problems. In the late phase it has been done some changes in the well design and there are problems. This attitude is both onshore and offshore, but the main responsibility is onshore, since they are responsible for how the operations are executed. They decide which data should be used and how it should be followed up.

Motivation and moral are key factors for safety and are therefore important. These factors are highly related to the personnel's satisfaction with the management system and their trust in the management (Itoh et al., 2004). The drilling leader do not always report experience in a proper way, because he claims that he reports a lot of data that never will be used. And in many cases it may be true, but this does not involve HSE-related incidents.

When IO was implemented and the detail procedures were introduced, the power during the executing of drilling operations was transferred from the drilling leader to onshore personnel. When the operational procedures are settled, the drilling leader has to contact the operation leader onshore if he wants to do some changes. Because of this, the drilling leader has lost much of the power he earlier had, and some of the drilling leaders did not like the new system when it was introduced. During deviation situations it may also reduce his possibility to improvise based on his offshore experience. In some situation, improvisation may be the only way to prevent a catastrophe (Sætre, 2006).

6.3 Findings according to systems and arenas

An evaluation of the different systems and arenas in Statfjord RESU and Statoil is presented in this chapter. First there is a classification of the different systems and arenas, made to present which of the systems and arenas contributing to tacit or explicit knowledge. Second are positive and negative factors addressed according to the different systems for experience in Statfjord RESU and Statoil. This chapter address some of the factors, but a more detailed evaluation of the different systems and arenas should be performed to find a way to reduce the number of systems and arenas for making the experience transfer more efficient.

6.3.1 Tacit and explicit knowledge

According to Aase (1997b) it is important to have both tacit and explicit arenas for experience transfer. The systems and arenas for experience transfer in Statfjord RESU are both tacit and explicit. Figure 6.2 attempts to categorise the different systems and arenas described in chapter 2.3.

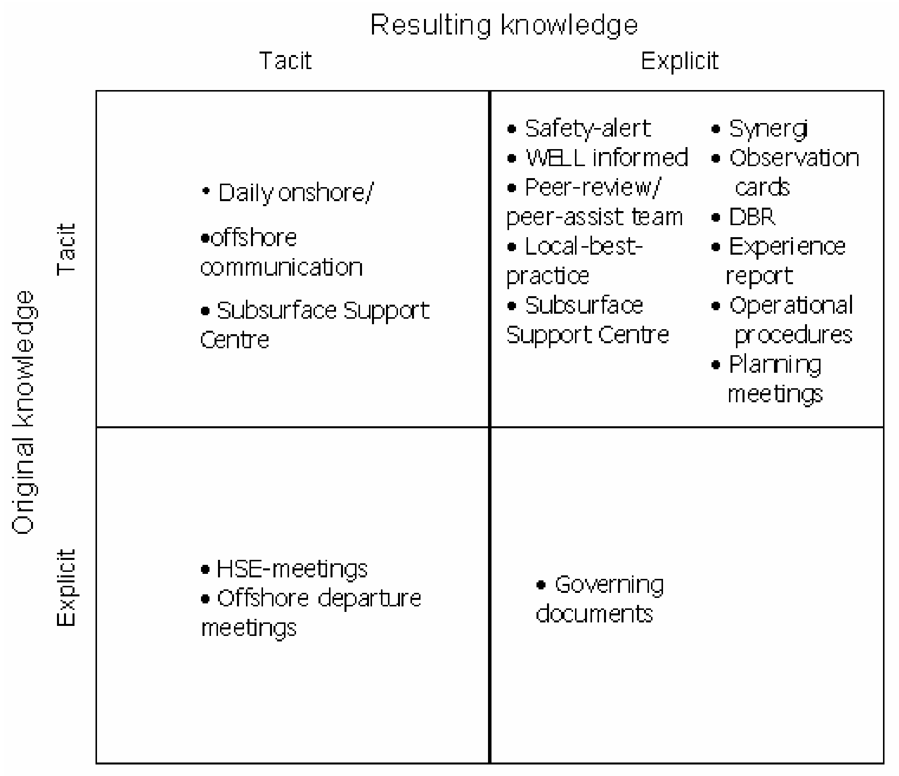

Figure 6.2: Categorisation of systems and arenas in Statfjord RESU

A main threat for experience transfer is the information overflow and figure 6.2 shows that there are many systems making tacit knowledge explicit. This amount of explicit experience transfer systems can make it over-complex. IO has not introduced new systems or arenas for experience transfer, but some of the systems have changed because of IO. The greatest changes are the communication between onshore and offshore, the standardisation of operational procedures and the planning meetings. Onshore is now more involved in the operations, they communicate more often and more people are involved in the operations and decisions. A lot of experience is transferred in the communication between onshore and offshore, which is mainly tacit knowledge. This means that issues discussed only are accessible to the persons involved. These conversations may give a lot of information and help to the particular issue discussed on a specific operation, but it may be difficult to use this knowledge on similar issues if none of the same personnel are involved.

In addition to the tacit knowledge between onshore and offshore which remain tacit, the planning meetings and procedures have contributed to transfer much of the tacit knowledge to explicit knowledge. But it is not possible to make all tacit knowledge explicit in these meetings and in the planning of procedures. The engineers should take into consideration explicit knowledge from Synergi and DBR when planning new operations, but this is not always accomplished. Therefore will some of the tacit knowledge which is transferred to explicit knowledge through Synergi and DBR not be taken into consideration. Another problem is when the drilling leader do not report experience in DBR, then the tacit knowledge will remain tacit and unknown for the onshore personnel, and will therefore not be taken into consideration in the planning of new operations.

There is not introduced new systems for experience transfer, but IO has resulted in new possibilities for the existing ones. IO has resulted in more transfer of tacit experience and some of it remains tacit, e.g. the communication between onshore and offshore, but some of the tacit experience is also made explicit, e.g. through planning meetings and operational procedures.

6.3.2 Systems and arenas for experience transfer in Statoil

Table 6.2: Positive and negative factors according to the different systems for experience transfer in Statoil

System/arena	Positive factors	Negative factors
Synergi	- Synergi contains incidents from all the platforms in Statoil and contributes to experience transfer between platforms - Each of the suggested preventive measures in Synergi have one responsible person to make sure the measures are followed-up.	- D&W report incidents to Synergi, but do not use much of the data in their work, e.g. the engineers do not use Synergi when they are planning operations. - Many of the reported incidents are incidents without relevance for either HSE or operations, e.g. blunt knifes in the canteen. - Some of the suppliers get instruction about reporting a certain number of incidents during a certain period, which result in reporting of unimportant incidents. - Synergi is used to find preventive measures on single incidents. The HSE-coordinators do not perform systematic search on incidents to find problem areas because of the lack of time and prioritising.

System/arena	Positive factors	Negative factors
Safety-alert	- Contributes to experience transfer between platforms and companies.	
DBR	- DBR is used every day and is the most used system in Statfjord RESU. The focus is mainly on operational factors, but because of the link to Synergi it also to some extent take into consideration HSE-incidents. - DBR contains a lot of information and many people have access. Therefore the whole DBR is an area for experience transfer, not only the experience part. - A new system is introduced, where the experience automatically is sent to the discipline advisor in the given discipline area. He must control the experience and approve if it is correct and necessary. - Contributes to experience transfer between platforms.	- The drilling leader is responsible for writing experience in DBR, but he often delegate the reporting to other personnel, e.g. engineers. It may be difficult for an operator or an engineer onshore to describe the detailed processes exact, and therefore the written experience is not always correct. - The routines for writing experience in DBR are not good enough yet, and therefore do not Statfjord write a lot of reports. - DBR is searchable on both codes and text, but some think it is bothersome and difficult. And some think it is a need for an expert to do the searches on relevant issues.
Peer-review/ Peer-assist	- Contributes to experience transfer between platforms. Use expert knowledge and experience in the organisation.	
Local-best-practice	- The whole organisation has access to the routines in Local-best-practice. This contributes to experience transfer between platforms.	- The documents are more or less updated, only some of the platforms update the documents. - The documents are in many cases not used and some of the engineers have not heard of the system.
Governing documents		- Too many governing documents
Subsurface Support Centre	- Close collaboration with the discipline network and they can therefore involve people with expert knowledge and professionals to support operations quickly. - They are a gateway to relevant experience and has the best relevant experience available. Therefore they both refer to relevant experience and support operations. - They have access to real-time data from Statfjord RESU, but also the other platforms in Statoil. They may therefore contribute to experience transfer between platforms. - The support is time-consuming and they have limited resources, but they are now going to expand.	- They only have access to a limited amount of data, and that may contribute to wrong decisions because they form a wrong picture of the situation, but this is also the situation in the operations room. - They always talk to onshore when they support operations, but sometimes the drilling leader is involved. The contractors who are doing the job are not involved and the plans therefore has to be communicated through more links, and may result in filtration of information.
WELL informed	- Contributes to experience transfer between platforms and suppliers. - Personnel involved in operations write articles and therefore they may communicate first-hand experience.	- The informants do not feel that WELL informed is a good channel for experience transfer because many of the articles are not relevant and they do not have time to read it. - Many also feel that they do not have time to share experience by writing articles. - All the informants mean that it is useful with the contact information in the articles, but none of them have used this opportunity to gain experience and knowledge.

6.3.3 Systems and arenas for experience transfer in Statfjord RESU

Table 6.3: Positive and negative factors according to systems and arenas for experience transfer in Statfjord RESU

System/arena	Positive factors	Negative factors
Observation Cards	- Incidents are evaluated before they are reported in Synergi and that prevents reporting of unimportant incidents.	
Planning meeting	- The planning meetings make it possible to involve more people with knowledge and experience in the preparation of drilling programs	- Some of the knowledge and experience from these meetings remain tacit, but some of the information (the conclusions) are written down. - Often it is a collision between different planning meetings and/or operations and this forces the engineers to prioritise. Often they prioritise the operations. This results in the loss of possibilities for the engineers to gain and share experience that could have been valuable for both the engineers and the operations. - The engineers feel that there are too many meetings. Some also feel that every operation do not need the same quantity of planning, e.g. small operation compared to big and difficult operations.
Operational procedures	- According to the informants the operational procedures are the best consequences of IO - A lot of the tacit knowledge in the organisation is taken into consideration in the detailed procedures through the planning meetings before the operations. But it is difficult to take into consideration all the tacit knowledge. - The work with the procedures makes it possible to involve more people with knowledge and experience in the preparation - The operational procedures have contributed to more standardisation of the procedures and the operations.	- The work with the detail procedures do not take into account data from Synergi and DBR. - It was both positive and negative responses when the detailed procedures were introduced. They contributed to less power to the drilling leaders because they now must follow the procedures punctually and ask onshore if they want to do some changes. But some thought it was good to have everything written-down.
Experience report	- Used to get an update on the status of the wells, e.g. depth, pipes and equipment used and valves.	- Experience about safe ways to drill and experience from incidents are not in this report. - It takes a lot of time to write the report and they want to have people back in productive work quickly, especially when there is a lack of people offshore already. The reports probably get thinner and thinner, and therefore the value of the report is uncertain. - The reports are filed in an archive on the installations and it is also stored electronicly in Statoil's intranet. In many cases the report is just filed in an archive and then the report do not have much value. - The reports are most likely not searchable, therefore it may be difficult to get access to the experience.

System/arena	Positive factors	Negative factors
Daily onshore/ offshore communication	- One settled meeting every morning where problems and future operations are discussed. - Many actors participate and result in a lot of experience transfer on these meetings. On a typical morning meeting in Statfjord RESU it is four operations offshore and 25 person onshore participate on the meeting. - All the Statfjord platforms attend and experience transfer across the platforms are possible.	- No formal report is written from the morning meetings or other conversations between onshore and offshore. It may therefore be difficult to get access to the issues and experience discussed on these meetings in the future. Therefore a lot of the experience and knowledge transferred will remain tacit.
Offshore departure meetings	- The offshore workers get an update on the incidents that happened when they were off duty. - Repetition of the HSE-expectation at the Statfjord field - Info about the work to be done in the period while they are offshore	
HSE-meetings	- A HSE-meeting every time the operators are offshore - They go through relevant HSE-incidents	- The HSE-coordinators offshore do not attend these meetings.

6.4 Summary research question 2

The three previous chapters (6.1, 6.2 and 6.3) indicate that there are some possibilities and threats because of IO influencing the experience transfer in Statfjord RESU. The main threats and possibilities influencing the experience transfer are:

Main possibilities:

1. ***Improved operational procedures***

All operations have their own master-procedure which is tailored to every operation. The master-procedure is updated if relevant experience is gained during the operation. IO has made it easier to prepare and update the procedures because of the operations room. The work with the operational procedures is an example of double loop learning which contributes to organisational learning.

2. ***Better utilization of competence in the organisation***

It is now possible to co-operate independently on physical location because of ICT. This means that both internal support from the operations room at Forus Vest and external support is possible without travelling. This results in more efficient support. In addition are all the planning done onshore and this results in better utilization of competence in planning.

3. ***Better collaboration between onshore and offshore***

The onshore personnel are more involved in the operations than earlier because of the operations room. They may now follow the operations closer since real-time data is sent onshore and it is possible to communicate between onshore and offshore with videoconferences and net-meetings. This also results in more efficient support.

Main threats:

1. ***Information overflow***

There are many systems and arenas for experience transfer in both Statfjord RESU and Statoil. This results in information overflow where the personnel can not find the right information at the right time. This may contribute to the creation of new systems and random use of experience data.

2. ***Lack of priority to transfer experience***

The personnel onshore feel that they do not have time to share or gain experience, because they are busy doing their own tasks. IO has resulted in a more hectic work day and this is mainly because of an increased number of planning meetings. They often have to prioritise between operations and meetings where experience is transferred. IO has also resulted in an increased workload on the drilling leader offshore, which contributes to the lack of time for transferring experience and follow operations on the drilling floor.

3. ***Lack of "hands-on" experience among the engineers***

IO decreases the engineers possibilities to gain operational knowledge and experience because they most of the time follow the operations from the operations room. In addition to follow the operations from the operations room, they have to read reports to gain experience. This makes it difficult for the engineers to imagine how things look like. Generally the offshore workers and the engineers onshore have different knowledge, experience and understanding of the operations.

Other threats are communication, resources and attitudes. The systems and arenas for experience transfer have not changed, but some of them have gotten new possibilities. IO has resulted in more transfer of tacit experience and some of it remains tacit, e.g. communication between onshore and offshore, but some of the tacit experience is also made explicit, e.g. through planning meetings and procedures.

7 RQ 3: How can the experience transfer in Statfjord RESU and in Statoil be improved?

Based on the findings in chapter 6 this chapter gives recommendations on how Statfjord RESU and Statoil can improve the experience transfer and organisational learning. The main focus will be on improvement in Statfjord RESU. The recommendations are based on findings in RQ 1, RQ 2 and theoretical aspects.

7.1 Increased management focus on experience transfer

Organisational management is a critical factor for experience transfer and organisational learning. It seems like Statoil is a centralized organisation where decisions have to come from the top management to coordinate systems in the organisation, because the report “*Integrerte Operasjoner i Statfjord RESU* 2004 - 2006“ (Bergjord, 2006) shows that the cooperation between different units are bad and that each unit has to find its own solutions on different issues. It is therefore necessary to involve groups/personnel in the top management to improve experience transfer between different platforms in Statoil. It is important to have governing variables which describe how experience transfer in Statoil should take place. A description of the governing variables is not enough and there is also a need for systems that make it possible to achieve the objectives in the governing variables.

Slowness in the organisation is a barrier because people stick to existing working routines (Aase et al., 2001), but if the governing variables are adjusted and the instructions are given from the top-level, slowness may be prevented. Experience transfer and HSE have to be prioritised over production to be improved (Mearns et al., 2003). Several of the informants said that they did not transfer experience because they did not have time and it was a question of priority. This indicates a need for clear routines for prioritisation between experience transfer, HSE and production to prevent goal conflicts (Rosness, Guttormsen, Steiro, Tinmannsvik & Herrera, 2004). These routines have to come from the top-management. HSE was not an objective when IO was implemented in Statfjord RESU and IO has not contributed to a higher HSE level (chapter 5.3). This may be an indication of the importance of the managements focus on HSE to make the personnel involved in the operations focus on HSE and maybe contribute to a higher HSE-level.

To make an efficient system, it is necessary to involve people from the sharp end, i.e. close to the hazard source, e.g. operators and offshore platform superintendents, because it is expected that they have more updated and detailed hands-on knowledge of the system they operate than the actors in the blunt end, e.g. designers, planners, analysts and regulatory institutions (Rosness et al., 2004). This will contribute to experience transfer which is necessary to make a realistic system, because the personnel in the sharp end knows the operational challenges and the goal conflicts they run into.

7.2 Close the loop

To gain the organisational learning, the loop has to be closed (figure 6.1) (Kjellén, 2000). This means that corrective actions have to be implemented to correct the deviations and problem areas. Based on the problem areas found in chapter 6.1 and 6.2, some corrective measures will be suggested in this chapter. The implementation of IO has also resulted in positive changes for experience transfer and it is important to utilize and continue developing these possibilities. Some suggestions for further development are also given in this chapter.

7.2.1 Improved procedures

“Best-practice”

The operational procedures are one of the best results from the implementation of IO and has resulted in double-loop learning. The system is functioning in Statfjord RESU, but it is also important to share this experience with other fields in the Statoil organisation. All the fields have their own individual differences, therefore the method needs some altering to fit each of the specific fields. The master-procedures may be shared with the other platforms in Statoil through the system Local-best-practice. This will not require extra work since the master-procedures are updated constantly after operations. Based on these documents the other platforms in Statoil can always be updated on the best practice in Statfjord RESU, and Statfjord RESU may see the other platforms master-procedures and gain experience from them. Local-best-practice is an already existing system in Statoil and it will therefore not result in a new system. Statfjord RESU do not use Local-best-practice systematically today.

Include incident and operational experience

Incidents from Synergi and DBR should be included in the operational procedures, because important risk factors are not taken into consideration when they are not included. It is also a requirement in Statoil’s governing documents (Statoil, 2005d). By using these systems, experience from other platforms can also be included in the planning.

7.2.2 Better utilization of competence

Structure of the network

IO has resulted in better utilization of competence because of the access to real-time data which makes it possible to collaborat independent of geographical location. Sometimes it may be difficult to find relevant competence in the organisation, especially for new people. It could therefore have been a better structure of the network in Statoil to find relevant personnel. The network should not be linked to specific persons because people often change positions. Personal contacts and informal networks are one of the best arenas for experience transfer (Aase, 1997b), and the network should therefore be organised in a well arranged structure which makes it easy to find relevant personnel.

Channels for tacit experience transfer

Personal contacts and informal networks are channels for tacit experience transfer and may include e.g. learning histories, dialogue, learning laboratories, organizational support for personal networks and ad hoc networks. These channels can represent alternative and complementary approaches to the explicit systems, and may foster creativity and freshness in the learning activities (Aase, 1997b).

Statfjord RESU should continue to utilize external competence

Today Statfjord RESU utilizes competence from the Subsurface Support Centre, and they should continue to do so because all the informants were very satisfied with the support. It has also been necessary to use the Subsurface Support Centre on some of the tasks, because Statfjord RESU do not have all the necessary competence available internally in Statfjord RESU. It is also important to utilize the knowledge and experience in the Peer-assist and Peer-review teams. They could be contacted when Statfjord RESU is going to start new or difficult operations, or should use new technology in some of their operations. This will contribute to identify important risk factors.

7.2.3 Better collaboration between onshore and offshore

Explicate tacit experience

The collaboration between onshore and offshore has become better after the implementation of IO. The communication is mainly tacit, which is an efficient channel for experience transfer. Even though tacit experience transfer is efficient for problem-solving of a specific problem, it will not contribute to experience transfer in the organisation unless it is made explicit. Therefore it could be created a system for making the tacit experience explicit or at least some of the experience. This will make the experience accessible to other personnel in both Statfjord RESU and Statoil.

7.2.4 Information overflow

Structuring of systems and arenas

The systems and arenas should be structured and coordinated, because this will make it easier to find information in the systems whenever needed. It is important that this process is top-driven, but personnel from the sharp end should also be involved. It is important that the whole organisation uses the same systems to prevent overlap. A project group may try to find the need for experience transfer in Statoil, and the different platforms routines and systems for experience transfer should be addressed. On these basis they could try to find a system which could have contributed to efficient experience transfer in Statoil. An evaluation of some of the systems and arenas for experience transfer in Statfjord RESU and Statoil is made in this thesis, but a more detailed evaluation of more platforms is necessary to find efficient experience transfer systems across different platforms in Statoil.

Make the systems searchable

Several of the systems are not searchable and therefore it is difficult to find information. This is why all the systems should be searchable and have an user-friendly interface. The users should also have training where they learn to use the systems in a proper way.

7.2.5 Lack of priority to transfer experience

Integrate experience transfer in the daily work

Experience transfer comes in addition to their daily task and is often given a lower priority. It is important to integrate experience transfer in the philosophy, objectives and the HSE-methodology (the systems, organisation, communication, documentation, implementation and evaluations), and not to look at experience transfer as a goal alone (Aase, 1993). If experience transfer becomes an integrated part of their daily tasks, it may not be less prioritised. It is also important to communicate experience transfer as a goal and to find a balanced priority between time used to experience transfer and operations to prevent goal conflicts (Rosness et al., 2004).

Evaluate the size on planning meetings

Governing documents require different planning meetings before every operation (Statoil, 2005b). According to one informant, the requirements do not distinguish between the degree of difficulty of the operations, and therefore all the operations must go through the same amount of planning. A gradation of the different operations may reduce the number of meetings, because small operations do not need the same amount of planning as big and difficult operations. This would also reduce the engineers work load. It may result in released time to perform other tasks and maybe they can reduce the number of ranking of priorities between operations and planning meetings.

7.2.6 Lack of “hands-on” experience among the engineers

The future

IO decrease the engineers possibilities to gain operational knowledge and experience, because they most of the time follow the operations from the operations room. Even though it is not a big problem at present time, it can possibly be a big problem in the future. It is not a big problem now because many of the personnel onshore have been offshore earlier and may help the engineers during planning. In about 10-20 years the personnel with experience have retired and then the main problem will arise. It is therefore important to let the engineers gain operational knowledge and experience, since one day the experienced personnel will not be onshore to supplement the plans. Some kind of personnel-rotation may therefore be an opportunity to let the engineers offshore gain operational experience and knowledge. It is also possible that experienced offshore personnel are transferred onshore when they reach a certain age to transfer their experience to the planning of operations.

Simulator training

When the engineers do not gain operational experience they have to read reports to gain experience. Maybe it could be useful to do operations in a simulator where different problems may arise, and gain relevant operational experience based on that training.

7.2.7 Communication

Relieve the drilling leader according to communication between onshore and offshore

It seems like the drilling leader offshore may be a barrier between onshore and offshore in some situations, because he is the single-point-of-contact. Maybe a system where more personnel may be contacted offshore, would have relieved the drilling leader. Increased number of links in the communication channel is not good (Hovden, 2003), but this system is only made to sort the incoming calls and to put the person calling through to relevant personnel. It is of course necessary to have an organized system to ensure efficient communication and that the right messages reach the right people. This may decrease the barrier for onshore personnel to contact the platforms to ask questions that not involve the drilling leader directly.

Structure the communication between onshore and offshore

Today, most of the communication between onshore and offshore is more random and they contact each other if they detect a problem. They could have communicated based on fixed criteria or fixed points of time to make it more structured. This can also solve the problem according to who is allowed to contact the platform to notify problems in the operations, which earlier has been a problem.

Communication of analyses made onshore could also be more structured to ensure that the result is communicated and at the right time. The potential in the real-time data could also be utilized, and results from analyses based on real-time data could be communicated at the right time to ensure proactive learning.

Reduce the number of links in the communication channel between onshore and offshore

Some of the informants feel that the number of links in the communication channel between personnel onshore and the executing personnel offshore are too many. This results in an increased filtration of information and some important elements may not necessarily be communicated to the personnel actually carrying out the operations. Therefore, the number of links in the communication channel should be reduced as much as possible. It is important to think about how different issues are communicated and to insure that the recipients have understood the messages.

7.2.8 Attitudes

The employees need to have trust in the systems

According to the ABC model, antecedents is necessary for a behaviour to occur (Flemming et al., 2002). One antecedents that triggers the behaviour is that the employees do not trust the systems for experience transfer, e.g. the drilling leader do not report experience because he does not believe that the information will be used later. The management should therefore take this seriously and demonstrate commitment and prioritise experience transfer and HSE (Flemming et al., 2002). They need to show the employees that experience data are important and used in the daily work. Experience transfer requires resources and the operators need to use time to report experience, and therefore it is important that they can see results from the work they do. They should also frontline health and safety behaviour through, e.g. Behavioural Safety Programs and site rules, to make the employees understand the importance (Flemming et al., 2002).

7.3 Accident investigation

Based on the result in chapter 5 and the evaluation of Synergi, there are found some potentials in Synergi which are not utilized.

Accidents investigations are important in organisational learning, because they may transfer experience about what, where and why an incident happened (Hovden et al., 2004). This information can be used to prevent the incidents from happening again. Synergi is a database system with experience transfer as the main objective. As indicated in chapter 5.2.3.1, the main causes reported in Synergi are work practices, and according to Reason (1997) it is the same as saying that all incidents are caused by human errors. Human error is the starting point of an investigation because an incident is caused by human, organisational and technological factors which are dependent on each other (Dekker, 2002). This means that if Statfjord RESU want to learn from incidents, they have to go deeper in the incidents and try to find out why humans acted like they did, and not just say that work practices are the causes. This may contribute to organisational learning, because the problems then can be handled on a higher level, and contribute to the changing of governing variables which contributes to double-loop learning.

In addition to the reporting of causes, it would have been informative to use Synergi more systematically to find problem areas. An evaluation based on more incidents should be done (Hovden et al., 2004), compared to the finding of preventive measures after every incident which is the practice in Statfjord RESU today. If more incidents are included in the evaluation, it may result in an implementation of preventive measures that contributes to prevention of more problem areas. One assumption is the quality of the reported incidents. It may be difficult to find problem areas if all incident just are caused by human error, because human error is not the only cause. It is important to distinguish between random and systematic factors causing errors (Reason, 1997). Systematic use of Synergi will also make it easier to prioritise where to implement preventive measures, both to reduce number of incidents, but also in a cost-benefit view. Data from Synergi should also be implemented in the procedures in such a way that the problem areas are taken into consideration during operations. It will contribute to double-loop learning, because the incidents contributes to changes in the procedures (Argyris et al., 1996).

7.4 Summary of research question 3

Management is a critical factor for experience transfer and organisational learning. It seems like Statoil is a centralized organisation and it may therefore be necessary to involve groups/personnel from the top management to improve experience transfer between platforms in Statoil. It is important to have governing variables according to experience transfer and systems that make it possible to realise the objectives in the governing variables. There is a need for clear routines for prioritisation between experience transfer, HSE and operations to prevent goal conflicts. There is also important that the management focuses on HSE and experience transfer to make the personnel in the sharp end focus on HSE, and this may contribute to a higher HSE-level. It is necessary to involve personnel from the sharp end when systems for experience transfer are created, since they may contribute to make more realistic systems. They know the operational challenges and the existing goal conflicts.

IO has contributed to new possibilities for experience transfer and it is important to utilize and to continue developing these possibilities. According to the improved operational procedures, the system should be shared with other fields in Statoil. The master-procedures could be stored in the system Local-best-practice, and therefore contributed to the experience transfer between different platforms in Statoil. The detail-planning, could cover incidents and operational experience from e.g. Synergi and DBR to involve important risk factors from both Statfjord RESU and other platforms in Statoil. To make use of the competence in the organisation in an even better way, the structure of the network could be structured to make it easier to find relevant personnel in the network. Channels for tacit experience transfer for transfering knowledge and experience across the personnel and platforms in Statoil could also been created. A lot of the information between onshore and offshore is tacit, some of this could be explicated makeing it accessible to other personnel in both Statfjord RESU and Statoil.

There should be done some corrective actions according to the threats against experience transfer to improve the organisational learning. Information overflow could be reduced by structuring existing systems and arenas. The systems should also be searchable which makes it easier to find relevant information. Experience transfer should be integrated in the daily work to make it a more prioritised activity. Lastly, the employees need to have trust in the systems to use them. Lack of time is a critical factor for experience transfer and since IO has contributed to more meetings, an evaluation of the size on the planning meetings should be performed to reduce the workload. This may reduce the number of priorities where the engineers need to choose between operations and planning meetings. According to the lack of “hands-on” experience among the engineers, it is necessary to think about the future and find solutions to the problems which may arise when personnel with operational experience onshore retires. Simulator training may be a corrective action for making the engineers gain some operational experience.

The communication between onshore and offshore may be improved if the drilling leader is relieved according to be the single point-of-contact. The communication could also be more structured, and the communication between onshore and offshore could be based on fixed criteria or at fixed points of time. To decrease the amount of filtration of information, the number of links in the communication channel should be as low as possible. It is necessary that the management make the personnel trust the systems to change the human attitude towards experience transfer.

Accident investigations are important to organisational learning, because they may transfer experience about earlier incidents and accidents. Statfjord RESU has reported working practice as the most frequent cause, but humans act based on human, organisational and technological factors. It is therefore necessary to address all these factors and change the governing variables which may contribute to organisational learning.

8 Conclusions

This thesis describes how the use of IO has influenced the HSE-level and the experience transfer in Statfjord RESU in Statoil. IO is here limited to onshore engineering support of offshore operations through an operations room.

The first research question: ” How does the use of IO influence the HSE-level in Statfjord RESU? “ two main elements are important. Firstly, HSE was not an objective when IO was implemented in Statfjord RESU. Secondly, IO has not contributed to any reduction in the number of reported personnel injuries or other incidents with high potential. Considering these two elements, Statfjord RESU has some challenges according to HSE in IO. How IO will influence HSE in Statfjord RESU in the future is dependent on how the two elements are taken into consideration.

Research question two: “What possibilities and threats does the use of IO cause for the experience transfer in Statfjord RESU?” addressed three main possibilities and three main threats. The main possibilities were to improve operational procedures, better utilization of competence in the organisation and better collaboration between onshore and offshore. The main threats were information overflow, lack of priority to transfer experience and the lack of “hands-on” experience among the engineers. Other threats were communication, resources and attitudes. IO has resulted in more transfer of tacit experience and some of it remains tacit, e.g. communication between onshore and offshore, but some of the tacit experience are also made explicit, e.g. through planning meetings and operational procedures.

In the third research question: “How can experience transfer in Statfjord RESU and Statoil be improved?” The managers attitude towards experience transfer is an important element and it is therefore important that they demonstrate this towards the different units in Statoil and contribute to make efficient systems. There are many systems today, which are not used efficiently and are not used in the planning and execution of operations. There is a need for clear routines for prioritisation between experience transfer, HSE and operations to prevent goal conflicts. To improve experience transfer in Statfjord RESU and Statoil, it is necessary to close the control-loop. IO has contributed to new possibilities for experience transfer and it is important to utilize and continue developing these possibilities. It should also be done some corrective actions according to the threats against experience transfer to improve the organisational learning. The corrective actions should involve changes of the governing variables which may contribute to organisational learning. In addition a better and more systematized accident investigation based on the accident database Synergi, can contribute to increased organisational learning.

9 Reflection

This discussion is based on the concepts credibility, verification and transferability in results.

Credibility is about mapping and evaluating possible sources of errors in the research material. During the work with this thesis I have had three teaching supervisors, two in Sintef and one in Statoil. They have contributed to find relevant information on the research field and have also strengthened the possibility to avoid errors. They also read the report before it was due. It was important to let a person from the industry read the thesis to verify the content and the Statoil specific terms. It was also important to involve personnel from Sintef to get an evaluation related to the research method and the findings and recommendations. This may also have contributed to avoid errors.

Verification is about whether the thesis actually answers the questions given, or whether the research gives correct answers. During the data acquisition, only interviews with onshore personnel were performed, except of one interview with a HSE-coordinator offshore. The result may have been somewhat changed if some offshore personnel had been interviewed in addition to the onshore personnel, but it was not possible to get in touch with offshore personnel involved in the operations. The onshore personnel interviewed had different positions in Statfjord RESU, and that may have contributed to get different views on the questions asked. The results from the interviews were structured and I have also mainly tried to use findings from interviews confirmed or mentioned by more then one informant.

In addition, the evaluation of the HSE-level is based on to few incidents to talk about a trend, and the result in this thesis is therefore not absolute. It was not possible to involve more periods because Statfjord RESU has only used IO in a limited period.

Transferability is important for the possibility of transferring results to similar cases. During the work it was observed that findings in Statfjord RESU and findings in the theoretical framework concerning experience transfer were much the same. It is therefore likely to believe that several of the results are transferable to other platforms in Statoil and in the oil and gas industry.

Further work

During the study some areas of interest were seen, but because of this thesis' scope and limited time, it was chosen not to go further into these areas. It is recommended to perform an evaluation of these areas.

The frequency of personal injuries has increased after the implementation of IO and four LTI-incidents have occurred. It is recommended to evaluate the personal injuries, and especially the LTI-incidents, to see whether it is a link between the implementation of IO and the increased frequency of personal injuries.

Statfjord RESU and Statoil have several systems and arenas for experience transfer. The research has identified a need for more structured systems for experience transfer which makes it easier to find relevant information. It is therefore recommended to do a more detailed evaluation on the different systems and arenas for experience transfer in Statfjord RESU and other platforms in Statoil. This should be done to get an overview of the different systems and arenas for experience transfer and to address the need for experience data.

This thesis has identified several threats according to experience transfer. It is recommended to evaluate these issues in more detail to find effective corrective actions to solve the problems and contribute to increased organisational learning.

There were not enough periods used in the evaluation of the HSE-level to talk about a positive or a negative trend. It is therefore recommended to perform a new evaluation on the HSE-level later to demonstrate how the implementation of IO has influenced the HSE-level in Statfjord RESU.

10 Literature

Aase, K. (1993): *Experience transfer in management of safety, health and environment*, Foredrag ved EEU-kurs: Safety management, 28.10.1993

Aase, K.: (1997a): *Erfaringsbarrierer og virkemidler,* Offshore & Energi, Offshore Norge AS

Aase, K. (1997b): Doktor ingeniøravhandling 1997:133 Institutt for industriell økonomi og teknologiledelse. *Experience transfer in Norwegian oil and gas industry. Approaches and organizational mechanisms,* NTNU, Trondheim

Aase, K., Ringstad, A. J., Sandve, K. (2001). Erfaringsoverføring og organisatorisk læring: Bruk og ikke-bruk av erfaringsdatabaser. I K. Grønhaug & K. Hansen (Eds.): *Medvirkning, læring og konkurranseevne*. Fagbokforlaget.

Argyris, C. & Schön, D. (1996): *Organizational learning II: Theory, method and practice,* Reading, Mass: Addison Wesley.

Baker, J. A, Leveson, N., Bowman, F., Priest, S., Rosenthal, I., Erwin, G., Gorton, S., Tebo, P., Hendershot, D., Wigmann, D. & Wilson, L. (2007): *The report of the BP U.S. refineries independent safety review panel.*

Bergjord, O. G. (2006): *Integrerte Operasjoner i Statfjord RESU 2004-2006*. Statoil Intern

Bolman, L. G. & Deal, T.E. (2002), *Nytt perspektiv på organisasjon og ledelse*, Gyldendal, Oslo

Dekker, S. (2002): *The field guide to Human Error Investigations,* Aldershot : Ashgate

Dekker, S. (2004): *To engineer is to err*. Sandom, C. and Harvey R. (Eds.): *Human Factors for Engineers,* Institution of Electrical Engineers, London

Flemming, M. & Lardner, R. (2002): *Strategies to promote safe behaviour as part of a health and safety management system*, Health & Safety Executive, Research report 430/2002, United Kingdom

Henderson, J., Wright, K. & Brazier, A. (2002): *Human factors aspect of remote operations in process plants,* Health and Safety Executive, Research report 432/2002

Hovden, J. (2003): *Risk communication.* NTNU

Hovden, J., Sklet, S. & Tinmannsvik, R. K (2004): I etterpåklokskapens klarsyn: Granskning og læring av ulykker. Lydersen, S. (Eds.): *Fra flis i fingeren til ragnarok. Tjue historier om sikkerhet*. Tapir akademisk forlag.

ISO-standard 17776 (2002): *Petroleum and natural gas industries. Offshore production installations. Guidance on tools and techniques for hazard identification and risk assessment*

Itoh, K., Andersen, H. B. & Seki M. (2004): *Track maintenance train operators' attitudes to job, organisation and management, and their correlation with accident/incident rate*, Cogn Tech Work Vol. 6, pp. 63-78, Springer-Verlag, London

Johnsen, S., O., Bjørkli, C., Steiro, T., Fartum, H., Haukenes, H., Ramberg, J. & Skriver, J. (2004), *CRIOP: A scenario method for Crisis Intervention and Operability analysis*, Rapport nr. STF38 A03424, Sintef Industrial Management, Safety and Reliability, Trondheim. Electronic version available at
http://www.CRIOP.sintef.no/The%20CRIOP%20report/CRIOPReport.pdf

Johnsen, S. O., Lundteigen, M.A., Albrechtsen, E. & Grøtan, T.,O. (2005): *Trusler og muligheter knyttet til eDrift,* Sintef Teknologi og samfunn, Sintef-rapport nr. 38 A 04433, Trondheim

Kjellén, U. (2000): *Prevention of accidents through experience feedback*, Taylor & Francis, London

Mearns, K., Whitaker, S. M.& Flin, R. (2003): *Safety climate, safety management practice and safety performance in offshore environments*, Safety Science Vol. 4,1 pp.641-680, Elsevier

Milter, J., Bergjord, O.G., Høyland, K. & Rugland, B. (2006): *Use of real time data at the statfjord field anno 2005*, SPE-99257-PP, Society of Petroleum Engineers, prepared for presentation at the 2006 SPE Intelligent Energy Conference and Exhibition held in Amsterdam, The Netherlands, 11–13 April 2006.

OLF (2002a): *Temahefte-edrift på norsk sokkel.* http://www.olf.no/?18389.pdf. Last visited 01.11.2006

OLF (2002b): *eDrift på norsk sokkel-det tredje effektiviteringsspranget.* http://www.olf.no/?15204.pdf. Last visited 24.09.2006

OLF (2004): *Petroleumstilsynets tilnærming til edrift.* http://www.olf.no/io/eldrerapporter/?23938.pdf. Last visited 01.11.2006

OLF (2003): *Tiden moden for edrift.* http://www.olf.no/io/aktuelt/?50709. Last visited 04.05.2007

Piccoli, G., Powell, A. & Ives, B. (2004): *Virtual teams: team control structure, work processes, and team effectiveness*, Information Technology & People Vol. 17, No. 4, pp. 359-379, Emerald Group Publishing Limited

Ptil (2005): *Human Factors i bore og brønnoperasjoner. Utfordringer, prosjekter og aktiviteter.* Report no: 2005-4029. Electronic version available at http://www.ptil.no/NR/rdonlyres/BB6BDFA3-E32D-4016-9809-76921F858492/10022/HFrapport.pdf.

Reason, J. (1997): *Managing the Risks of Organizational Accidents*, Aldershot:Ahsgate

Ringdal, K. (2001): *Enhet og mangfold*, Fagbokforlaget Vigmostad & Bjørke AS, Bergen

Ringstad, A. J. & Andersen, K. (2006): *Integrated operations and HSE - major issues and strategies.* SPE International Conference on Health, Safety, and Environment in Oil and Gas Exploration and Production, Abu Dhabi, U.A.E.

Rosness, R., Guttormsen, G., Steiro, T., Tinmannsvik, R. K. & Herrera, I. A. (2004): *Organisational Accidents and Resilient Organisations: Five Perspectives,* Sintef-rapport 38 A 04403, Trondheim

Statoil (2005a): Statoil styrende dokument. *Optimalisering av produksjon ved samhandling basert på sanntidsdata.* Arbeidsprosesskrav, WR2093.

Statoil (2005b): Statoil governing document. *Non-conformities and dispensations.* Work process requirement, WR0011

Statoil (2005c): Statfjord late life. http://www.statoil.com/statoilcom/SVG00990.NSF?opendatabase&lang=en&artid=81C0B9A3D731800AC1256FB300333BA2. Last visited 27.05.2007

Statoil (2005d): Statoil governing document. *Planning of Drilling & Well Operations.* Work process requirement, WR0442.

Statoil (2005e): Statoil rådgivende dokument. *Forventninger til Statoil's boreoperasjonsledere/brønnoperasjonsledere*. Arbeidsbeskrivelse, WD0829.

Statoil (2006a): Statoil styrende dokument. *Håndtering av uønskede hendelser og HMS-data i UPN.* Arbeidsprosesskrav, WR0015.

Statoil (2006b): Picture of the Statfjord field. http://www.statoil.com/STATOILCOM/SVG00990.nsf/Attachments/statfjordOversikt/$FILE/statfjord_to_coast_ny.pdf. Last visited 04.05.2006

Sætre, P.O. (2006): Masteroppgave, Institutt for industriell økonomi og teknologiledelse, *Improvisasjon som middel til vellykket gjenvinning av situasjonskontroll.* NTNU, Trondheim

Zedtwitz, M. (2004): *Managing knowledge in virtual organisations: an Introduction*, Int. J. Networking and Virtual Organisations Vol. 2, No. 4, pp. 283-286

Wahlen, M., Landmark, T., Sandven, K., Høydalsvik, H., Hellebust, A. (2005): *Utredning om konsekvenser av omfattende innføring av e-drift (integrerte operasjoner) på norsk sokkel for arbeidstakerne i petroleumsnæringen og muligheter for utvikling av nye norske arbeidsplasser.* Electronic version available at http://www.npd.no/NR/rdonlyres/4B68AADC-4653-456E-BAA9-EEB6B37CCCD3/10938/SluttrapporteDriftogkonsekvenserrevidert121205.pdf. Last visited 18.12.2006

Appendix A: Interview guide

Introduksjon

1. Litt om meg og oppgaven, samt målsetningen med intervjuet.
2. Informasjon om intervjuet: båndopptaker, ca. 1 time.
3. Stilling, ansvarsområde?

Innledning

4. Hva var hovedmålsetningene med innføringen av ingeniørstøtte fra land?
    - Har det vært bedre samarbeid hav/land, økt avkastning, forbedret HMS?
    - Dersom økt HMS nivå har vært et hovedmål - spør hvordan er det fulgt opp og hvilken læring er knyttet til det?
    - Dersom økt HMS ikke har vært et hovedfokus - spør hvorfor ikke?
5. Hvordan har innføringen av ingeniørstøtte fra land påvirket din arbeidshverdag?
6. Hvilke positive og negative konsekvenser opplever du av innføringen av ingeniørstøtte fra land?

Dagens praksis for rapportering

7. Hvilke rutiner og systemer brukes for å rapportere?
8. Føler du at innføringen av ingeniørstøtte har påvirket rapporteringen på plattformen? Hvis ja, på hvilken måte? (rapporteres det mer/mindre, mer alvorlige hendelser?)
9. Hvem har ansvaret for å rapportere og følge opp innrapporterte hendelser?
10. Hva tror du er den største trusselen ift uønskede hendelser på plattformen? Har dette endret seg etter innføringen av ingeniørstøtte fra land?
11. Hva føler du er de mest vanlige årsakene til hendelser etter innføringen av ingeniør støtten fra land? Er dette andre årsaker enn hva som var tidligere?
12. Har du eksempler på episoder/hendelser som du tror skjedde som følge av innføringen av ingeniørstøtte fra land?
    a. Hva var årsakene til dette (rot årsaker og bakenforliggende årsaker)?
    b. Hvilke konsekvenser hadde hendelsen?
13. Føler du at dere følger Statoils styrende dokumentasjon ift rapportering? Hvis nei, på hvilken måte?

Dagens praksis for bruk av erfaringsdata

14. Hva tror du er det viktigste hinderet er for økt HMS, eller bruk av erfaringsdata?
15. Hvilke deler av organisasjonen involveres i læringsprosessen?
    a. Blir du involvert, leverandører…

16. Hvordan lærer dere av hendelser?
    a. Endres rutiner i hele organisasjonen eller slukker man brannen?
    b. Finnes det nettverk internt/eksternt der man utveksler erfaringer fra egne hendelser?
17. Hvorfor vil dere lære av hendelser?
18. Hvilke organisatoriske utfordringer ser du ift bruk av erfaringsoverføring? Har disse endret seg ved innføringen av ingeniørstøtte fra land?
19. Føler du at den tause kunnskapen i organisasjonen blir ivaretatt? Hvis ja, på hvilken måte? Hvis nei, hvordan kunne dette vært gjort?
20. Er det andre utfordringer ved å implementere tiltak nå etter innføringen av ingeniørstøtte fra land enn hva det var tidligere? Hvis ja, hvordan?
21. Hvordan går dere fram for å implementere nye tiltak?
22. Måles effektene av et tiltak? Hvis ja, på hvilken måte?
23. Brukes erfaringsdata regelmessig i HMS-arbeidet (for eksempel ulykkesstatistikker) eller etter hver hendelse/ulykke?

Support senteret

24. Hvordan føler du behovet for et ekspertsenter som samler inn erfaringer på tvers av ulike plattformer er?
25. Hvilke positive og negative effekter har ekspertsenteret medført for HMS-nivået på plattformene?
26. Føler du at støtten fra Support senteret når fram til de aktuelle personer og grupper?
27. Hva tror du er det største hindret for at støtten fra Supportsenteret ikke skal kunne bidra i operasjonene og heve hms-nivået?
28. Hva føler du er det mest effektive tilbudet som ekspertsenteret kan tilby som bidrar til økt organisasjonslæring? Hvilke tjenester benytter dere dere av?

WELL informed

29. Leser du WELL informed?
30. Hvilken nytte har du av bladet?

Annet

31. Er det noe innen temaet som du føler ikke er blitt dekket av spørsmålene?
32. Ser du andre relevante vinklinger som det ikke er spurt om?