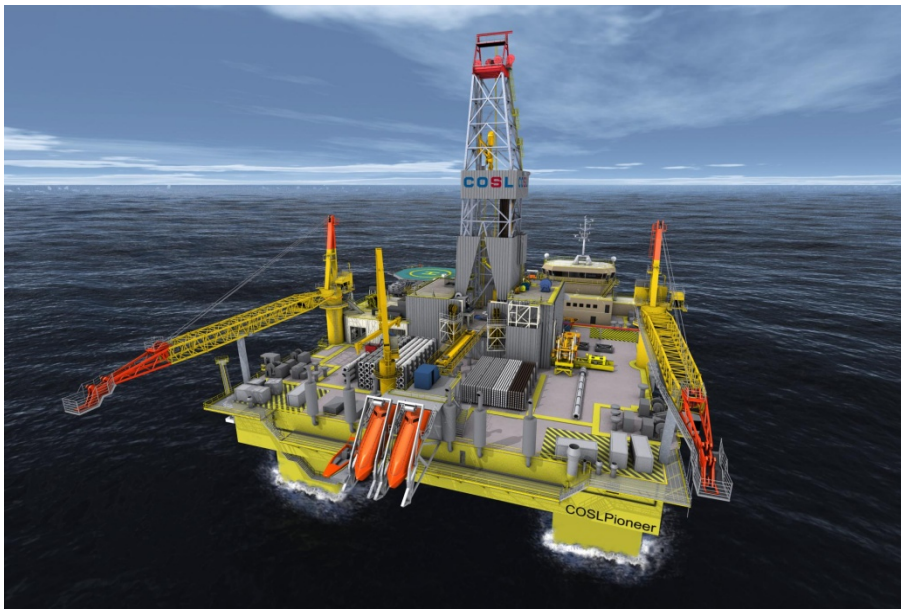
The use of Working Environment Area Chart (WEAC) offshore



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The use of Working
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(WEAC) offshore

Project outline:
We want to look at possibilities of improving the use of Working Environment Area Chart (WEAC) in the operational phase, as well as investigate possible ways of making individual risk aspects more visible. The target is that the workers in better ways should be aware of the dangers they are exposing themselves to, and the actions needed to prevent unwanted incidents.

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Preface

This report is written as a mandatory and closing part in the three year Bachelor Degree 'Health, Environment and Safety engineering' at Stord/Haugesund University College in Norway. The project was carried out during spring 2009.

When we inquired to write our bachelor thesis together with COSL Drilling Europe AS, they were very forthcoming. Only one week after our first contact, we received a proposal on a project outline.

During the project we had difficulties gaining information regarding WEAC. Both in literature and among people in the oil and gas industry it seemed to be a lack of knowledge. This was experienced to be time-consuming, and affected the progression in the project.

The different chapters in this report are present to embrace readers with different background. For instance chapter 3 and parts of chapter 4 are written to introduce the topic to people who are not professionally related.

We want to express our gratitude to the following:

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Marion Tveiten and Kristin Dragsund at COSL.

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Executive summary

The biggest industry in Norway is the petroleum industry. The industry holds a high standard on health, environment and safety (HSE), but the work conducted offshore still involves potential risks. To continually improve the HSE-work, the operating companies must meet requirements from the prevailing regulations. To communicate risk it is important to consider how you adapt, design and formulate risk messages. Good risk communication is defined by well aimed information adapted to the receiver's premises.

Through good management, risk-factors can be handled so that they do not constitute unwanted risk to the health of the employees. The basic working environment charting is a systematic charting which are to be carried out when a new work place is designed and when an existing work place is being modified. The purpose is to ensure that the specific working environment requirements are fulfilled. According to NORSOK standard S-002, Working Environment Area Chart (WEAC) or similar must be used to document and improve the working environment. The objective of this standard is to make sure that the projecting and construction of an installation contribute to a good working environment in the operational phase.

The main purpose of the report was to investigate the use of WEAC on offshore installations. We have, in collaboration with COSL Drilling Europe AS, looked at possibilities of improving the use of Working Environment Area Chart in the operational phase, as well as investigated possible ways of making individual risk aspects more visible. We performed a study of literature regarding the topics, and further we conducted interviews with people of different professional background in the petroleum industry. This was i.a. done by performing a questionnaire to create a picture of how these parties execute and make use of area and work position-based charting for the working environment,

During the project we discovered that little information existed on the topic, and this made us rely most of our work on expert opinions and feedback.

WEAC seems like a good tool with respect of geographical focuses, i.e. working environment in an area, but not so much for jointly working environment exposure on a group of workers. E.g. mechanics will carry out work in various areas, and this demands a different approach to collect information about their working environment exposure. It appears to be a handy tool when measuring quantitative working environment factors such as noise, illumination and temperature, but not so much with respect to qualitative factors as ergonomics and outdoor operations. This is because the qualitative factors are hard to put in concrete terms in the chart.

A challenge with the local based information is to recover and trace historical documentation. In general, from the companies contacted in this project, the WEACs are controlled, updated and maintained by the onshore organization.

There have been several attempts on developing useful IT-based tools in relation of storage and use of results of working environment charting. So far there has been little or no substantial success in covering this object in combination with practical use. From feedback received in the questionnaire, it seems like some of these specialized programs are too expertise demanding. Because of this they may demand a higher level of computerized competence to keep the documentation updated and maintained. The result of this may be that updating of the WEAC-system has to be carried out

onshore. The best approach, in our opinion, is to make use of basic software, as for instance Microsoft Word or Excel, and to develop a supplement base-application with respect to storage and use of results of working environment charting. By utilize basic and well known software, one can achieve well aimed information adapted to the receivers' premises.

A Safe Job Analysis (SJA) may comply with the requirements in the NORSOK S-002 and the WEAC, and connect it to everyday situations. The WEAC is connected to a specific working area, while a SJA is carried out with respect to certain working procedures or operations. By making use of the WEAC during a SJA, one may also incorporate the exposure to local based working environment factors.

It is our impression from working with the project that the WEAC is purely designed to meet authority requirements, and its targeted groups have not been taken into consideration with respect to user-friendliness. It is our opinion that the WEAC alone is not suitable as an information tool to make the workers aware of the dangers they are exposing themselves to.

It is rather surprising that the NORSOK S-002 has been revised four times since 1994, but the WEAC has remained more or less exactly the same. Because of the seemingly lack of knowledge amongst quite a few of the people in the industry regarding WEAC, one could argue whether there should be conducted an authority campaign to investigate the use of WEAC and its user-friendliness.

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Definitions and abbreviations

As-built: An installations condition when finished by the construction company

HSE: Health, Environment and Safety

NCS: Norwegian continental shelf

Qualitative: Relating to, or expressed in terms of, quality. Qualitative research is based on individual, often subjective analysis. It is a general description of properties that cannot be written in numbers, and cannot be reduced to something that can be enumerated. Relating to, or based on, the quality or character of something, often as opposed to its size or quantity. Typically describes people's knowledge, attitudes or behaviors (http://www.knowledgetransfer.net/dictionary/Statistics/en/qualitative.htm, viewed 20.04.2009).

Quantitative: Related to, or expressed in terms of measured numeric values, quantity or statistical comparison derived from systematic survey, observation or analysis of the subject. Quantitative research is based on measurable data gathered from a wide range of sources, often followed by objective analysis. A general description includes facts, figures and scientific observations that can be statistically analyzed and then can be reduced to something that can be enumerated. The collected data is often subjected to statistical tests to see if the results are internally consistent or representative of random chance. Typically, it describes patterns and trends in size and quantity. Quantitative data is often classified as being real (http://www.knowledgetransfer.net/dictionary/Statistics/en/quantitative.htm, viewed 20.04.2009).

Risk Matrix: A tool used in the risk assessment process, allowing the severity of the risk of an event occurring to be determined.

SJA: Safe Job Analysis.

WEAC: Working Environment Area Charts.

1.0 Introduction

1.1 Background

The biggest industry in Norway is the petroleum industry. After almost 40 years of oil and gas production in seas that are exposed to some of the world's worst weather conditions, Norway has acquired the knowledge and expertise needed to exploit petroleum resources in an efficient and safe way (http://www.norway.org.uk). Even though the industry holds a high standard on health, environment and safety (HSE), the work conducted offshore involves potential risks. These may be e.g. gas leaks, falling objects and noise-related injuries. To continually improve the HSE-work, the operating companies must meet requirements from the prevailing regulations.

The companies themselves are responsible for ensuring a proper working environment. Through good management, the risk-factors can be handled so that they do not entail unwanted risk to the health of the employees. The regulations provide guidance on how to reduce risk. A good working environment is important in itself, but it is also an important precondition to maintain a low major accident risk. Factors are mutual dependent, and to understand the causes of major accidents, these factors must be considered altogether (http://www.ptil.no).

To document and improve the working environment, working environment area charts (WEAC) may be used. All executive parties with employee-responsibility in the petroleum industry are obliged to obtain the requirements of the NORSOK-002 standard. The standards objective is to make sure that the projecting and construction of the installation contribute to a good working environment in the operational phase. The WEAC is a part here (Annex F in S-002), and a proposed template on how to document the charting. Companies are not obliged to use the WEAC in particular, but then their replacement has to be just as satisfying or better to meet the requirements. The basic working environment charting is a systematic charting which are to be carried out when a new work place is designed and when an existing work place is being modified. The purpose is to ensure that the specific working environment requirements are fulfilled.

The main purpose of the report is to investigate the use of WEAC on offshore installations. It is as mentioned mainly used during design and construction, and not so much in the operational phase. In collaboration with COSL Drilling Europe, we will thrive to take a closer view at how to make people aware of different risk aspects, how other companies are putting WEAC in to use and how to best take advantage of it on upcoming COSL Drilling Europe installations in operation. We want to look at possibilities of improving the use of Working Environment Area Chart in the operational phase, as well as investigate possible ways of making individual risk aspects more visible. The target is that the workers in better ways should be aware of the dangers they are exposing themselves to, and the actions needed to prevent unscheduled events.

To gain background knowledge of the topic we are looking into, we have discussed the following questions with experts from authorities, working environment consultants and safety managers onshore/offshore:

- What is WEAC?
- Challenges and difficulties by using WEAC

Increased focus from the Norwegian Petroleum Safety Organization (PSA) has put charting of working environment on the agenda through the campaign “Groups exposed to risk” (PSA, (04.12.2008), *Risikoutsatte grupper)*. This is one of PSA`s priority areas in 2009 to obtain proper working environment to employees. This means that audited companies have to explain how they indentify exposed groups. The PSA is challenging the industry to identify these groups and execute follow-ups.

Companies need to provide documentation of the exposure given to their employees to obtain the permission to operate on the Norwegian Continental Shelf (NCS). Under influence of the authorities, the companies are encouraged to use WEAC as their main tool of the indication of locality exposure. The WEAC provides action data, based on thorough documentation, to help making good priorities and decisions.

1.2 COSL Drilling Europe AS

COSL Drilling Europe AS is a subsidiary to China Oilfield Services Limited, Beijing, China. COSL Drilling Europe AS is located in Stavanger, Norway.

The company provides offshore exploration, exploitation and increased oil recovery operations. They are currently owners of two accommodation units on the *Ekofisk Field*, and are expecting three semi submersible drilling units from China, which are currently under construction. These units will also be operating on the Norwegian continental shelf. (http://www.cosl.no/, accessed 16.02.2009)

1.3 Limitations

We have no first-hand experience of using WEAC in any phase of its cycles. Our report deals with principles regarding WEAC, and not on any module in specific. The objective is not to make a recipe on how to complete a WEAC, but to evaluate the WEAC as a tool. We have limited the research methods to studying literature and interviewing people of interest connected to the petroleum industry.

2.0 Methods

To investigate the use of Working Environment Area Charts (WEAC) on offshore installations, we have performed a study of literature regarding the topics, as well as conducted interviews with people of different professional background in the petroleum industry. As a preliminary activity prior to distributing a questionnaire, we spoke to expert-sources to generate a selection of professional people for input and later as contributors in the questionnaire. Through meetings with our collaborating company COSL, we made sure that the questions were in conformity with our mutual interests.

2.1 Study of literature

While conducting the study of literature, we discovered that there is only a small amount of existing material on the topic, and hence we had to base our study on expert-opinions and their references. When searching libraries and search-engines on the Web for the expression “Working environment area chart” and its abbreviation “WEAC”, very few titles occurred. This was rather surprising to us, as all the executive parties with employee-responsibility in the industry are obliged to obtain requirements in the NORSOK-002 standard during construction and maintenance. The WEAC (Annex F in NORSOK S-002) has also remained more or less exactly unchanged since the first revision of the standard in 1994. Because of this, it may seem like there is a lack of knowledge among the parties it is directed towards.

Thus, except the theory part on risk, we have based our research on consulting with experts and by performing the questionnaire.

2.2 Interview

To create a picture of how other parties in the petroleum industry, i.e. oil companies, drilling companies, modification/maintenance companies, authority and consultancies, execute and make use of area and/or work position-based charting for the working environment, the project group chose to create and perform a questionnaire. The questions were formed so that the answer alternatives were completely left up to the respective parties, this to enhance their own opinions, attitudes and motives. The results of this questionnaire is presented in Chapter 5.1

The questionnaire has both strengths and weaknesses. By using open -answer alternatives, the results are not automatically comparable. Conducting this method is also rather time-consuming as it, by experience, takes a while for people to complete their feedback. In favor of the method are for instance that the objects are using their own words and sense of reality when answering a question. People can also choose when they want to complete their questionnaire, as the feedback is electronic. This can also be a weakness, as some might choose not to give their response.

3.0 Risk

Even though the industry holds a high standard on health, environment and safety (HSE), the work conducted offshore involves potential risks.

To make a point of connection for the later discussion and conclusion, basic elements of risk are underlined in this chapter. This includes a basic description of the risk concept, risk apprehension, risk communication and risk information, including how to adapt, design and formulate risk messages.

3.1 The concept of risk

There are countless definitions of risk, but none is more prevalent than the other. Risk is instinctively connected with negative incidents. Risk is to most people things or thoughts that worries them, and is often attended with insecurity (Leiss, 2004).

One approach to risk is suggested by Jardine and Hrudey (1997) by the means of classification. They divided risk into a technical, an everyday and a financial point of view. A technical definition of risk is based on probability and consequences. This does not take human experience, thoughts and emotions into consideration, and may be inadequate in many situations. An everyday approach is based on how humans perceive given situations. From a financial point of view, risk is necessary to gain profit (Jardine and Hrudey, 1997).

In statistical, economical and technical context, it is necessary to do a quantitative assessment of risk. To compare risks, a uniform size or unit is needed, and therefore the consequence must be measureable.

Irrespective of how risk is defined, all definitions contain an element of subjectivity. Risk always involves humans or human behavior (Wester-Herber, 2004).

3.2 Risk apprehension

To express risk information in the best way possible, it is important to know how individuals respond to the different risks. A technical approach to risk is inadequate, because it does not include the fact that people embrace the same risk differently. Information about different risks gives more knowledge, and a better foundation to grasp the situation. The information may also affect how people experience the probability of an incident, and increase the risk experience (Jardine and Hrudey, 1997)

Through research it is shown that ordinary people are just as good at ranking risks as experts, but they complete a quantitative risk with various qualitative factors. Most people have an intuitive feeling of danger, but struggle to describe just how dangerous the situation is. The qualitative factors have been categorized, depending on the relationship between person and risk (Breck, 2002).

According to Breck (2002) these factors can be categorized as follows:

- Knowledge and familiarity

- Control
- Utility and justice
- Effect and consequences

In addition to these quantitative factors, there are a set of social and cultural factors which play a role in the way people perceive risk. In today's society many risks are technical and are often man-machine relations. The technical risks are relatively easy to estimate, but the social components are important if one wishes to study human risk comprehension. The social components are also very important in the matter of risk communication.

According to Wester-Herber (2004) these social components include:

- Personal judgment
- Justice- and equality aspects
- Moral
- Trust

People see risk from another view than authorities. An individual sees it from its own perspective, and authorities see risks from a social point of view. Increased social focus increases the need for joint views among individuals and authorities (Wester-Herber, 2004).

3.3 Risk communication

Increased risk awareness in society generates increased need for risk communication. Bad risk communication may result in larger risk than it is intended to control. Contradictory information may cause incorrect decisions, such as countermeasures to none existing risks (Breck, 2002).

If risks are defined and calculated by experts, good communication is informing the people or politicians about the expert opinion. Risk perception is individual. Risk communication intended for individuals should have a somewhat simplified character. Good risk communication is defined by well aimed information adapted to the receiver's premises. Risk may also be defined as a product of society, which means that risks depend on cultural differences rather than on individuals. Good risk communication will then be good relations of trust and mutual respect (Breck, 2002).

According to Bier (2001) five goals for good risk communication can be identified:

- Gain trust to the informer
- Increase risk awareness
- Educate the receiver
- Achieve mutual consent round good actions and goals
- Motivate good actions and affect the receiver's behavior

It is important to do a charting of the need for communication in advance, in order to distribute critical information and avoid misunderstandings (Bier, 2001).

3.4 Risk information

We surround ourselves with risk information in different types, shapes and colors. Examples are warning signs in traffic, limit values for chemical substances or recommended daily intake of food substances (Breck, 2002). The different types of risk information worries, engage, interests and affect a lot of people every day (Wester-Herber, 2004).

3.4.1 Adaptation of information

If a risk information campaign is to be considered as successful, it has to influence people's knowledge and attitude regarding risk. The targeted group has to receive the information easily, but more importantly, process it properly. This process happens partly unconsciously, and consists, according to Bonde-Teir & Westerståhl (2005), of the following steps:

- Perception
- Attention
- Cognition
- Emotion
- Memory
- Behavior

3.4.2 Formulating and designing a risk message

The way risk information is presented affects how people understand and remember a risk message. In *Risk Communication* (1994) Cynthia Atman underlines the importance of having the targeted groups understanding and knowledge in mind when designing and formulating risk information.

A safety manager may for instance interpret or apprehend some words in a completely different way than a derrickman. Words as e.g. cancer and radioactivity in a risk message may create fear in a person, and must be communicated with caution. People may choose to avoid messages containing these types of words (Hedman, 1999). The word-order in a risk message is also of significance. The words must be written in the sequence one want the targeted group to apprehend the message. A message like "push the green button after the gas is shut off" may cause the reader to think that the green button is supposed to be pushed before doing anything else. A better way to express the risk message would be "make sure the gas is shut off before pushing the green button" (Sanders & McCormic, 1992). A risk message is supposed to feed missing or unknown information which the targeted group may not be aware of, and hereby counteract misunderstandings. (Jardine & Hrudey, 1997)

The design of a risk message affects how successful it is on received by the targeted group (Proctor & Van Zandt, 1994). Some people may for instance have impaired eyesight, but a lot of these may still read the text in a message if it is designed properly. Examples of factors which affect how well the information reaches the targeted group are:

- Typography – relations between height and width of the letters
- Font size – important text should be enlarged
- Layout – a neat layout makes the message more eye-catching
- Choice of colors – colors as red, yellow and green may emphasize the different levels of risk

Symbols and pictures may express equal or more information compared with a large amount of text. Regarding concrete objects and actions, graphical representations are the most effective way to express information (Sanders & McCormic, 1992). They may be apprehended quickly, and may give the reader a lot of information in a short period of time. On the other hand, graphics may give too detailed and complex information. It is therefore recommended to combine text with symbols and pictures in information messages to achieve both fast and precise information transfer (Sanders & McCormic, 1992).

3.4.3 Risk matrices

One way of communicating risk is by using risk matrices. A risk matrix (fig.1) is used in the risk assessment process, allowing the severity of the risk of an event occurring to be determined. By using the colors green (small risk, efforts often not needed), yellow (medium risk, efforts are to be considered) and red (high risk, efforts are often needed immediately), most people can easily determine a risk level because of the natural relations of the colors. From everyday experiences with colored traffic signals, green is symbolizing “go”, yellow meaning “prepare to stop” and red symbolizes “stop”.

Green	Deviation from requirements (internal or authority) Low at risk Efforts usually not needed
Yellow	Deviation from requirements (internal or authority) Moderate at risk Efforts needed Problems in this area may require further assessment and charting to establish if efforts is needed
Red	Deviation from requirements (internal or authority) High at risk Efforts needed immediately

Fig. 1 – Risk Matrix

4.0 Charting and documentation of risk

To succeed the theory of risk together with the report-topic, this chapter highlights the main purposes of the Working Environment Area Chart (WEAC). It will be given a general introduction of charting and risk. The chapter shows an overview of prevailing laws and requirements which can be looked upon as a ground basis regarding working environment charting. This includes the WEAC and its area of use. The chapter also focuses on the journaling aspect of the WEAC, and its role in the important aspect of storing exposure risks attached to the work site. Furthermore it gives brief insight of the work tool Safe Job Analysis (SJA), which is carried out in advance of certain working procedures or operations. We will later suggest in chapter 6 to make use of the WEAC in combination with SJA. The SJA may comply with the requirements in the NORSOK S-002 and the WEAC, and connects it to everyday situations.

In general, risk management is the relation between accept-criteria, charting, risk assessment, composing different efforts, follow-ups and verification (Fig. 2 – Demning Cycle).

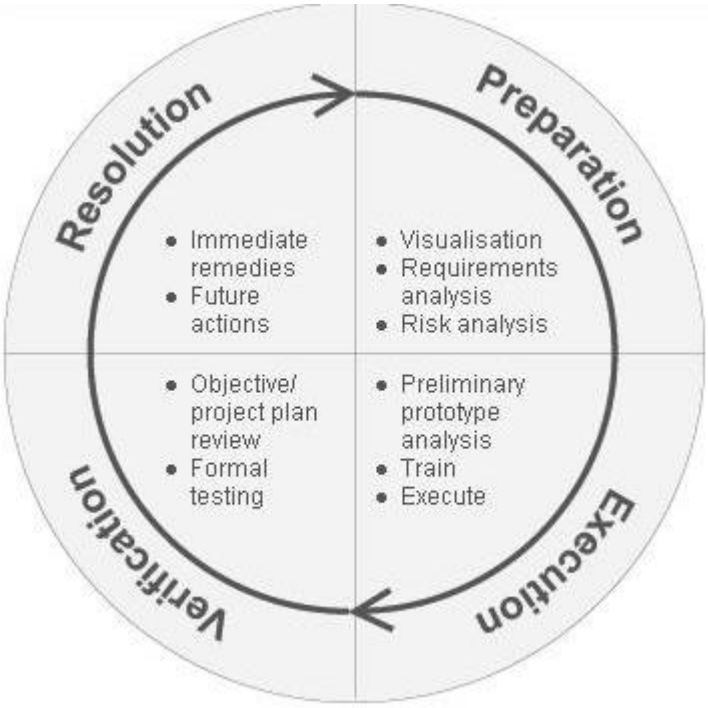

Fig.2 – Demning cycle, (http://dialogicx.com/pic/figure_8_sm.gif)

4.1 Risk-charting

According to the Regulations Relating to Health, Environment and Safety in the Petroleum Activities (The Framework Regulations, part of prevailing laws and requirements - Fig.1), “Harm or danger of harming people,…, shall be prevented or limited in accordance with the legislation relating to health, the environment and safety, including internal requirements and acceptance criteria.”

The NORSOK S-002 standard applies to the design of new installations and modification or upgrading of existing installations for offshore drilling, production, and utilization and pipeline transportation of petroleum, including accommodation units for such activities. This standard describes among other things a Working Environment Area Chart. This is used in terms of historical storage to show documentation of exposure to specific working environment factors in regarding specific areas.

Fig. 3 – overview of prevailing laws and requirements

The basic working environment charting is a systematic charting which shall be carried out when a new work place is designed and when an existing work place is being modified. The purpose is to ensure that the requirements of that specific working environment are fulfilled. In new- build projects the basic working environment charting must be documented in completed WEACs for each area onboard as a part of the as-built documentation. All work and recreation area onboard must be subject to a basic working environment charting.

In addition the charting must be used as a basis for the continuous control of the working environment, and should be carried out through observations of the daily work and supervision. The basic charting should be used as a reference. Physical measurements should be carried out when considered necessary to verify a subjective evaluation. Additionally, specific planned chartings regarding noise, light and chemical exposure are to be performed on a regular basis to verify continued compliance with requirements.

Documentation and journaling of the company's health services is founded in the Norwegian legislation. The journaling must cover several aspects. Firstly it is important for the company's health service to recall what has been done, and to communicate this internally. Moreover, employees should be able to have easy access to review their journals.

Most relevant to this study is the journaling which is used in the matters of inspection according to requirements from authorities, and as a base of documentation in prospective cases where employees claim that the company is liable for compensation. In these matters the historical storage cycle is essential.

The same sets of regulations apply whether the journaling system is printed in paper or IT-based. Most relevant to this project is the company journal where the WEAC is a good tool to store information about the work site, results from mappings and risk assessments etc. In addition (to this) there are employee journals which contain individual exposure conditions, results from health checks and consultations (Arve Lie, *Journalføring og journalhåndtering i bedriftshelsetjenesten*).

4.2 Safe Job Analysis

"A safe job analysis is a systematic and stepwise review of all risk factors prior to a given work activity or operation, so that steps can be taken to eliminate or control the identified risk factors during preparation and execution of the work activity or operation. The term risk factor includes all aspects that directly or indirectly may influence the risk of loss or damage to personnel, the environment or financial assets" (Definition from *OLF Recommended Guidelines: Common model for Safe Job Analysis*).

The *OLF Guidelines* describes further on responsibilities and general procedures for carrying out a SJA: "Most commonly the Offshore Installation Manager (OIM) is responsible for ensuring that a SJA is carried out. Parties in the SJA group may include OIM, supervisor, area authority, performing personnel, safety delegate, and personnel with relevant discipline skills for the analysis. This group carries out an inspection of the work site and identifies potential hazard elements for personnel, the environment or financial assets. Probability and consequences of these hazards are considered, and identifies primarily measures that can prevent the incidents from occurring. The SJA group then evaluates remaining risk and conducts a comprehensive evaluation to determine whether the work can be / cannot be implemented."

4.3 Working Environment Area Chart

Working Environment Area Chart (WEAC, see fig. 3 bellow) was from the starting point only a design tool developed by Norsk Hydro, and later included in the design standard for working environment NORSOK S-002. It should be carried out when a new work place is designed or when an existing work place is modified. It is to be used as assistance to keep track and to comply with standard requirements of working environment in different rooms or areas in a certain structure (Zachariassen S., Discipline leader Occupational health and safety, Petroleum Safety Authority Norway).

According to the standard "NORSOK S-002", detailed specifications of area limits for each room/work area which is readily accessible shall be established as input to engineering. The area limits shall be documented on WEACs as shown in Fig. 3.

According to ANNEX B in NORSOK S-002, WEAC or equivalent must be applied in documenting the working environment status. The Working environment area chart must be kept updated with the results of predictions, measurements, identified problem areas and deviations in evaluations and analyses and also the status of decisions on remedial actions.

Adequate calculations should be performed in order to ensure implementation of the area requirements in design and datasheets for vendor packages. These calculations must be documented on the WEAC where relevant. The implementation of the requirements shall be verified by appropriate measurement methods and documented in the WEACs (*NORSOK S-002, Chapter 5*.3.1).

The charting should be continuous, and it is common to carry this out through both observations in the everyday work and in more specific measurements as noise-level measurements and other physical working environment factors.

		WORKING ENVIRONMENT AREA CHART			Installation:	x
					Doc. No:	x
					Date:	xx.xx.xxxx
					Rev. No:	x
Room/Area name:				Room Number:		Manning level:
Coffee Shop				x		Permanently manned
WORKING ENVIRONMENT AREA LIMITS						
Factor		Limit/level	Preliminary prediction	Predicted at issue for construction	As built	Requirement reference
Noise:	Total	65	<65			NORSOK S-002, App. A
	HVAC	50				NORSOK S-002, App. A
Vibration		2				NORSOK S-002, App. A
Illumination	Normal	150				NORSOK S-002, App. A
Climate:	Temperature	19-26				NORSOK S-002, App. A
						NORSOK S-002, App. A
GENERAL						
PA announcing requirements:		Sound				NORSOK S-001, sect. 9.5
Types of hazardous substances:		Tobacco smoke (smoking section)				NORSOK C-001, sect. 7.8
Ergonomic:		Seating, sink, dishwasher				NORSOK C-001, sect. 7.7
Material handling:		No specific requirements identified				
Access:		Ordinary traffic and escape				NORSOK S-002, sect. B
						NORSOK S-001, App. D

Fig 3 – Example of an executed WEAC-form

Noise may be defined as the subjective experience of too much sound. Sound is measured in decibel (dB), (OLF, *Anbefalte retningslinjer for håndtering av hørselsskadelig støy).*

To briefly explain the use of WEAC, we will elaborate how the factor “Noise” is registered:

- The limit/level column contains a detailed specification of the working environment area limit for each room/work area on the installation. This limit is a prevailing requirement set to maintain the workers hearing.
- The preliminary prediction column in the example above predicts a decibel level less than 65 dB when the installation is to be constructed.
- “Predicted at issue of construction” means that one should execute preliminary noise measurements and noise measurements at issuing of building documentation.
- As-built means measured values during commissioning.
- The requirement reference column contains references to underlying documentation.

5.0 Questionnaire

To create a picture of how other parties in the petroleum industry execute and make use of area and/or work position-based charting for the working environment, the project group chose to perform a questionnaire. In respect of how the WEAC is meant to be used according to the NORSOK S-002, we desired information regarding practical use. The questions were developed in collaboration with working environment consultant Hasse Storbakken, Bærekraftig Arbeidsmiljø, and our external advisor Kjetil Tangen, COSL Drilling Europe AS. (Further background information regarding interviews can be viewed in chapter 2.1).

5.1 Background

The questions were as follows:

1. How does local and / or work based information related to work processes / ongoing working environment charting get stored at your company (or former)?

2. What are, in your opinion, the challenges with historical storage of local based information related to work processes / ongoing working environment charting? Do you use it-based tools in this case?

3. How does this information get presented in order to maintain the requirement of information about exposure to different working environment factors?

4. Are there existing procedures concerning whose duty it is to carry out the chartings, and if yes – how they are to be carried out?

5. How do you document attempts regarding improvement and executed actions as results of the chartings?

The questions were distributed to different parties in the industry, and we ended up with seven constructive feedbacks. These were, with line of work in paranthesis:

- **Aibel MMO - (section leader)**
- **StatoilHydro - (offshore safety manager/medic)**
- **StatoilHydro - (onshore occupational hygienist/technical safety manager)**

- **Kokstad BHT (consultant company)- (industrial health service, occupational hygienist)**
- **HMS-Design & Utvikling (consultant company) - (HSE-engineers)**
- **Occupational Hygiene Solutions (consultant company) – (organic chemistry engineer)**
- **Norwegian Petroleum Safety Association – (Occupational Health & Safety dept.)**

The impression from our preliminary studies during the project was that few people in the industry had vast knowledge of the topic. The selection of feedback reflects answers from experts and/or managers, and no representatives from craftsmen and other workers. By this, one may argue that few people in the selection operate actively on offshore installations. The three consultant companies answering the questionnaire have a broad knowledge and client base from the industry, and are by this not distinguished by one specific company's policy.

5.2 Results

Summary of answers from the participators:

1. **How does local and / or work based information related to work processes / ongoing working environment charting get stored at your company (or former)?**

   The answer here is "generally in electronic, but sometimes in manual, archives." Some use integrated follow-up systems as Synergi or other electronic health journals. Personal information in these journals is confidential. Some companies answered in addition that they hand out reports with departmental information.

2. **What are, in your opinion, the challenges with historical storage of local based information related to work processes / ongoing working environment charting? Do you use IT-based tools in this case?**

   Recovery and traceability of historical local based information are mentioned as challenges, especially related to company mergers, even though the information is generally stored electronically. Another mentioned difficulty is when an employee has had several employers. Here the employee has to give its approval for the new employer to get historical data from the former employer(s). Further on maintenance companies pronounced that their customers were not always that successful in storing information they were passed on in proper manners after a modification assignment. This could lead to difficulties during a next modification, as the historical stored information is not always accessible.

   Among the companies contacted during the project, there have been several attempts on developing and making use of IT-based tools regarding local based information.

   Mentioned tools with experiences:

   - **Microsoft Word:** The most used IT-based tool. A storage-system in Word is often developed by the building contractor in the design phase, and issued in an as-built edition to the operator company when the installation is finished. Further use of the

tool from the operator varies. The quantitative part of the WEAC (measureable factors as light and noise) is usually updated more often than the qualitative part (more subjective factors as arrangements and ergonomics).

- **Microsoft Excel:** Alternative to Microsoft Word. Often used in the design and construction phase where easy updating of the calculated values of the quantitative part of the WEAC has the main focus. A mentioned positive experience with Excel is that one may program a simple transfer system of data between the different area charts. On the other hand, Excel gets easily into difficulties if the tables contain a lot of text. In terms of the qualitative part of the WEAC, Excel has not proven to be particularly effective.

- **Pride Workmap:** used/has been used by some of the larger operator companies. This tool is experienced to be expertise-demanding in terms of collecting desired historical data. It is said to have a difficult user-interface, and to be time consuming in keeping the charts updated.

3. **How does this information get presented in order to maintain the requirement of information about exposure to different working environment factors?**

   Information about exposure is reported to be given to each employee, e.g. as a PowerPoint presentation on a safety meeting, with a general report to the involved department and manager. In some cases a report is also handed to the authorities, e.g. audiometry testing associated with work related diseases. WEAC is said to be used rarely as an information tool regarding exposure, and in fact several of the participators said that it was not suitable as an information tool because of its complex selection of exposure factors.

4. **Do procedures concerning whose duty it is to carry out a charting exist, and if yes – how it is to be carried out?**

   The answers here vary between the smaller and the bigger companies. The smaller ones are often connected to an external HSE consulting company, and herby make use of their competence and procedures related to charting. Bigger companies, e.g. operators and larger service companies, have their own procedures on whose duty and how the chartings are to be carried out. Here a charting team is established, which generally consists of medic/HSE-coordinator, employee representative and manager from the department of interest, safety deputy and working environment advisor or hired consultants, and a checklist for the charting is followed. It is common to have meetings in the various departments for all crews on the rig, and every employee must participate with comments and suggestions regarding their working environment. All areas and all common operations of work get assessed.

5. **How do you document attempts regarding improvement and executed actions as results of the chartings?**

   Different follow-up systems are used here, from simple lists to more advanced systems. An advanced system may store data and document the process from the planning stage of charting when the executed actions regarding improvement are carried out and verified. Particular exposed workers in some cases get followed up through personal health journals. In some companies authority requirements that cannot be performed get registered in a separate database. Here one establishes compensating efforts until the deviation gets fixed.

6.0 Discussion and conclusions

During the project we discovered that little information existed on the topic, and this made us rely most of our work on expert opinions and feedback. We will in this chapter discuss the information collected, and further give our opinion regarding the use of WEAC.

6.1 The use of WEAC

The WEAC is a historical document which should be present at, and followed by, an installation from the design phase to decommissioning. It measures such as modifications and successful technical solutions. Further on it deals with solutions that are to be avoided, statistics regarding injuries, close calls and work-related diseases. Results of working environment surveys and risk assessments should be available in the WEAC (*NORSOK S-002, chapter 4.3.3*). The main challenge is to transfer experience from construction to the operational phase. Continuous updates are necessary to ensure that the WEAC proceeds to be an ongoing and "living" document.

It is important for the WEAC to be a part in the operational phase as documentation regarding achieved requirements, as well as being updated during installation modifications. In the operational phase it is perhaps more an interest to carry out qualified surveys and risk evaluations independent of areas – and in these cases other tools than the WEAC may be more suitable.

WEAC is a good tool with respect of geographical focuses, i.e. working environment in an area, but not so much for jointly working environment exposure on a group of workers. E.g. mechanics will carry out work in various areas, and this demands a different approach to collect information about their working environment exposure.

From contact with experienced people regarding WEAC, it seems to be a handy tool when measuring quantitative working environment factors such as noise, illumination and temperature, but not so much with respect to qualitative factors as ergonomics and outdoor operations. Here it might be useful to carry out different studies and reference these in the relevant WEACs.

The offshore safety regulations don't take into account that it is intended on a vast composition of people. For functional requirements as electrical installations or the drilling process, the regulations are focused on users with education and experience within the specific fields. Operations like these are well known for the worker, ant it is thereby relatively easy to live up to regulations. But with respect to HSE, the picture gets more complex. Health, Safety and Environment are more unknown lines for a crew on an oilrig. HSE covers complex areas as for instance noise, ergonomics, chemical injurious to health and psychosocial working environment. This demands well-explained information rather than just referring to regulations.

The WEAC may be a useful tool in many cases, but this depends highly on input quality. During the project we looked at possibilities to simplify the design of the WEAC to make it easier to put in use in the operational phase (theory on formulating and designing a risk message; Chapter 3.4.2). We tried to remove the "Prediction" and "Design status" columns in the WEAC, as these are not relevant during operation. We thought about using colors as red, yellow and green to emphasize the different levels of risk (Chapter 3.4.3). This turned out to be a challenging task, as especially the qualitative

factors are hard to put in concrete terms in the chart, and thereby difficult to communicate in a simplified version. After consulting with expertise, we concluded not to proceed with this possibility, as we don't think this will make individual risk aspects more visible. We rather chose to investigate how to use WEAC as part of a risk assessment tool, as we think the WEAC is more suitable as a reference tool together with risk assessment procedures.

6.2 Challenges regarding local based information

A challenge with the local based information is to recover and trace historical documentation. In general, from the companies contacted in this project, the WEACs are controlled, updated and maintained by the onshore organization.

There have been several attempts on developing useful IT-based tools in relation of storage and use of results of working environment charting. So far there has been little or no substantial success in covering this object in combination with practical use. One of the main challenges is format conversion. A lot of existing historical data is not accessible because it is stored in incompatible IT-systems, and hereby the conversion is difficult, time-consuming and expensive. From feedback received in the questionnaire, it seems like some of these specialized programs are too expertise demanding (Chapter 5.1). Because of this they may demand a higher level of computerized competence to keep the documentation updated and maintained. The result of this may be that updating of the WEAC-system has to be carried through onshore.

As listed in the questionnaire results, all software have their pros and cons. Some may be too basic and some may be too complex. The best approach, in our opinion, is to make use of basic software, as for instance Microsoft Word or Excel, and to develop a supplement base-application with respect to storage and use of results of working environment charting. The reasons for this are that these programs are well known to most people, and they don't demand extensive computerized skills to be put in use. These kinds of software are also accessible on most computers. By utilize basic and well known software, one can achieve well aimed information adapted to the receivers' premises (Chapter 3.2-3.3). On an offshore installation there is an operator and e.g. drilling company and a maintenance company, and all these are exposed to many of the same working environment factors. If these parties want to make the information flow regarding working environment run smoothly, they should aspire a jointly IT-solution, and this could be a supplement base-application to software as e.g. Word or Excel.

6.3 Incorporate WEAC in a SJA

The *OLF Guidelines* states that "a safe job analysis is required when risk factors are present or may arise and these factors are not sufficiently identified and controlled through relevant procedures or an approved work permit associated with the actual work."

The WEAC is connected to a specific working area, while the SJA is carried out with respect to certain working procedures or operations. By making use of the WEAC during a SJA, one may also incorporate the exposure to local based working environment factors. Some working operations are not bound to a certain area, ref. the mechanic example above.

To exemplify how the individual exposure to some working environment factors are complex to determine, we will elaborate the factor noise through table 1:

Area noise dB(A)	Max retention time	Ear protection
> 110	Retention not recommended	Retention not recommended
105-110	½ hour per shift	Both ear muffs and ear plugs with a reside exceeding 10 min
100-105	2 hours per shift	
95-100	6 hours per shift	
90-95	6 hours per shift	Ear muffs or ear plugs
85-90	12 hours per shift	
83-85	No restrictions	
80-83		
75-80		No restrictions
< 75		

Table 1: Recommended maximum exposure periods (*OLF Anbefalte retningslinjer for håndtering av hørselsskadelig støy,* Tabell 6-3, (2008)).

If a noise level e.g. exceeds 95 dB, the maximum retention time for a worker in an area must be reduced if other working environment factors are present and affects negatively. Hence, an evaluation of retention time must be performed in each event. This is one of multiple issues regarding workers which are not bound to a certain area. These workers reside in different areas throughout their shifts, and by this, their working environment exposure is complex to determine (Table 1) *OLF Anbefalte retningslinjer for håndtering av hørselsskadelig støy* (2008). From the starting point of planning of work on the installation, working environment relations and safety for the personnel must be assessed. E.g. if one during the planning stage does not take into account that the retention time on personnel is limited in noise areas, one may reach a point where economy and progress pressure the personnel to conduct work in areas even though the noise level is exceeded.

6.4 Conclusions

All parties who wish to operate on the Norwegian Continental Shelf must have control on the employees exposure to working environment factors, both individual and jointly. The exposure values must comply with established standards and limitations according to regulations. No exceptions are given regarding overexposure of employees, and efforts must be taken to reduce the exposure.

It is our impression from working with the project that the Working Environment Area Chart is purely designed to meet authority requirements, and its targeted groups have not been taken into consideration with respect to user-friendliness (Chapter 1.1). It is our opinion that the WEAC alone is not suitable as an information tool to make the workers aware of the dangers they are exposing

themselves to. We don’t consider the WEAC to be a necessary addition to the already existing warning and information signs.

With a successful IT-solution, one could, in a simple way, store endless amounts of information as well as trace and present historical information effectively. By doing so, one could make information accessible to all employees on different locations, and this may contribute to better risk communication.

By not thinking mainly on the WEAC, but to focus on working procedures a Safe Job Analysis may comply with the requirements in the NORSOK S-002 and the WEAC, and connect it to everyday situations.

It is rather surprising that the NORSOK S-002 has been revised four times since 1994, but the WEAC has remained more or less exactly the same. Because of the seemingly lack of knowledge among quite a few of the people in the industry regarding WEAC, one could argue whether there should be conducted an authority campaign to investigate the use of WEAC and its user-friendliness.

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Appendix 1: WEAC-form

ANNEX F WORKING ENVIRONMENT AREA CHART (NORMATIVE)

WORKING ENVIRONMENT AREA CHART			Doc.no.	Rev.	Date	Page
Installation:	Room/area name:		Module/level:		Area no.:	Manning:[1]
WORKING ENVIRONMENT AREA LIMITS						
Factor	Limit/level[2]	Preliminary prediction[3]	Predicted at issue for construction[3]		As built[4]	Status[5] / Notes[6]
Noise: Total HVAC						
Vibration						
Illumination						
Temperature						
Air changes pr. hour						
Types of hazardous substances[7] :						
GENERAL						
Factor	Document id. no.[8]	Description of identified hazards/nonconformities/ comments		Decision		Status[5] / Notes[6]
Arrangements						
Ergonomics						
Technical appliances						
Chemical substances						
Outdoor operations						
Radiation						
Notes[6]:						
PREPARED BY[9] :	CHECKED BY[9]:		APPROVED BY[9]:			

Fig. 2 - WEAC from the NORSOK S-002