Compliance with legislation - to what extent can a risk assessment using the framework of IEC 61508 satisfy the requirements of other legislative requirements?

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Synopsis

Vast amounts of resource are committed each year to deal with new legislative requirements. "Over the last 30 years the EU has generated over 300 directives, regulations, decisions and recommendations relating to chemicals and consumer protection, occupational health, environmental protection, process and transport safety and the management of chemical substances" CEFIC review 2002-2003. To minimise the cost of regulatory compliance operators need to do what they can to combine the various assessments required for the current and future legislation. The speaker will discuss whether this is feasible - can one risk assessment suit all requirements? If so, what is the most appropriate framework for risk assessment? The speaker will use a case study to demonstrate how an IEC 61508 assessment was expanded to include the requirements of Seveso II, ATEX, IEC 61508 and Criticality. The benefits of this approach will also be discussed, in particular the holistic approach that can then be adapted to generating and prioritising improvement programs.

Introduction

The European Commission has over the past years issued various directives on the safety of pressure equipment, explosion prevention and safety devices. Guidelines have been developed to maintain the required safety levels by risk based inspection and maintenance.

These directives and guidelines are often dealt with on an individual basis. However, to minimise the cost of regulatory compliance operators need to do what they can to combine the various assessments required for the current and future legislation.

Aker Kvaerner provides tools, methodologies, verification and independent consultancy to comply with the individual directives and guidelines. This paper will in particular consider the requirements of ATEX, IEC 61508 and the Pressure Equipment Directive and their interrelation and approach to integrate these requirements in a framework risk assessment.

The need for EC directives

The need for European Directives on safety and control of risks is very much dictated by severe accidents in the past and presence involving lethality, injuries. For the operators loss of production facilities, social acceptance and insurance premium reductions are motivators to comply with the directives in a pro-active and integrated way.

In the offshore industry the explosion on the Piper Alpha platform in 1988 with 167 casualties tricked the requirement for "safety Cases" for al existing and new built platforms in the North Sea

For refineries the generic frequency of Major explosions is 2 per year according to the API

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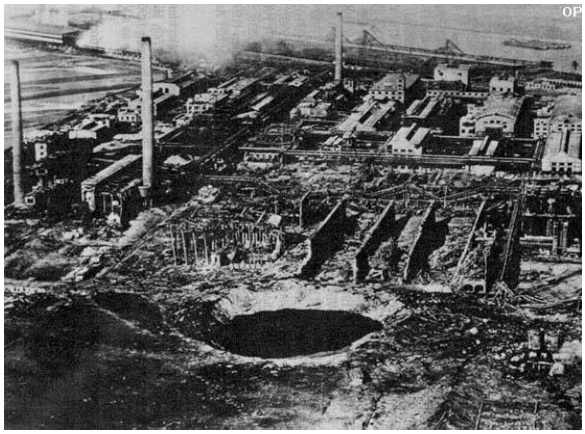
Major accidents in the Chemical Industry gave rise to the SOVESO II and ATEX requirements.

Some historical and recent major accidents are depicted below:

Piper Alpha platfom. 1978

Skikda Refinery, 2004



Opau, 1928

Bophal, 1984

Mexico City, 1984

Blaye, 1997

European Directives

A selection of recent legislative requirements as issued by the European Community in the form of Directives and ratified within the European Member States is listed below:

- Identification and compliance with legislation (EHS)
- Periodic Hazard Reviews (EHS)
- Job Safety Assessments (EHS)
- Periodic Review of Seveso II Safety Reports (EHS)
- IPPC improvement plans (EHS)
- Groundwater monitoring plans (Labs)
- ATEX mechanical and electrical inspections (Inspections)
- PED Vessel and Pipe work inspections (Inspections)
- IEC 61508 Proof Test of Instrumented Protective Systems (Maintenance).

The European Directives are not prescriptive, but rather setting goals.
General duties are established and implementation thereof is left to the company and manufacturers.
Risk Assessment is however the cornerstone of the European directives

Reliability and Production Solutions

Companies aim for performance improvement of their production in a cost effective way by increasing reliability of their facilities by means of good engineering practises, overall equipment efficiency improvement, cost effective inspection and maintenance.
Some of the methods and tools applied are listed below:

- Good engineering practises based on life cycle economics
- Piping System Integrity Analysis (PSI)
- Quality Assurance and Control Systems and Procedures
- Overall Equipment Efficiency improvement (OEE)
- Risk Based Inspection (RBI)
- Reliability Centred Maintenance (RCM)

These techniques are voluntarily used and aimed at life cycle cost optimization, but are implicitly techniques resulting in safer operation, inspection and maintenance.
Interesting enough, most of these engineering and production tolls and methods are based on Risk Assessments!

Integrated Risk Assessment

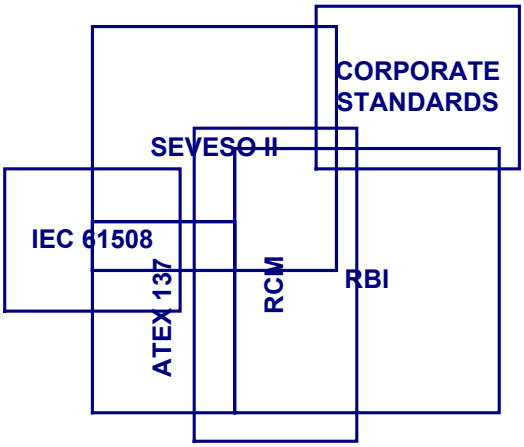
Considering that Risk assessments forms the same denominator for both the compliance with European Directives and Reliability and Production Solutions, forms the basis for an interrelation and approach to integrate these requirements in a framework risk assessment.
Question is to what extend one risk assessment gives compliance with all Directives, legislation and Engineering practises.

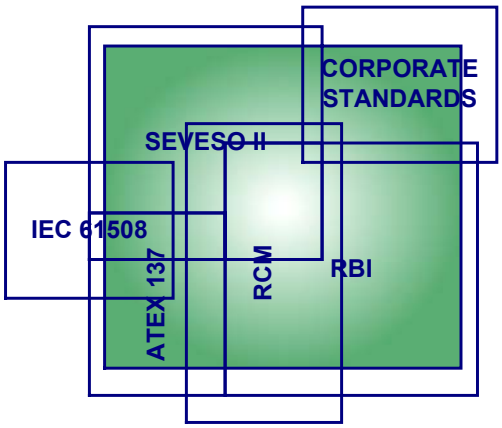
The generic risk assessment definition is outlined below.

A risk assessment should:

- Identify **HAZARDS**
  - Seeking out the identifying hazards is an essential first step in risk control
- Evaluate the **EXTENT** of the **RISK** involved
  - Likelihood of harm/reliability occurring
  - Potential Severity of harm/damage
  - Number of people exposed/ production loss
- Take account of **PRECAUTIONS** and their **EFFECTIVENESS**

The integration of risk assessments for the directives and engineering practises are very familiar and complementary to each other and can in principal be integrated as depicted below:





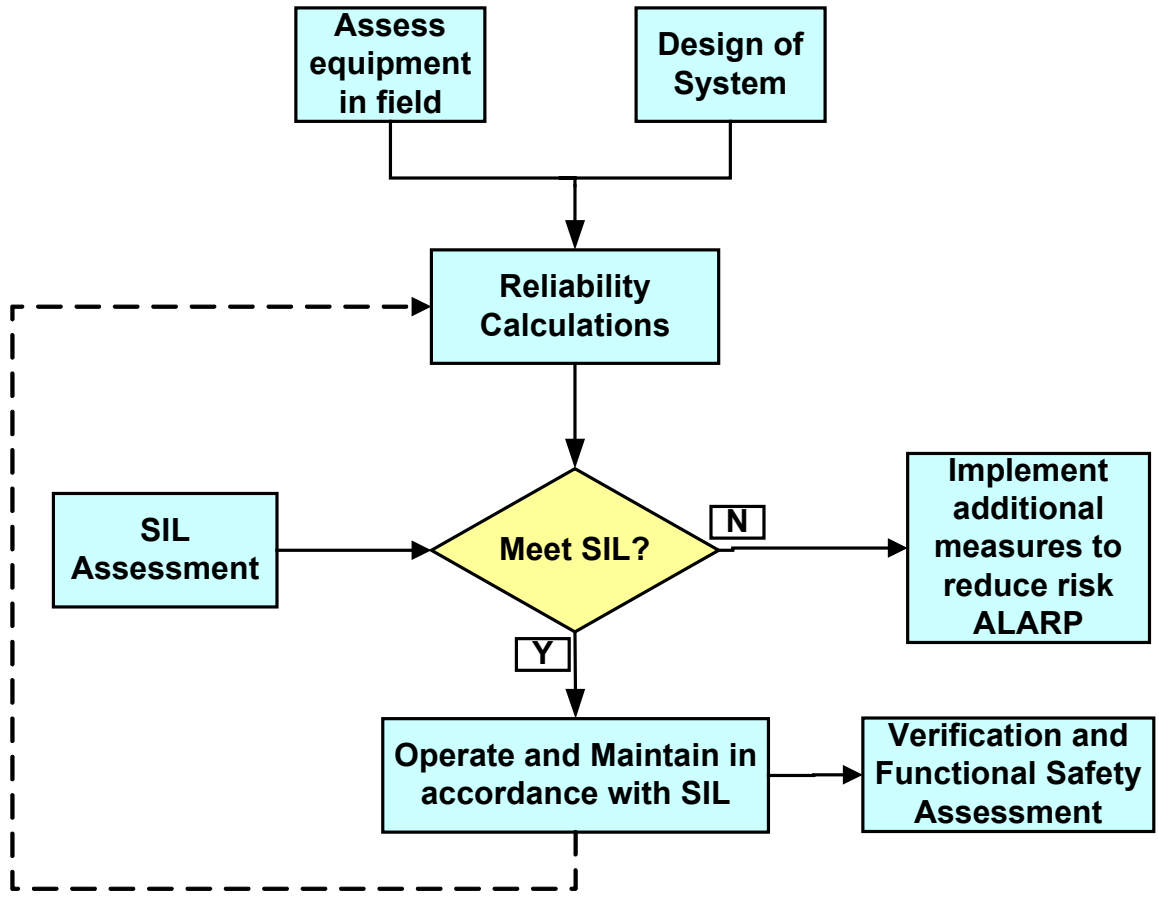
Multiple Risk and Criticality assessment

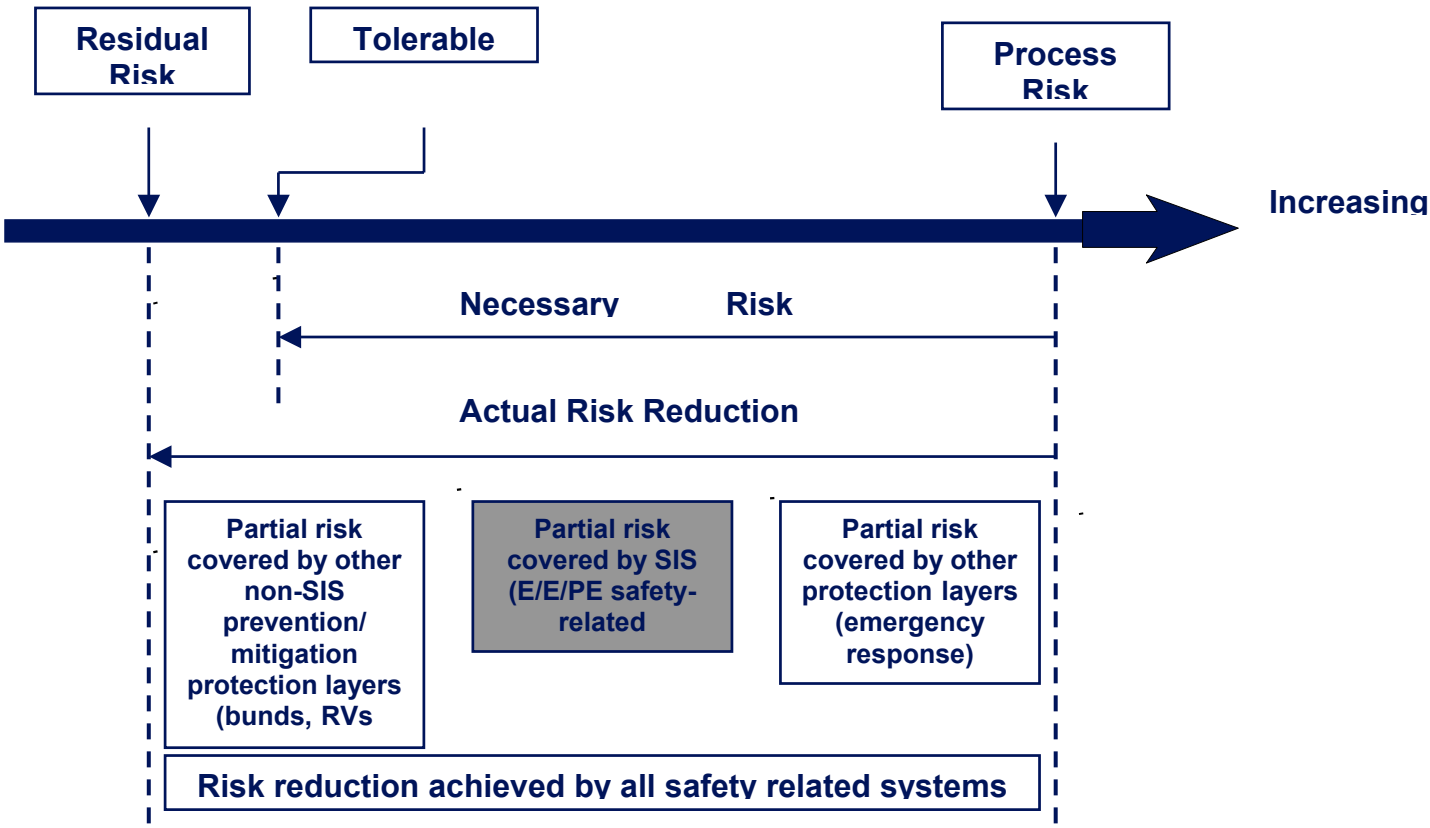
Single Risk & Criticality Assessment

A single risk assessment can be used as the basis for many of the legislative requirements. The IEC 61508 provides one basis that can be used for other risk assessments, whilst criticality can also be included in the assessment

The IEC 61508, also know as SIL classification approaches the risk assessment in a more or less integrated way, not only considering instrumented protective systems as a tool to reduce risk, but also other technical and procedural measures contribute to the risk enhancement as depicted below.

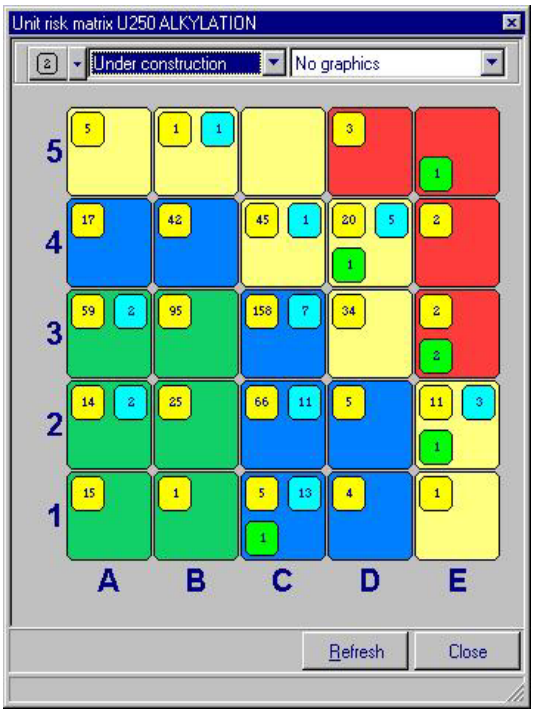
Outcome of the risk assessments are inspection regimes such as Risk Based Inspection and maintenance strategies like Reliability Centred Maintenance
The development of appropriate integrated software tools are useful, but have to be considered as tools and not developed or used as artificial intelligence black boxes, human intelligence and interrogation by skilled HSE experts is and will be required to fully comprehend the integrated risk assessment method.


Assess equipment in field
Design of System
Reliability Calculations
SIL Assessment
Meet SIL?
N
Y
Implement additional measures to reduce risk ALARP
Operate and Maintain in accordance with SIL
Verification and Functional Safety Assessment


Residual Risk
Tolerable
Process Risk
Increasing
Necessary Risk
Actual Risk Reduction
Partial risk covered by other non-SIS prevention/ mitigation protection layers (bunds, RVs
Partial risk covered by SIS (E/E/PE safety-related
Partial risk covered by other protection layers (emergency response)
Risk reduction achieved by all safety related systems

Typical outcome of a Risk based and Reliability Centred Maintenance Risk Assessment are in the form of a criticality matrix as depicted below.

Likelihood

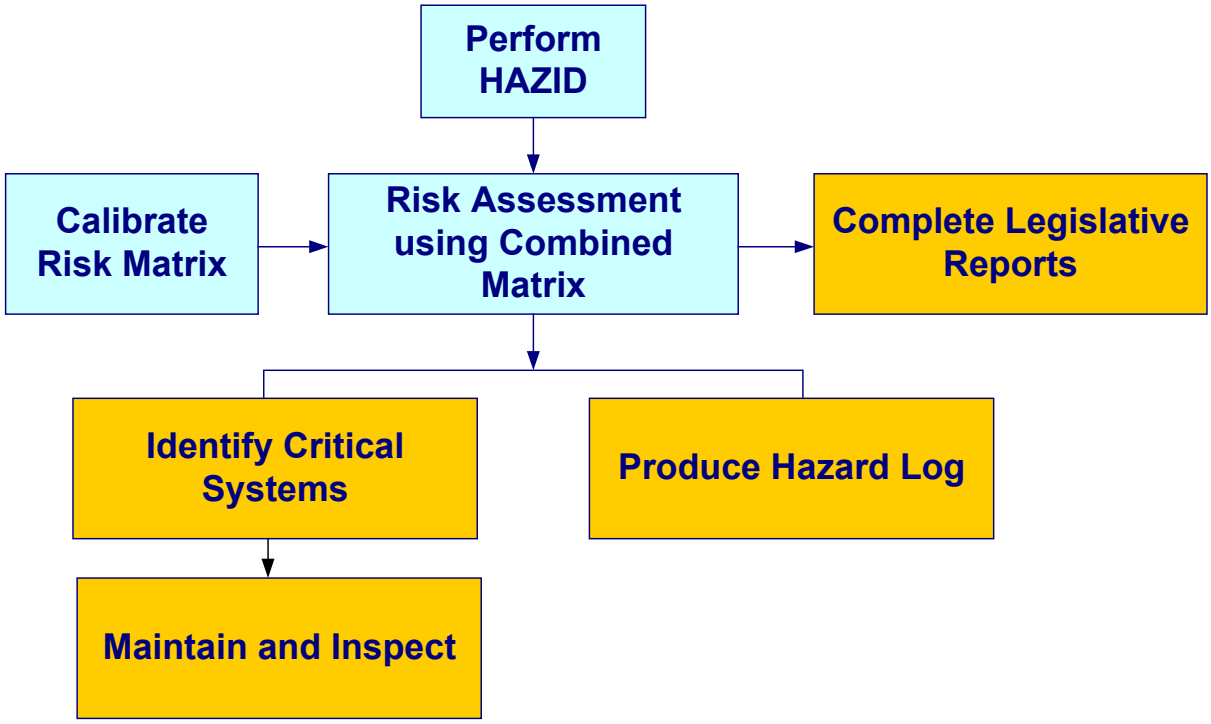


Gravity

Benefits of an integrated single Risk and Criticality Assessment are:

- Less duplication of effort
- All risks considered
- Trade off between risks considered
- One assessment, one dossier
- A central register of hazards and risks – hazard log
- Easier to maintain
- Significant cost savings by optimising maintenance and inspection work

The execution procedure of an integrated risk assessment is schematically depicted below:



The identification of potential hazards related to risks in terms of accidents, environment and production is the first step of the procedure.

An integrated calibrated risk matrix forms the basis for a single combined risk assessment resulting in the identification of critical systems and remedial actions in the form of additional protection layers, intensified inspection, maintenance strategies and form, Preventive/Corrective)

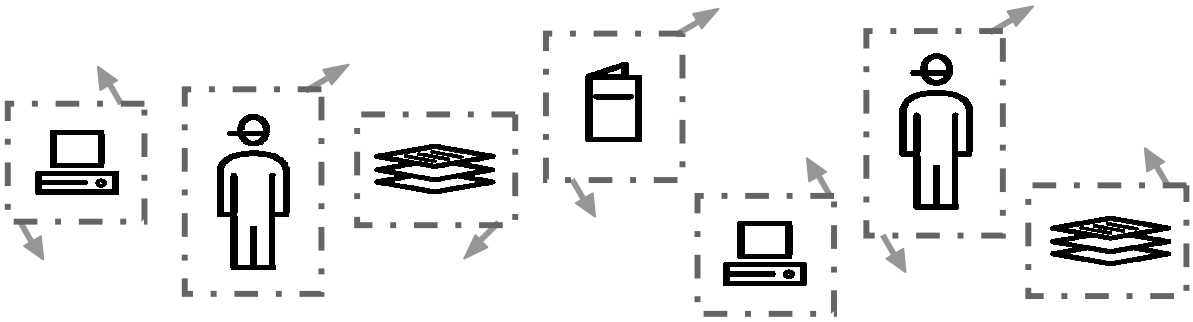
In case of mitigating actions or protection, the risk assessment should be repeated to assess the effect thereof and residual risk to be compared with the risk criteria.
The risk assessment forms also the basis for completion and reference for the required legislative reporting.

The hazard log also results from the risk assessment and should be reviewed on a regular basis.
In case of extension or modifications this process has to be repeated and reported.

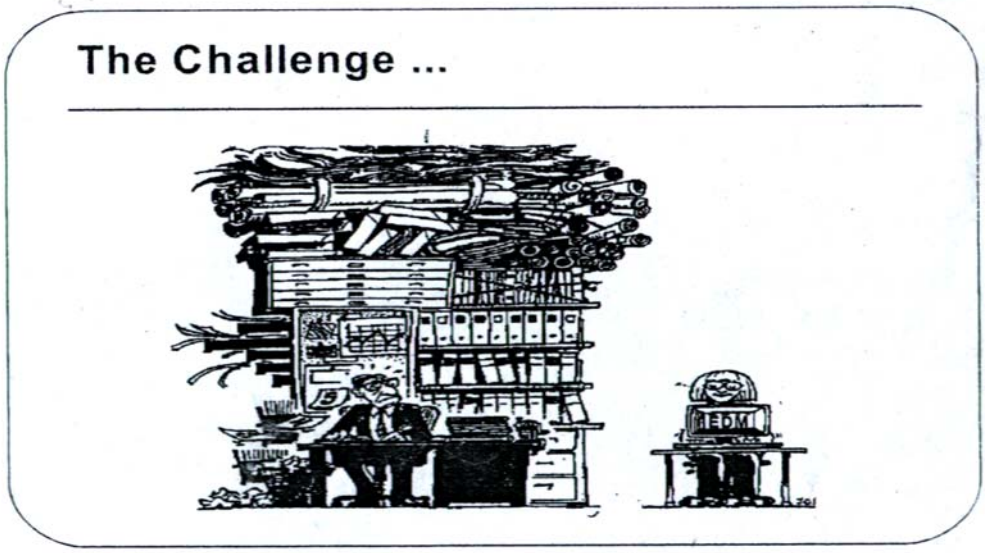
Engineering Document Management System

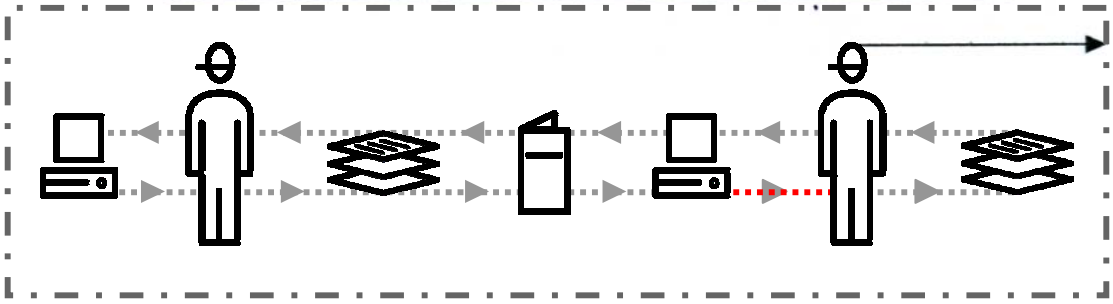
An essential part of the work is to identify and manage the engineering, procurement, production, inspection and maintenance documents. In many cases this documentation is available in many forms, from blueprint up to digital format and in various libraries.
The as built status and consistency of the documents is essential not only for fulfilling the requirements for the legislative reporting, but also for the inspection and maintenance procedures and in case of extensions and or modifications to the facilities.

Having the engineering and documents management system up to standard is a tedious but necessary exercise of which the costs should not solely be subscribed to any of the documentary requirements but as a collective QA effort and burden.



Scattered knowledge → Inconsistent actions → What Work? At What time?





business process and Consistent organized way to capture and use information. Integrated Risk Assessments → actionable knowledge Information System provides easy access to a Common Knowledge Repository → consistent action ***The Right Work at The Right Time***

In conclusion

- The challenge is to comply with Directives and Regulations at minimum cost.
- We have looked at the potential for combining risk assessments to minimise the number of assessments carried out and produce consistent output.
- The objective is to create the right work at the right time by the right people
- A joint industry effort is needed to arrive at the integrated approach objectives