

Risk Management and control of exposure

*SAIOH 2019 PDC 15th of October,
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Part 3 - Risk assessment

PREPARED.

Disclaimer



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Development of OELs



When and where were the first OELs developed ?

When was the first OELs established in South-Africa ?

Development of OELs



First published (in Germany)

1886 Ammonia and sulphuric acid

South-Africa

1916 - 1917

- South Africa published Quartz OEL
8.5 mppcf (million particles per cubic foot)
- U.S. Bureau of Mines published Quartz OEL
10 mppcf
- In the late 1920's a company in West Virginia ignored the 1917 OEL and allowed 2,000 miners to be grossly over exposed to over 98% pure silica quartz dust as they tunneled through a mountain.
 - >400 workers died within 2 years
 - Almost all remaining workers eventually died of silicosis

Norway

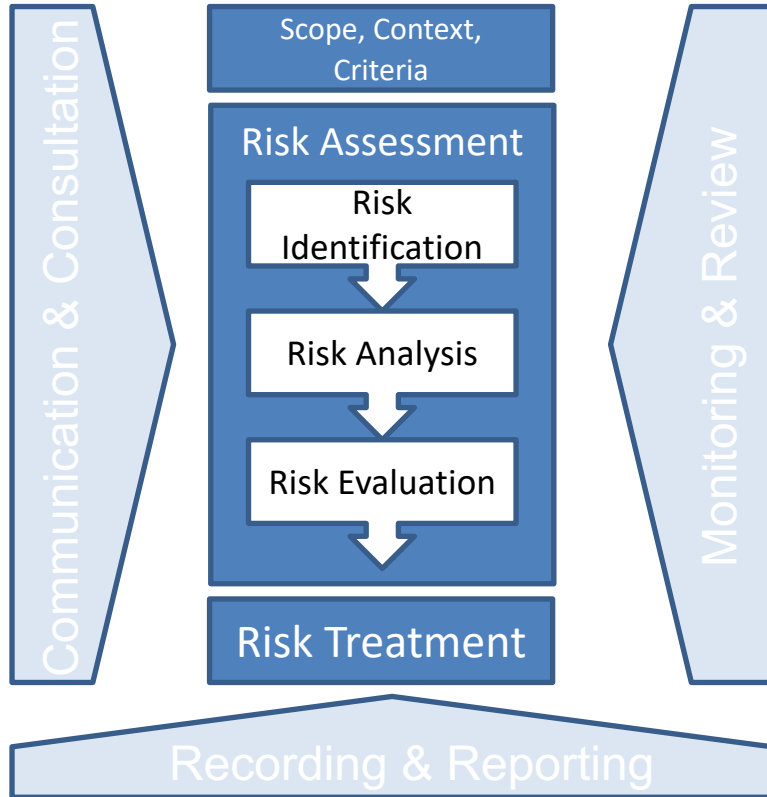
1976

(copy of ACGIH TLVs)



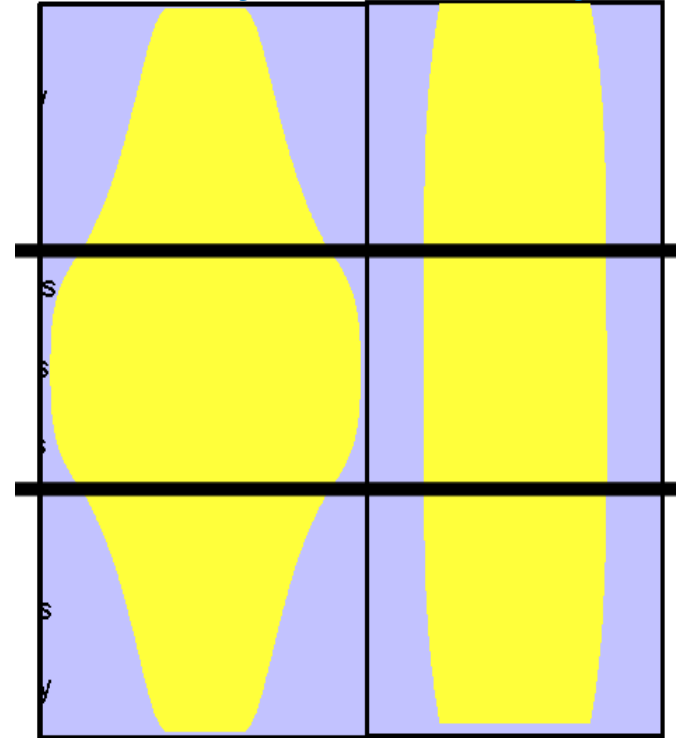
Risk Assessment Process

Risk Assessment process

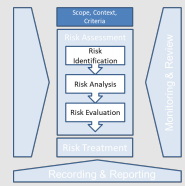


Typical risk analysis

Balanced risk analysis

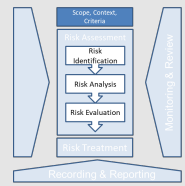


Problem Definition



- What is the purpose of the analysis?
 - Ensure safe/efficient operation
 - Meet time & cost
 - Satisfy regulatory/internal requirements
 - Satisfy regulatory/internal expectations
 - Optimise design
 - Optimise program (activity)
 - Evaluate non-conformance(s)
 - Dimensioning the Emergency Response
 - Plan maintenance
 - Communication (perceived risk)

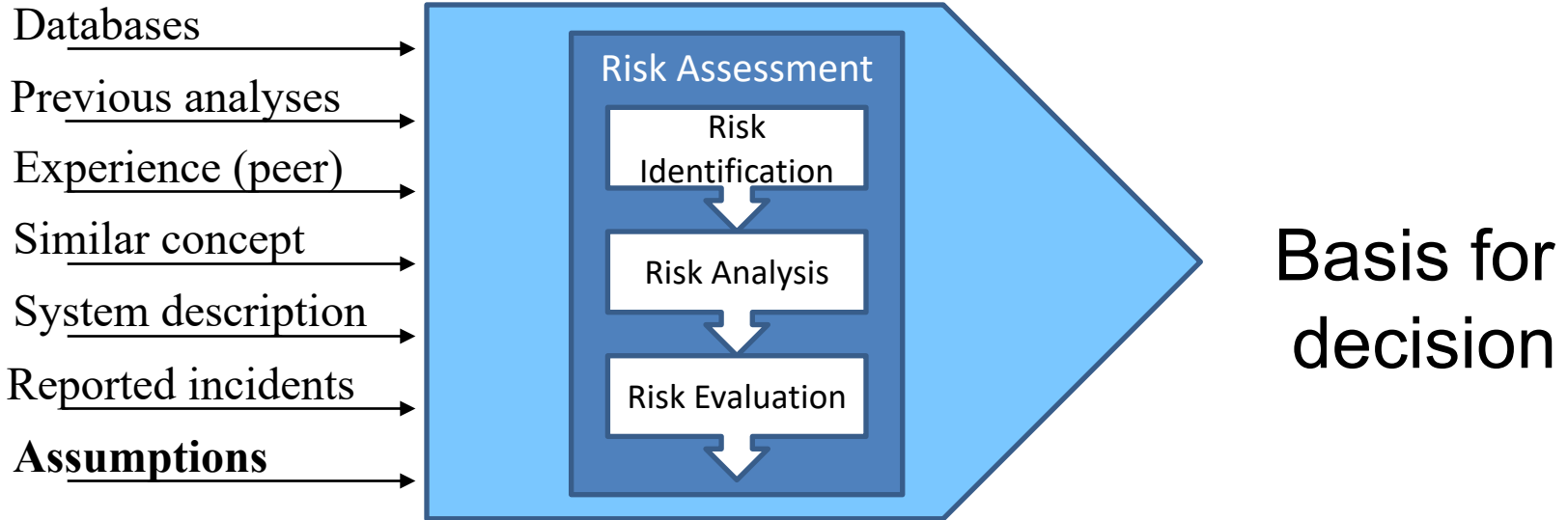
Information gathering



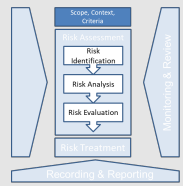
INPUT

ANALYSIS

OUTPUT

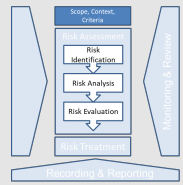


Decision Criteria



- What objectives, criteria's and principles shall be used?
 - ALARP principle
 - Precautionary principle
 - Carefulness principle
 - Risk Acceptance Criteria
 - Risk Appetite
 - Risk tolerance

Selection of method



Important factors when selecting method:

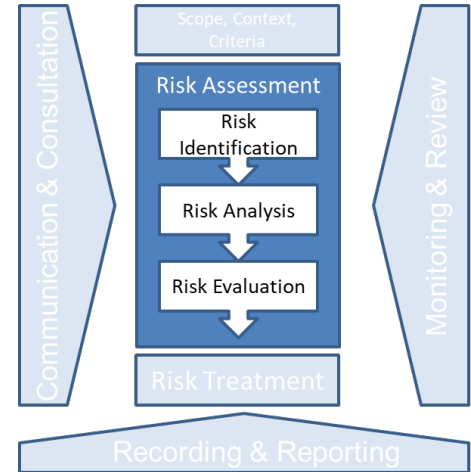
- Problem definition (decision)
- Importance of system,
- Complexity of system
- Available information
- Available resources
- Regulatory requirements

Risk Assessment

Risk Identification



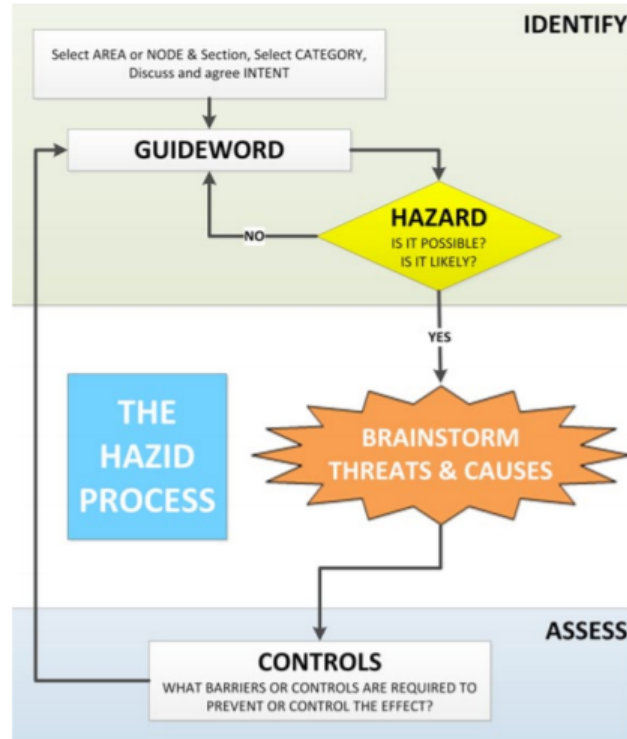
- Tangible and intangible sources of risk
- Causes and consequences
- Threats and opportunities
- Vulnerabilities and capabilities
- Changes in the external and internal context
- Indicators of emerging risk
- The nature and value of assets and resources
- Consequences and their impact on objectives
- Limitations of knowledge and reliability of information
- Time-related factors
- Biases, assumptions and beliefs of those involved



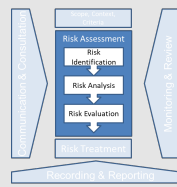


Thinks...
HAZARD

The HAZID process



Hazard Identification



- Hazard in the first and the most critical activity in the risk analysis.
- Basis elements:
 - Knowledge regarding systems and components
 - Knowledge regarding activities and operations
 - Knowledge on accidents
 - Knowledge on undesired events and near-misses
 - Hazard Identification techniques

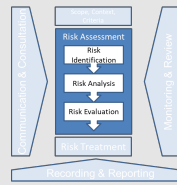
Guideword	Description
Weather	Unclear weather restrictions or unexpected deterioration of weather - weather forecasting
Impact	Impact between objects
Position	Object, grillage or barge not in correct position
Drop	Drop of objects from a higher level or to seabed, e.g. from items to be deployed or recovered
Power	No power or insufficient power
Instruments	Malfunction or lack of instruments
Communication	Malfunction or lack of communication equipment
Movement	Objects or vessels moving in an uncontrolled manner
Stability	Unstable conditions/objects toppling over
Tolerances	Tolerances for positioning, grillage tolerances,
Stuck	Movement cannot be performed
Rupture	Rupture of critical equipment
Access	Insufficient access
Not cut	No or insufficient cutting of items to be cut by
Barriers	No or insufficient barriers
Tension	High tension in e.g. running wires or wire slings
Execution	A work task is incorrectly executed or in wrong order
Procedures	Missing or unclear procedures/task plans
Environmental	Potential environmental pollution

Checklist – Risk Workshop



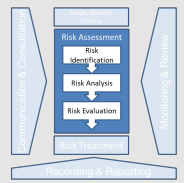
"SOFT" UNCERTAINTIES	
Resources	(capacity, experience, availability, priorities, common, shared, 3 rd party)
Cooperation	(operator, rig owner, committees, project place, change, on/offshore)
Competence	(ordering, training, experience, overview, documented, HSE, adequate)
Planning	(goal, means, timing, common, work processes, milestones, involvement)
Implementation	(tracking, performance, quality, monitoring, measuring, verification)
Decisions	(process, management, authority, support, basis, change, crisis)
Management	(weak, determined, defined, understanding, exposed, trust, motivated)
Responsibility	(accountability, proactive, documented, clarified, agreed, trust)
Expectations	(promises, agreed, goals, change, documented)
Communication	(what, when, preparedness, external, written, authorities, documented)
Attitudes	(supportive, aggressive, positive, negative, judging, flexible, loyal, critical)
Philosophies	(diverging, known, change, hidden agenda, agreement, understanding)
Requirements	(common, understood, audits, see-to-it, processes, procedures)
"HARD" UNCERTAINTIES	
Applications	(PLANC, SUT (AoC), discharge, A/C, risk, identified, audits, changes)
Time	(delays, too late/too early, sufficient, conflicts, Popcorn, planned)
Projects	(Yard stay, Rig Intake, unplanned, conflicts, delays, risk, management)
Documentation	(procedures, processes, standards, project place, hierarchy, differences)
Reporting	(systems, format, software, hardware, follow-up, ownership, continuity)
Budgets	(money, available, preparedness, follow-up, risk, contract)
Equipment	(age, replace, redundancy, different needs, experience, verification/QA)
Systems	(work processes, documented, best practice, continuous improvement)
Technology	(age, existing, changes, improvement, needs, history, knowledge)
Software	(new, old, duplication, choice, training, support, common, transfer)
Location	(common, supply base, helicopter, cooperation, systems)
Contracts	(existing, changes, holes, conflicts, limitations, sufficient)
EXTERNAL UNCERTAINTIES	
Authorities	(changes, expectations, focus, regulations, conformity, communication)
Infrastructure	(support, service, supplies, changes, established, present, available)
Partners	(approve, stability, alliances, economy, supporting, conflicts)
Third party	(identified, follow-up, common, vessels, helicopter, quality)
Suppliers	(Standby vessels, helicopter, drilling, HOFD, medical)
Competition	(identified, threats, recruitment, resources, procurement)
Stakeholders	(identified, requirements, needs, expectations, new, communication)
Unions	(strike, conflicts, resources, support, help, agenda, involved, consent)
Crimes	(sabotage, bribery, theft, vandalism, industrial espionage)
HSE UNCERTAINTIES	
Major accident	(leakage, fire, explosion, blow-out, explosives, collision, rig move)
Occ. Accidents	(campaign, philosophy, focus, falling/swinging loads, dropped objects)
Material	(toxic, inflammable, irritating, datasheets, information, verification)
Working env.	(noise, temperature, chemicals, vapours, gasses, psycho-social)
Environment	(waste, chemicals, radiation, drain, leaks, discharges/emissions, flare)
Decision criteria	(common, conflicts, philosophy, differences, understood)
HSE Performance	(targets, continuity, figures, agreed, communicated, motivated)
Safety systems	(philosophy, design, framework conditions, limitations, history)
Emergency prep.	(plans, notification, medical, oil spill, facilities, area, resources)
Emergency org.	(robust, common, support, competence, training, motivated, experience)

Black swans and Perfect storms



Risk Assessment

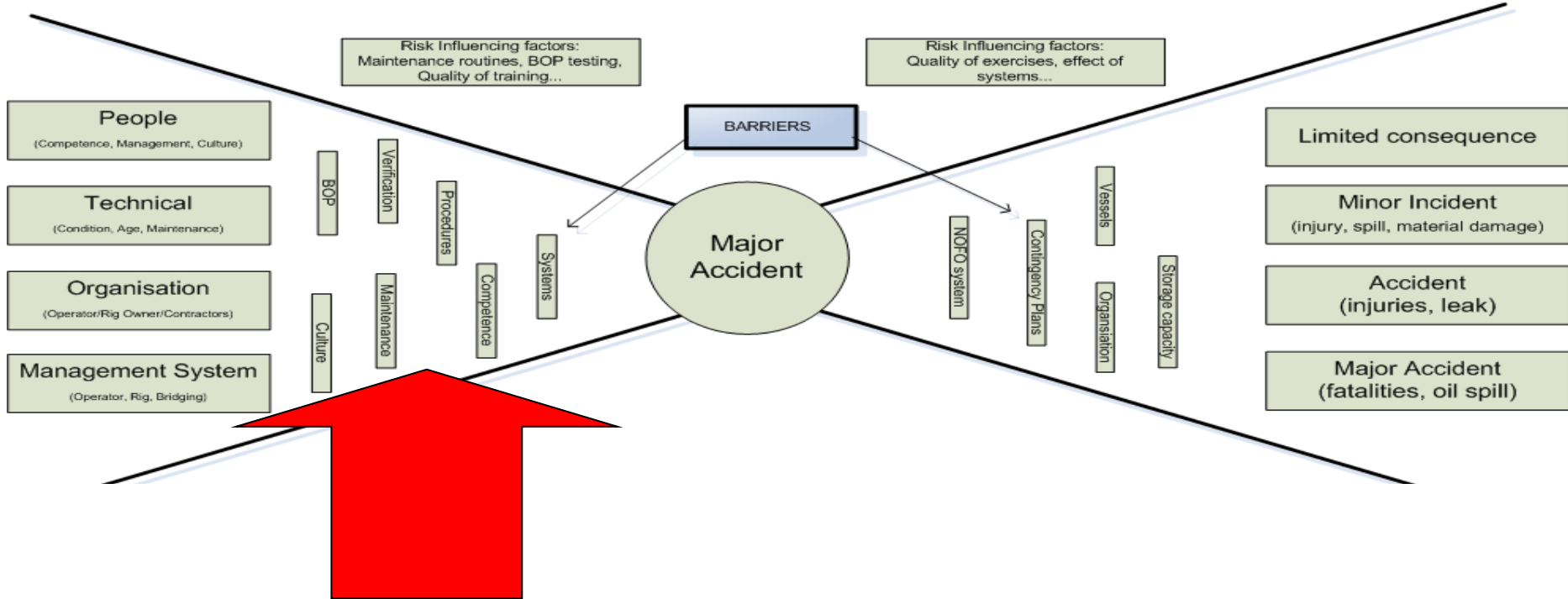
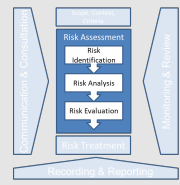
Risk Analysis



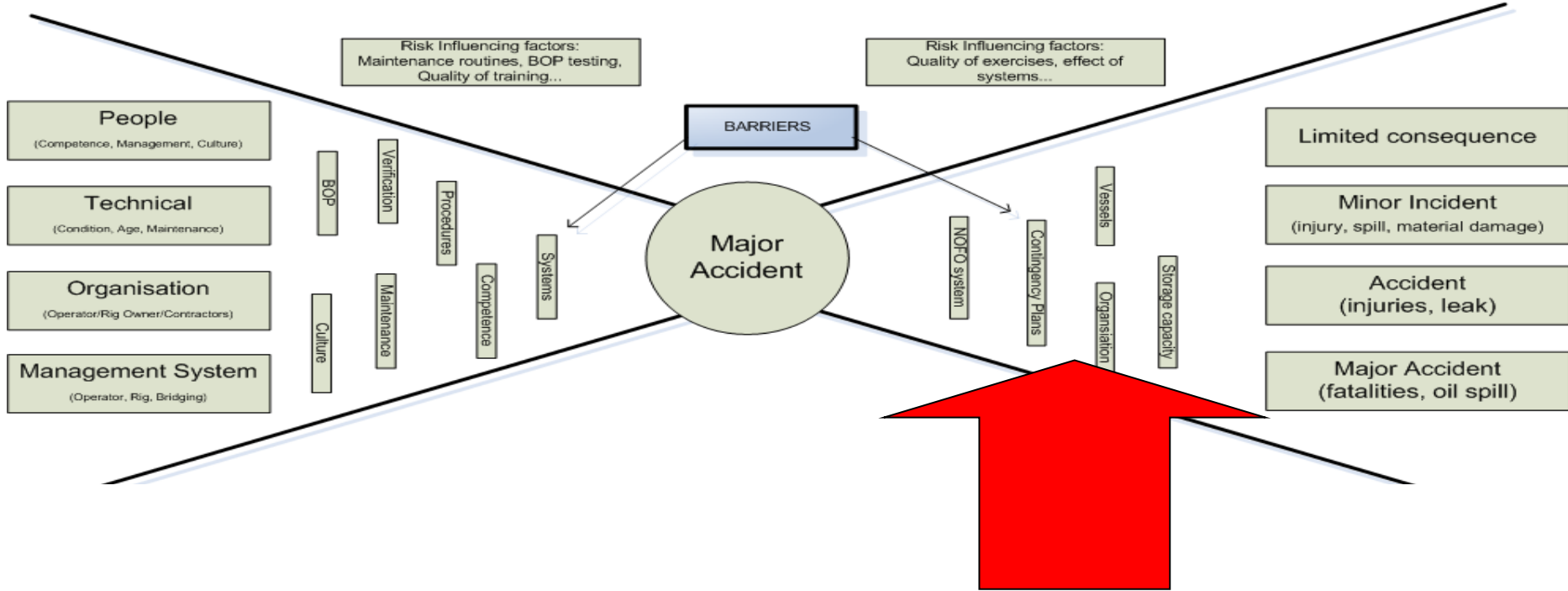
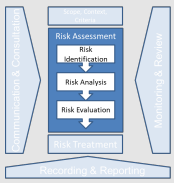
Risk analysis should consider factors such as:

- The likelihood of events and consequences
- Exposure levels
- The nature and magnitude of consequences
- Complexity and connectivity
- Time-related factors
- The effectiveness of existing controls
- Sensitivity and confidence levels

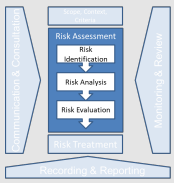
Cause Analysis



Consequence Analysis



How to evaluate consequences?



1) Experience data

Statistics (internal/external data) – Occupational Illness, accidents etc

Tests/experiments/modelling

Exposure measurements

2) Consequence models

Release / emission rates

Chemical Spill

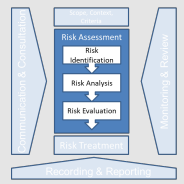
Impact on people (Dropped Object)

Drift calculations (emergency response)

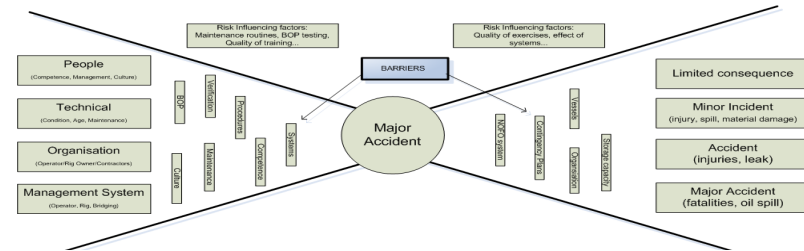
3) Combination of 1) and 2)

Risk Assessment

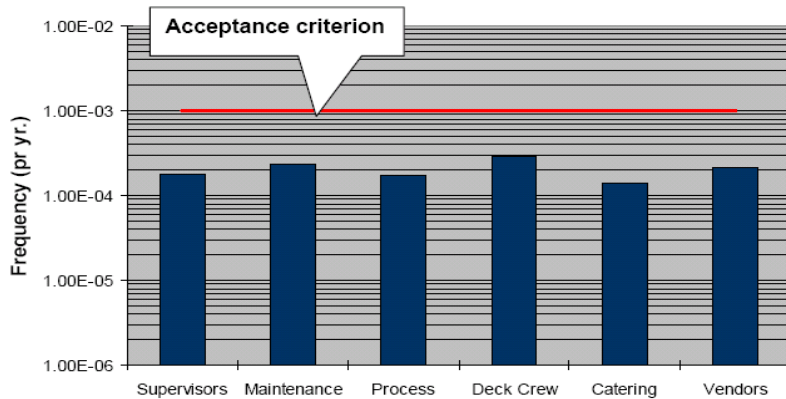
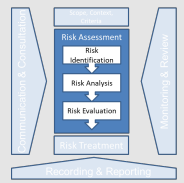
Risk Evaluation



- Purpose is to support decision to:
 - Basis for considering risk treatment options
 - Undertake further analysis to better understand the risk
 - Maintain existing controls
 - Reconsider objectives



Risk Evaluation

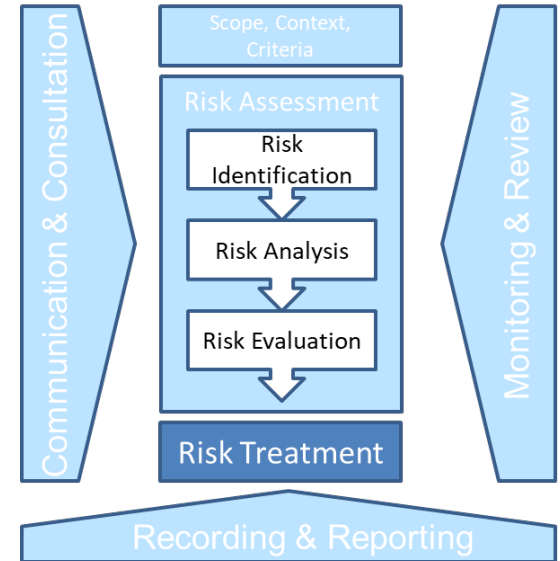


Risk matrix - Operations					Never heard of in O&G industry	Has occurred in the O&G industry	Incident has occurred or could have occurred in our company	Incident is known to have occurred more than once within a number of O&G companies	Incident is a regular occurrence within the O&G industry
					$p < 10^{-4}$	$10^{-4} < p < 10^{-3}$	$10^{-3} < p < 10^{-2}$	$10^{-2} < p < 10^{-1}$	$p > 0.1$
Economical effect	Reputation	Well Control	Damage to people	Probability Consequence	Highly unlikely (P1)	Unlikely (P2)	Could happen (P3)	Likely (P4)	Very likely (P5)
>300 MNOK Lost well, sidetrack, recompletion	International impact	Loss of primary barriers	Multiple Fatalities	Catastrophic	D				
30-300 MNOK Lost well, sidetrack, recompletion	National impact	Loss of secondary barriers	Single Fatality Major injuries to multiple persons	Very serious					A
3-30 MNOK Delays, reduced ROP, equipment failure.	Limited impact	Reduced integrity of barriers	Major Injury	Serious/ Considerable			B		
<3 MNOK	Slight impact	Minor reduced integrity of barriers	Medical treatment/ Loss time injury	Small/Limited	C				
<0.5 MNOK	Slight impact, local public awareness	Negligible	First aid	Minimal					E

Risk Treatment

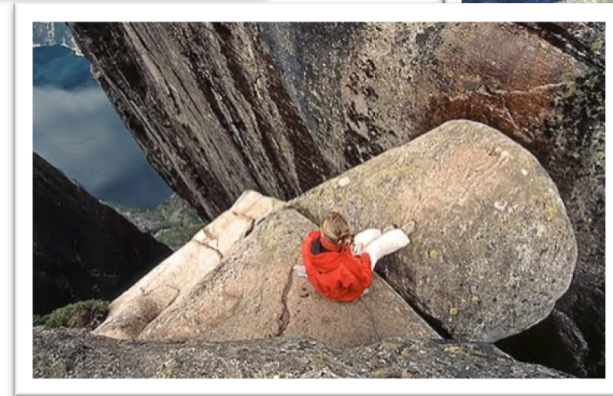
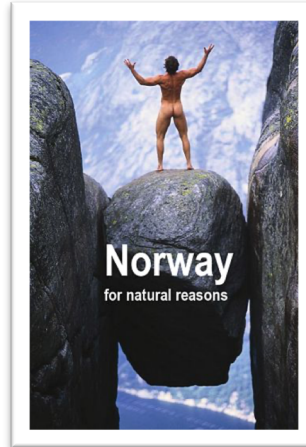


- Formulating and selecting risk treatment options
- Planning and implementing risk treatment
- Assessing the effectiveness of that treatment
- Deciding whether the remaining risk is acceptable
- If not acceptable, taking further treatment



Risk analysis as a basis for decision

Kjerag – Lysefjorden – 1000m



Basis for decision?



Risk matrix - Operations					Never heard of	Has occurred	Incident has occurred or could have occurred	Incident is known to have occurred more than once	Incident is a regular occurrence	
					Probability	$p < 10^{-4}$	$10^{-4} < p < 10^{-3}$	$10^{-3} < p < 10^{-2}$	$10^{-2} < p < 10^{-1}$	$p > 0.1$
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<3 MNOK	Slight impact	Minor reduced integrity of barriers	Medical treatment/ Loss time injury	Small/Limited						
<0,5 MNOK	Slight impact, local public awareness	Negligible	First aid	Minimal						

Richards decision



«The risk associated with an activity means the combination of possible future incidents and their consequences, and associated uncertainty»

Before treating the risk



- Do the results make sense?
 - Was this what you expected?
- Identify those factors that influence the outcome of an event:
 - Important assumptions/presuppositions
 - Models (reflecting key issues)
 -
- Sensitivity Analysis
 - Performed?
 - What changes in input may change the conclusion

Risk Treatment options



- Avoiding by deciding not to start or continue with the activity that gives rise to the risk
- Taking or increasing the risk in order to pursue an opportunity
- Removing the risk source
- Changing the likelihood
- Changing the consequence
- Sharing the risk
- Retaining the risk by informed decision

Principles for risk treatment



ALARP-principle

- Risk shall be reduced as **As Low As Reasonably Practicable**

Carefulness principle

- Exercise caution when there is uncertainty related to the consequences, i.e. in relation to an activity (or implement measures to prevent uncertain consequences).

Precautionary principle

- Do not initiate an activity, or implement measures to prevent potential negative consequences when there is scientific uncertainty related to the consequences.

Risk Acceptance Criteria

- Express what has been evaluated to be an acceptable (tolerable) risk level and express upper limit for risk.

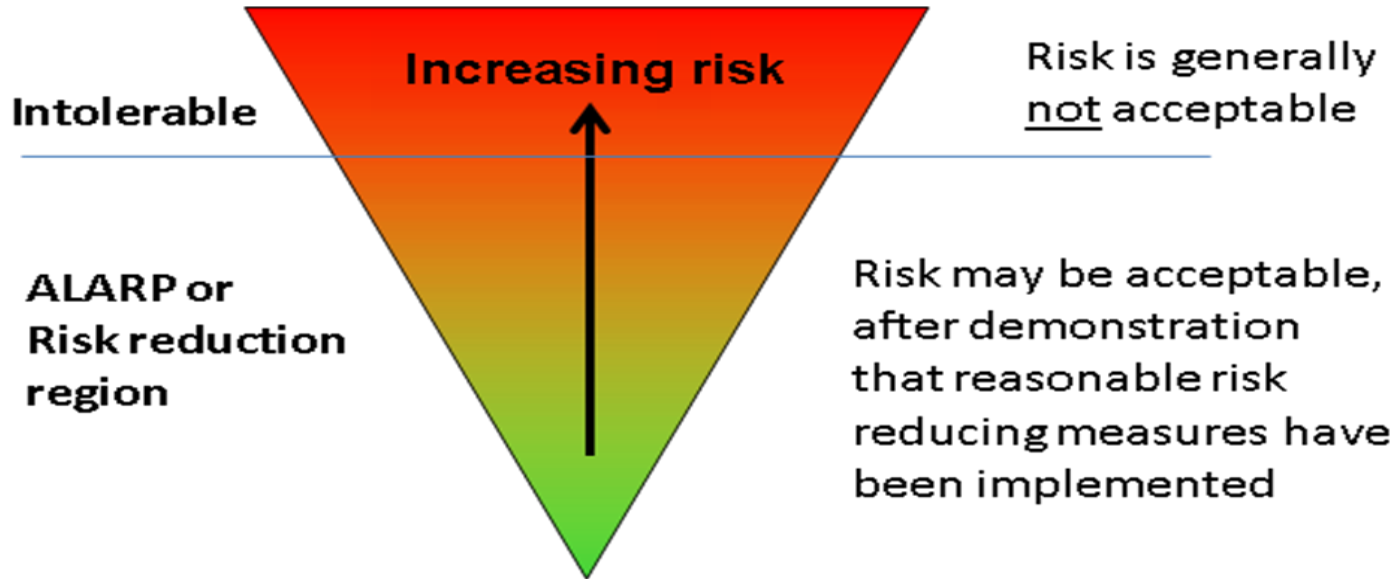
Risk appetite

- Extent and type of risk that the company are willing to pursue, keep og accept (acceptable balance between growth, risk and profit)

Risk tolerance

- Acceptable level of variation in relation to goal achievement (measures in the same units as the goals)

Risk Acceptance Criteria - ALARP

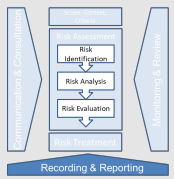


ALARP evaluation

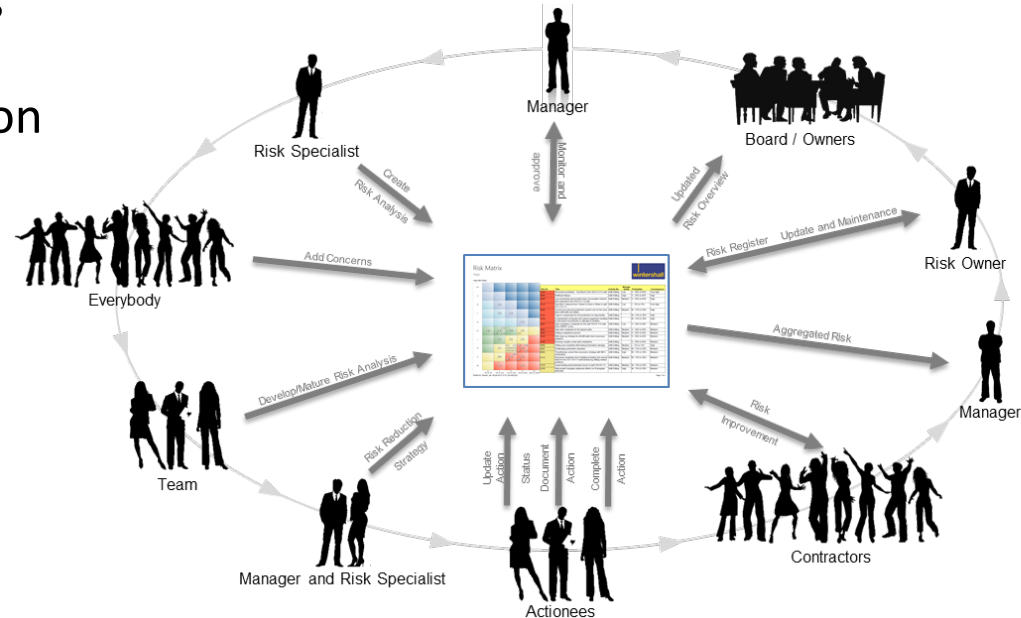


- *ALARP-evaluation*: The risk shall be reduced **As Low As Reasonably Practicable**.
- For a risk to be ALARP it must be possible to demonstrate that the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained
- Determining that a risk has been reduced to ALARP involves an assessment of the risk to be avoided, of the sacrifice (in money, time and trouble) involved in taking measures to avoid that risk, and a comparison of the two.

Recording & Reporting



- Communicate risk management activities and outcomes across the organisation
- Provide information for decision making
- Improve risk management activities
- Assist interaction with stakeholders, including those with responsibility and accountability for risk management activities



EN 689 Workplace exposure – Measurement of exposure.....

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 689:2018+AC

April 2019

ICS 13.040.30

Supersedes EN 689:2018

English Version

Workplace exposure - Measurement of exposure by inhalation to chemical agents - Strategy for testing compliance with occupational exposure limit values

Exposition sur les lieux de travail - Mesurage de l'exposition par inhalation d'agents chimiques - Stratégie pour vérifier la conformité à des valeurs limites d'exposition professionnelle

Exposition am Arbeitsplatz - Messung der Exposition durch Einatmung chemischer Arbeitsstoffe - Strategie zur Überprüfung der Einhaltung von Arbeitsplatzgrenzwerten

This European Standard was approved by CEN on 2 March 2018 and includes Corrigendum 1 approved by CEN on 2 March 2018.

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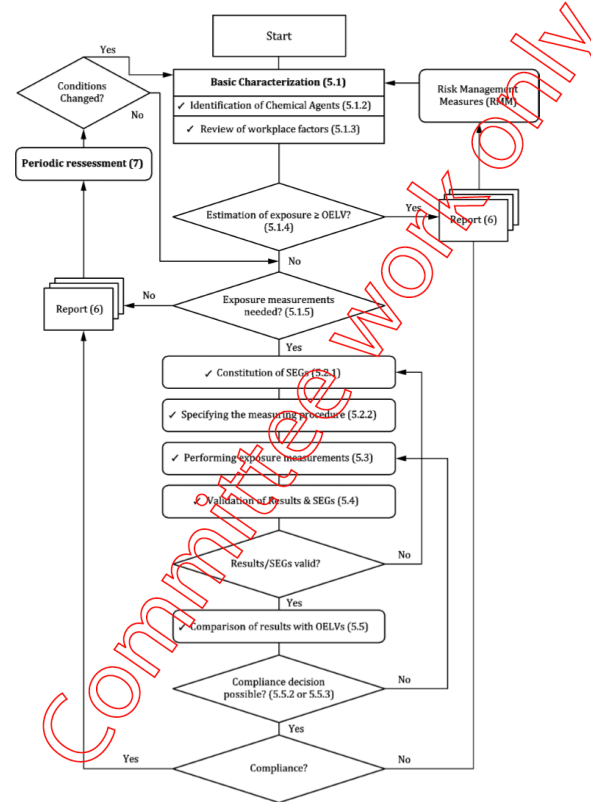
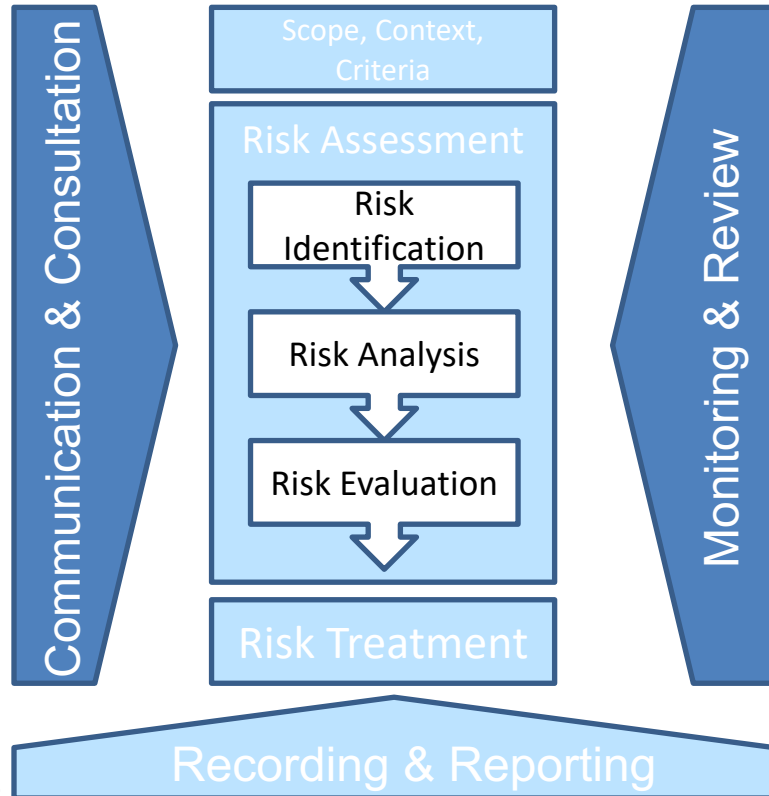


Figure 1 —Schematic overview of the occupational exposure assessment procedures [AC]



Risk management

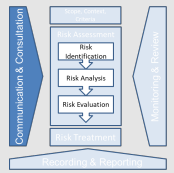
Risk Management Process



Risk Management:

Coordinated activities to direct and control an organisation with regard to risk.

Communication & consultation

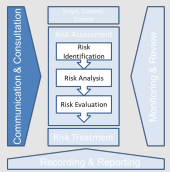


Communication: Promote awareness and understanding of risk

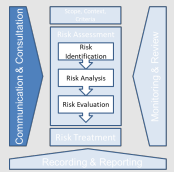
Consultation: Obtaining information to support decision-making

- Aims to:
 - Bring different area of expertise together (for each step in risk management)
 - Ensure different views are appropriately considered
 - Provide sufficient information to facilitate risk oversight and decision-making
 - Build a sense of inclusiveness and ownership among those affected by the risk

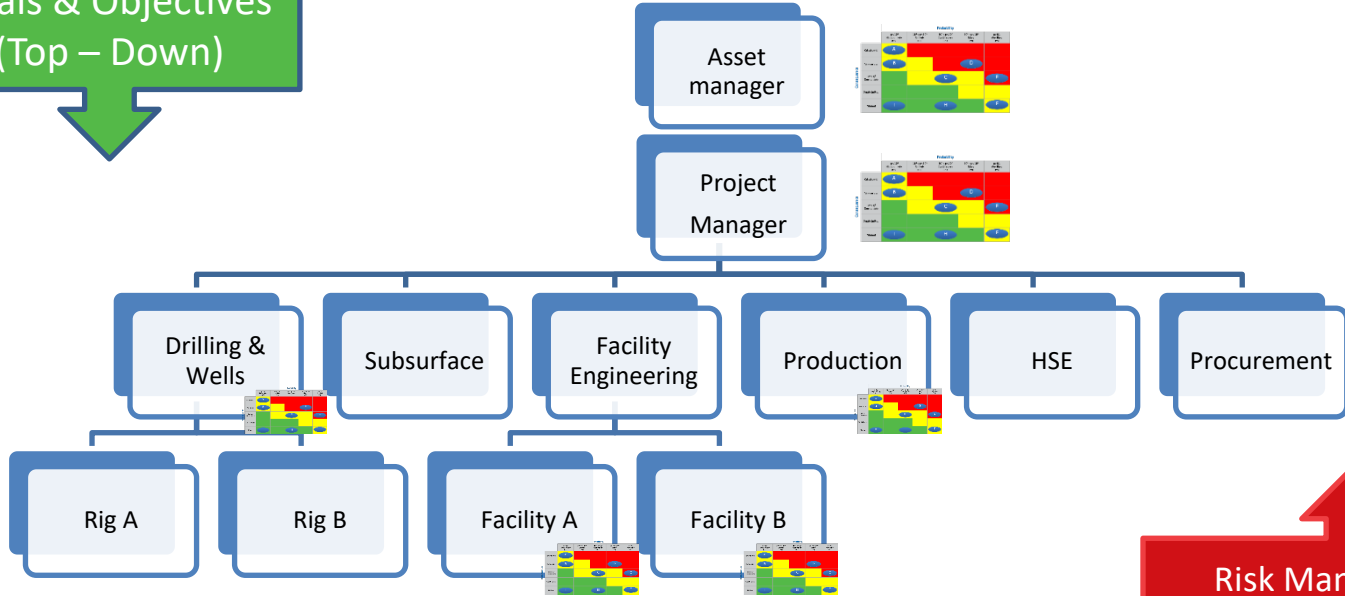
Communication and Consultation



Communication



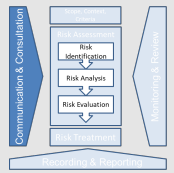
Goals & Objectives
(Top – Down)



Risk Management
(Bottom Up)

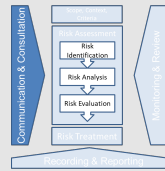
Corporate Governance vs. Enterprise Risk management

Offshore operational risk



- Working at heights
- Lifting Operations
- Isolation of Energy
- Chemicals exposure
- Exposure to electrical equipment
- Drinking water
- Manual handling
- Osv.

.. managed by operational requirements

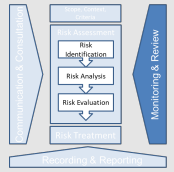


- PRO-001 Work Permit
- PRO-002 Safe Job Analysis
- PRO-003 Entering tanks
- PRO-004 Working in heights
- PRO-005 Lifting Operations
- PRO-006 Isolation of Energy
- PRO-007 Waste management
- PRO-008 Chemical mngm
- PRO-009 Electrical systems
- PRO-010 Personal protection
- PRO-011 Helicopter Operation



Monitor and review

Assumptions / presuppositions



Effect of changes in.....

- Weather Conditions
- Competence
- Integrity
- Hot work
- Process conditions
- Compliance
- HPHT experience
- Reservoir conditions
- Drilling Program
- Etc.



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