Health and Safety: Guidelines for Risk Assessment and Management

Task 4.3 of WP4 from the MERiFIC Project

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Written by

David Haverson & Dr Patrick Foster (University of Exeter)

invention to reduce it. If the risk is small, insistence on great expense would not be considered reasonable.

The above can be used across all layers in the 4 layer model, with the exception of the consideration of individual “major hazards” (high consequence-low likelihood events) that may be undertaken at the top two levels. Here there should be some more formal consideration of acceptability and this is starting to be done with Bow Tie Analysis diagrams and Control Effectiveness techniques.

3.4.5 Treat the Risks

If there is a need to reduce risk further then the risk assessment team needs to consider possible new controls. When considering what remedial actions are to be implemented it is important that consideration is given the hierarchy of risk control, which is adopted in many regulatory approaches, as outlined in Table 3-1, below.

Elimination	Remove the hazard so consequence is virtually zero
Substitution	Replace or reduce the magnitude of the hazard so there is less consequence (note that replacing introduces a different hazard)
Separation	Remove the hazard or the target at the time of exposure by design (not procedure which is an Administrative Control)
Engineering Controls	Reduce the probability of the unwanted event through hardware design
Administrative Controls	Reduce the probability of the unwanted event through procedural approaches
Personal Protective Equipment	Reduce consequence at the target

Table 3-1: Hierarchy of Controls

Such a hierarchy reflects that eliminating the risk and controlling the risk at source, by the use of engineering controls are more effective than those that rely solely on people. When identifying such remedial actions, the Team must consider the following:

- Will the revised controls if successfully implemented and adhered to reduce the risk to a level that is as low as is reasonably practicable?
- Are any new hazards created?
- Will the revised controls be used in practice and reduce the risk of the hazard occurring to a level that is as low as is reasonably practicable.

3.4.6 Monitor & Review

Monitor and review refers to the critical need for ensuring that existing or new controls are in place, as well as ensuring that the hazard or conditions that might affect the risk have not changed. This is a regulatory requirement and generally monitoring and reviewing can be informal or formal. Auditing and incident investigations are both examples of monitoring tools that can be used.

This area is often found to be very weak in industry risk assessment studies. It tends to lead to loss of continuity and eventually the need to repeat the whole risk assessment process from scratch. It generally represents poor management commitment to maintaining the process treating it as such as a ‘one off’ and/or ‘paper exercise.

3.5 Risk Assessment Team

3.5.1 Purpose of Team

Risk assessments should not be carried out by individuals drawing up hazardous scenarios from their own experience of the job. Risk assessments are most valuable when they are carried out by a small multi-disciplinary team consisting of individuals from different levels in the organisation who are associated with the boundary that is being assessed. This team should be made up of a range of people representing a ‘vertical slice’ of the organisational structure associated with what is being assessed. This can typically include:

- Facilitator
- Corporate Management
- Operations Manager
- Shift Supervisors

- Machine Operators/Technicians
- Technical Engineers (electrical, mechanical etc.)
- Equipment Suppliers

Each risk assessment team should be led by a competent facilitator in order to ensure that the assessments are consistent, of high quality and at an appropriate level of detail. Before a risk assessment is undertaken the facilitator should gather together as much information, relevant to the boundary that is being assessed, as possible. The facilitator should be familiar with the risk assessment process that is being used. The person does not necessarily have to be fully familiar with the area being assessed as their role is to steer the Team during the assessment, rather than lead them.

Due to the specialist nature of renewable energy, it may be appropriate to have a representative from the equipment manufacturers as they have the best technical understanding of their product, especially if additional controls are required. For example, additional fire suppression technology is becoming an area of increasing interest in wind turbines yet it is not necessarily standard equipment.

When conducting risk assessments at Layer 1, of the four layered model (Figure 3-2) the purpose of an overall project assessment is to ensure a consistent and minimum standard of control across the site. The working group should reflect this by being made up of a broad cross section of individuals. This should include Senior Management, safety, engineering & specialist staff, as well as representatives from the supervisory and operator level.

At the other end of the scale, assessments at Layer 4 are more focused at operational/task level assessments and should be more focused more on getting input from those who face the hazards on a daily basis. This should include supervisors, artisans, workmen and safety representatives etc.

For the occupations/persons that have been identified for the assessment it is vital that management should send along experienced and appropriate people to participate in a team, in order to gain the full benefit of the assessment. Inexperienced people and employees who are on restricted activity days may be more readily available but do not necessarily represent the most appropriate people to participate in the assessment.

3.5.2 Training for Risk Assessment

All employees involved in a marine energy project should be aware of the risk assessment process in place at each life cycle stage. Training provisions are one of the primary mechanisms by which this objective should be achieved. Training for risk assessment should, as a minimum, be provided at the following three levels:

1. **Risk Assessment Sensitisation:** To be provided to all employees this level of training should focus principally on continuous risk assessment, and how employees can employ risk assessment principals in their everyday lives (work and social). This sensitisation process is particularly suited to inclusion in both new employee and post leave induction training.

2. **Working Group Training:** To be provided for prospective members of a risk assessment team prior to an assessment being carried out. The training should provide sufficient insight into the risk assessment process to enable all working group members to make a meaningful and effective contribution. Working group training is potentially most effective when delivered at the beginning of a working group exercise by a competent facilitator.

3. **Advanced Training:** To be provided to all senior managers, facilitators and safety specific staff The training provided must address both the theoretical and practical elements of the risk management process, in particular, how the process is implemented and works in practice during the project.

In the context of the four layered model of risk management, risk sensitisation should be provided to all those involved at level 3 and 4 with every-day informal risk management and routine work processes. The working group training should be provided for those who will help contribute to project risk assessments at layer 2. The advance training is for those who will become facilitators and lead the working groups at all levels.

A mechanism to assess training effectiveness in meeting well defined objectives is essential. To ensure that required training standards are met and maintained it is necessary to identify and document training objectives and key learning points for each course.

For **Risk Assessment Sensitisation**, the primary training objectives should be to provide employees with an understanding of:

- The ideas and concepts behind risk assessment and how they are used.
- How risk assessments are used to help ensure health and safety during the project and the associated legal requirements.
- Their responsibilities for health and safety and the need for continuous risk assessment.
- The roles and responsibilities of management and employee representatives in the projects risk assessment process.

For the **Working Group Training** the overall objective of this training is to provide employees who are about to participate in a risk assessment working group with a sufficient understanding of the risk assessment process to enable them to make a positive contribution towards the production of a 'suitable and sufficient' assessments of risk. The primary training objectives will include providing team members with an understanding of:

- The ideas and concepts behind risk assessment and how they are used.
- The definitions of hazards, controls, control shortcomings and risk and how they will be identified.
- The project risk assessment process and recording form(s).
- The boundaries of the risk assessment they are about to undertake and the hazards that may have already been addressed by previous generic assessments
- The roles and responsibilities of management and employee representatives in communicating their assessment findings and implementing action plans.

The **Advanced Training** should be designed to meet the needs of project management and safety staff, and other personnel who require a more detailed understanding of the process such as, full time health & safety representatives and members of any health and safety committees. The objectives of the Advanced Training are to provide senior staff with a detailed understanding of the whole risk assessment process as used during the project in particular:

- the roles and responsibilities of persons with respect to risk assessment.
- organising and undertake ‘suitable and sufficient’ risk assessments
- evaluating and managing the information produced in risk assessments
- facilitating risk assessment working groups

More discussion on the content of these three levels of course is given in Appendix 1.

4 Risk Assessment and Analysis: Tools for Managing Risk

4.1 Types of Risk Assessment

When undertaking risk assessments, there are two further types of assessment depending on what you are assessing, and these are referred to as being either 'routine' or 'pre-emptive' risk assessments. Routine risk assessments are assessments undertaken on existing operations, equipment or activities (levels 1 & 3 in the four layer model), whilst 'pre-emptive' risk assessments are those undertaken on new operations or equipment (layer 3 of the four layer model). This distinction is important due to how control measures are considered.

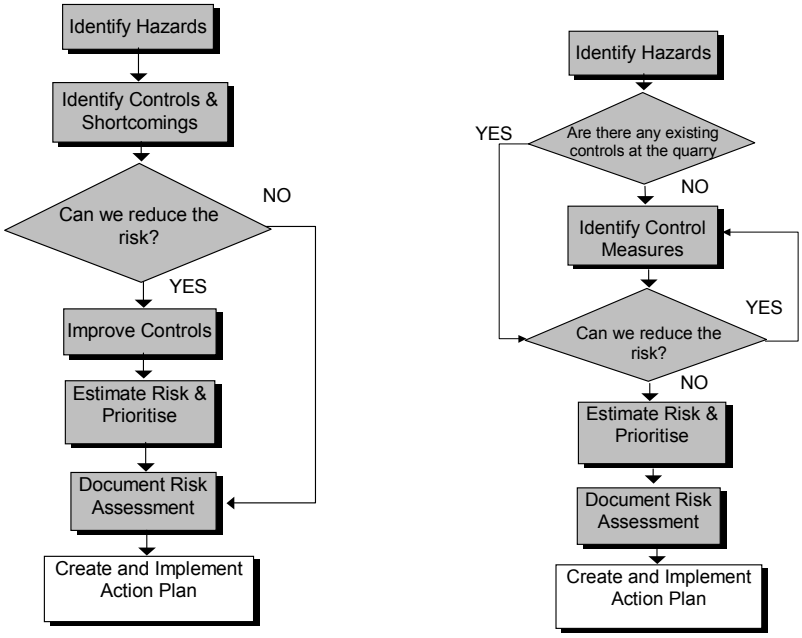

Figure 4-1: Routine Risk Assessment Process & Pre-emptive Risk Assessment Process

In existing activities where routine risk assessments are carried out, control measures are already in place and so the focus here should be on reviewing their effectiveness. For new operations 'pre-emptive' risk assessments are to be undertaken as no controls

are in place and the emphasis is on identifying new control measures. These differences are expanded upon below.

4.1.1 Routine (current operations)

Within industry there is a wealth of control measures that have been introduced over years of development. Accidents that occur highlight shortcomings with control measures. In a risk assessment, when identifying what controls are currently in place, it is vital to review the effectiveness of each control, to identify any shortcomings, and to assess how effective they are in practice. For example, if personal protective equipment (PPE) is identified as a current control measure but is infrequently worn, then its reliability as a control must be questioned. It is not sufficient to try to solve the problem by recommending 'enforce the use of PPE'. It is necessary to determine why the PPE is not worn and often this root cause then provides the route to an effective solution. Another example is with standard procedures which are among the most common hazard control measures used in quarrying. If a control shortcoming is identified as, 'procedures not being followed', the effective solution is often not as straightforward as enforcement, or discipline, or re-training.

Where a "failure to follow standards" is identified, it is necessary to determine why they are not being followed. There is a need to ask questions such as[14]:

- Are the procedures practical?
- Does everyone know the rules?
- Has everyone been trained?
- Is the training effective?
- Is the supervision effective?
- Do people "turn a blind eye" to rule breaking?

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[14] P.J. Foster, H.J.M. Rose & C.F Talbot (1998) Risk Assessment: An Opportunity to Change Health & Safety Performance. Journal of South African Institution of Mining & Metallurgy, Vol 98, No 7.

In a routine risk assessment, some assessment of the reliability of current control measures must be undertaken. Although this can seem like quite a daunting task it is not as difficult as it first appears. Although situations may be encountered where expert advice is required to assess or improve control reliability, on most occasions the experience of those who supervise or does the job will provide the answers. There is the element of a safety inspection to this approach but this is necessary if the assessment is to be effective, more than just a piece of paper, and play any role in improving performance.

By following the process in the figure, once hazards, controls and shortcomings are identified, the assessors can ask the vital risk assessment question "*can we do any more to reduce the risk*" bearing in mind what has been found. Additional controls or control improvements can then be identified and implemented if the answer to this question is 'yes', the risk can be estimated (using scales or matrices) and the assessment documented.

4.1.2 Pre-emptive (new operations)

The objective of pre-emptive risk assessment is to pre-empt potential health and safety risks by ensuring that they are adequately controlled from day one of a new or changed operation. Such assessments may need to be done in abstract and the primary emphasis is on potential hazards. Important factors to note are:

- Following the identification of potential hazards, the assessors have to consider whether there are any current control in place at the quarry, which would eliminate or reduce the risks.
- If there are no controls or existing controls do not reduce the risk to an acceptable level (i.e. ALARP) then the assessors need to consider appropriate additional control measures to eliminate or reduce the potential risks.
- The Assessors must then consider whether the proposed controls once in place are likely to reduce the risk to the acceptable level.

4.2 Risk Assessment Tools

There are a wide variety of risk assessment tools available, some of which were introduced in Section 3.4.2. However, not all are necessary for the marine energy sector. For example, HAZOP (a Hazard and Operability Study) is a tool for assessing process based activities, which are not found in the marine renewable energy sector. After consideration, the four main risk assessment tools considered are:

- Workplace Risk Assessment and Control
- Bowtie Analysis
- Job Safety Analysis
- Failure Modes and Effects Analysis

This Section shall detail the methodology of each tool and provide example templates in which to conduct these processes.

4.2.1 Workplace Risk Assessment and Control

The WRAC process is a risk assessmentl method that was developed and widely used in the mining industry. It is a column based risk assessment whereby the risk is assessed as a culmination of the likelihood, or probability, of a hazard occurring and the consequence of that hazard occurring.

It is a useful tool for identifying general risks/events and can be used on a wide scale of situations, providing the scope of the assessment is properly defined. This allows risks to be prioritised. It is also often used a method for determining issues/events that require further detailed studies, i.e. major hazards. This will be discussed later in this chapter.

In the offshore industry, it is typical that a single offshore platform encompasses a complex system with simultaneous operations and processes. As such, it is appropriate to divide up the platform into sections, with clear boundaries, so that the risk assessment is not overly broad and does not miss any hazards. For renewable projects, it may be appropriate to either break up the assessment into components, such as differentiating between onshore and offshore activities, and/or between the different life cycle stages of the project.

Figure 4-2, below, provides an overview of the process of a WRAC.

Figure 4-2: WRAC Process

The recording and presenting of the assessment can be split into two parts: risk exposure and the action plan. These are shown in Tables 4-1 and 4-2. A full example of WRAC form can be found in Appendix 2. Table 4-1 represents stages 2-4 in the process, whereby the hazards are listed in a column with their corresponding existing controls, rated likelihood, consequence and the resulting risk rating.

Risk Exposure						
No.	Phase in Project	Unwanted Event	Current Controls	Likelihood	Consequence	Risk Rating

Table 4-1: Risk exposure element of WRAC Form

Table 4-2 represents stage 5 whereby if the risk rating for a particular hazard is not deemed acceptable, then appropriate measures can be taken to reduce the risk further.

Action Plan				
Improvements/ Additional Controls	Acceptable ?	Agreed Action	By Whom	By When

Table 4-2: Action plan element of WRAC Form

Scope

All successful risk assessments start with proper prior planning. Being prepared before undertaking an assessment will help keep the task on track and avoid unnecessary discussions.

Identify the Hazards

A useful way of identifying hazards is to use energy analysis. The principle behind energy analysis is this: for an injury to occur, a person must be exposed to an injurious influence – a form of 'energy'. This may be a moving machinery part, electrical voltage, etc. In using this method, the concept of energy is treated in a wide sense. Energy is something that can damage a person physically or chemically in connection with an event. An injury occurs when a person's body is exposed to an energy that exceeds the injury threshold of the body.[15]

Examples of the different type of energies can include:

- Physical – noise, vibrations
- Gravitational – can anything fall over/down, collapsible, engulfment
- Mechanical – moving parts (nip points, snag points, etc.)
- Pressure – water, hydraulics, pneumatic
- Electrical – AC, DC, static
- Chemical – gas cylinders, chemical substances
- Radiation – hot/cold surfaces
- Biological – presence of dangerous wildlife
- Locational – above water, difficult access, confined space
- Biomechanical – climbing/crouching/crawling activities

Identify the Controls

Whilst many marine renewable projects may start from scratch, there may well be existing corporate procedures and practices for dealing with certain hazards. Experiences of working in the marine environment, from industries such as oil & gas, have led to wide understanding of how to deal with existing hazards. The challenge for developing a pro-active risk management environment is to identify potentially new hazards that have not yet occurred and as such there may not be existing controls.

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[15] Harms-Ringdahl L. (1993) Safety Analysis: Principles and Practice in Occupational Safety, London: Elsevier Applied Science.

Analyse the Risks

The most commonly used method for analysing the risk in a WRAC is the risk matrix. This is a qualitative method whereby the risk is rated as a function of its likelihood and consequence. This gives a risk score that is indicative of priority of risk, rather than acceptability. A typical risk matrix is shown in Figure 4-3, and their uses are discussed more in Section 4.3.1.

Event Risk Rating					
Consequence / Likelihood	1 Minor	2 Low	3 Medium	4 High	5 Major
5 Almost Certain	Medium (19)	Significant (10)	Significant (6)	High (3)	High (1)
4 Likely	Medium (20)	Medium (16)	Significant (9)	High (5)	High (2)
3 Possible	Low (23)	Medium (18)	Significant (13)	Significant (8)	High (4)
2 Unlikely	Low (24)	Low (21)	Medium (15)	Significant (12)	Significant (7)
1 Rare	Low (25)	Low (22)	Medium (17)	Medium (14)	Significant (11)

Figure 4-3: Risk Matrix

Review

The review stage is a further reflection of the general risk management process as shown in Figure 3-3, that the risk assessment process is an iterative process. Once a risk rating has been identified for a hazard, the next question is whether or not that rating is acceptable? If the risk is not acceptable, can the risk be reduced by further controls? If further recommendations are required, it should be recorded and an action plan should be devised as to when and who should make those improvements.

Report

Once the risk assessment is completed the results need to be recorded. The results should be reported in two ways. The first is to compile all the hazards and their associated documentation into a risk register. The risk register provides a record of all the risks that are present throughout the project/site and is a useful tool for reviewing

hazards on a routine basis. It allows management to build up a portfolio of experiences to quickly assess hazards for new and similar projects.

Along with a risk register, the results of an assessment should be used to produce a report. The purpose of the report is to document everything the team has done. It should reflect the need of the assessment and the process of how it was achieved. It should record all the hazards that were considered and all the subsequent recommendations that were made as a result.

The report should be conducted in two phases: an initial draft and a final submission. The purpose of this is that it allows the management to digest all the information from the draft report and consider all the recommendations. The final report should, therefore, reflect this consideration. Along with all the information from the initial draft, the final copy should include the decisions made by management. If management have rejected any recommendations, then it needs to record why they were rejected.

As an example, the structure of a final WRAC report could look like the following:

- Introduction
- Description of the methodology used
- Objectives and Scope of the assessment
- Description of the operation/process studied
- Major recommendations
- Major actions taken
- List of recommendations rejected and why
- List of recommendations being evaluated and expected timings of follow-up actions
- WRAC log sheets

4.2.2 Bowtie Analysis

The key difference between a WRAC and a bow tie analysis is their level of detail. WRACs are useful tools for identifying hazards more generally, across a project, and highlight which events require further investigation. Bowtie analysis is the tool which allows a particular priority or major hazard event to be broken down further in to much

more detail. Example events that would require a bowtie analysis could include tower collapses and mooring failures.

Describing the analysis as a bowtie comes from the shape of the diagram used to explain hazardous events, as shown in Figure 4-4. the bowtie method was an evolution of combining a fault tree analysis and event tree analysis. The basic structure consists of four main parts. The main hazardous event is placed at the centre of the diagram. A list of all the different causes that can lead to the central event, are spread to the left. A list of all the potential consequences, as a result of the event, are spread out to the right of the central event. Finally, separating the causes and consequences from the main event are the controls.

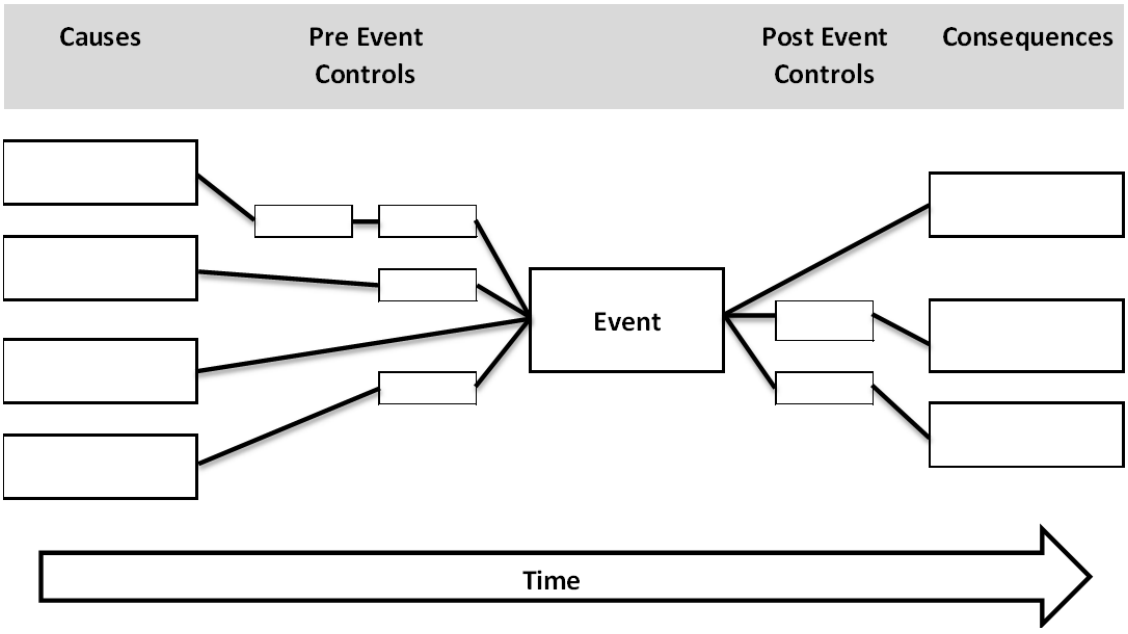

Figure 4-4: Bowtie Diagram

Figure 4-5, below, provides an overview of the process of a bowtie analysis.

Figure 4-5: Bowtie Process

Identify Major Hazards

The level of detail to which a particular hazard can be analysed through a bow tie provides a very comprehensive understanding of a particular hazard. However, it would not be appropriate to undertake a bowtie of every hazard. As such, there should be a criteria for identifying those which are considered major hazards.

The WRAC process offers the best way for identifying major hazards. Using the risk matrix, as discussed in the previous chapter, any hazard that results in a consequence in the final two columns should be regarded as a major hazard, regardless of the likelihood of the event occurring. This means by the definition of this guideline, a major hazard is an event that will result in a permanent total disability, a single fatality or multiple fatalities.

	Consequence				
Likelihood	**1 Insignificant**	**2 Minor**	**3 Moderate**	**4 Major**	**5 Catastrophic**
5 Almost Certain					
4 Likely					
3 Possible					
2 Unlikely					
1 Rare					

Table 4-3: Major Hazard Identification

Identify Causes

Initial risk assessments, such as WRACs, only focus on what can go wrong with a hazard and when it does. A detailed assessment, such as a bowtie, is about understanding why it will happen/what will cause it to happen.

Identifying causes to an event is similar as identifying hazards in a WRAC, by identifying the different energies that have the potential to cause the realisation of the event. The causes should be a comprehensive list of all the potential causes regardless of the likelihood of them occurring. However, potential causes go beyond just the different energies. Potential causes also include such things as uncertainty in design or human factors, such as incompetency.

Identify Consequences

The list of consequences should be a comprehensive list of all the worst case scenarios. Typically, the consequences of the hazards that are likely to be subjected to bowtie analysis will most likely cover harm to people or damage to the assets. However, as with the identification of consequences for a WRAC, the consequences can cover a spread of the different loss categorises be they financial, regulatory or reputational.

Examples of different marine renewable major hazards may include:

- Wind turbine tower collapse
- Vessel collision with wind/wave/tidal
- Helicopter crash
- Nacelle fire
- Moorings failure of a wave energy device
- Inrush of water during construction of a tidal barrage

It is clear that the consequences of all of these major hazards will have elements of physical harm to people and assets. However, it is important to recognise the significance of the reputational damage, to not only to individual projects but also, to the industry. Effective health and safety management is significantly stronger if it is widely and uniformly adopted across the industry.

Identify Pre/Post Controls

Once all the known causes and consequences have been identified, it is possible to start mitigating against them. It was previously mentioned, that there is a hierarchy to effective controls, as presented in Table 3-1. It is important that controls are considered on both

sides of the hazard. Pre event controls are only effective at mitigating against potential causes. In the result of the event occurring, only the post event controls will be effective in mitigating potential consequences.

Identify Additional Controls

An important feature to a bowtie is the realisation that there may be threats to controls. In certain scenarios it is possible that certain procedures can override certain controls or supersede other procedures to prevent hazards to concurrent operations. However, this is often when a combination of smaller events/incidents can lead to bigger and more serious events. Therefore, it is important to identify additional controls to potential threats to the initial controls.

It is important to note, that if a particular control has a large number of subsequent threats and additional controls, it should be questioned as to whether the initial control is appropriate and fit-for-purpose.

4.2.3 Job Safety Analysis

A Job Safety Analysis (JSA) is typically used for the general identification of hazards and controls for specific tasks when planning routine and non-routine jobs. It is the main method used for developing Standard Operating Procedures. Compared to other risk assessment methods, this method does not look at how or why hazards occur but is seen from the perspective of the worker undertaking the specific task. It is used to determine the hazards the worker is exposed to during the individual steps of the task. It is important to remember it is not the worker being analysed but the job they are undertaking.

Figure 4-6, below, provides an overview of the process of a JSA.

Figure 4-6: Job Safety Analysis Process

Identify Critical Jobs

It is important to distinguish between a hazard and a critical job. A hazard is anything with the potential to cause harm, whereas, a critical job is something that has the potential to cause harm when not performed properly.

The best way to analyse all the critical jobs is to first create a list or inventory of all the different tasks. Typically with the oil & gas sector, drill rigs can be physically large and have a wide range of concurrent operational disciples. Attempting to compile a list of all the critical jobs of the rig as whole, would be a daunting task, that may result is tasks not being identified. Therefore, the best approach is to break down operations into the different occupations. From there, it is possible to compile a list of each of the jobs within each occupation.

There are three main ways of identifying which jobs require further analysis. The first is based on their potential to cause harm. Tasks that have high consequences are obviously ideal candidates for further analysis and should take priority over lower consequence task. It is important, though, that even if there is no evidence of harm from certain tasks, if they have the potential for harm they should be analysed, regardless of their likelihood. This leads on to the second way to identify hazards: previous accidents. If there is a history of accidents with particular tasks then these tasks definitely require further analysis. The final branch of tasks is those that are new. If a task has never been performed before, then an analysis should be done. Effective risk management comes from being pro-active. Analysis of a new task should be done first, thus providing a useful tool for training workers on how to undertake the task safely.

Analyse Critical Jobs

The best approach to conducting a JSA is to be systematic and methodical. This allows the assessment to be thorough. Each job should be broken down into subsequent steps, such that each step is required so that that the job can progress from one step to the next. It is important to note that the steps include not just physical tasks, such as lifting, but also administrative steps, such as recording data and figures.

The analysis can be broken down into three parts, as shown in Table 4-4 below, which shows the JSA form that is used to help document the assessment. A full example of a Job Safety Analysis form can be found in Appendix 3.

Job/Task Step	Unwanted Events arising from or associated with the job / task step or equipment usage	Requirements (controls) to protect people from the identified Unwanted Events

Table 4-4: Element of Job Safety Analysis Form

The first step in the process is to record each step. It is good practice to record all the steps first, without the hazards and controls, allowing a clear flow of thought to the job. The hazards and controls can be recorded after. It is important that the description of each step is not too detailed but equally not too vague. The description needs to describe what needs to be done, not how it is done.

As with all risk assessments, the best assessment is conducted by a team of relevant individuals. The most appropriate people to conduct a JSA are a combination of the supervisors and the workers who conduct the tasks. Their knowledge and experience of the 'hands-on' work is invaluable.

Once every step has been identified, the team should systematically work through each step identifying their associated hazards. With a JSA, rather than considering hazards, it is better to think of them as unwanted events. For example, instead of the hazard being 'an object getting hot', the unwanted event would be 'the worker is burnt'. Every unwanted event should be recorded regardless of their likelihood. Identifying energies, as previously discussed, is a good method for identifying unwanted events.

Once all the unwanted events have been recorded, their respective controls can be identified. The controls need to protect those undertaking the task from the unwanted events of each step. As previously discussed the hierarchy of effective controls can be found in Table 3-1.

Develop Procedures/Practices

The purpose of undertaking a JSA is so to identify how a task can be performed correctly and safely. The information gathered throughout the exercise should not then be filed away but used to develop procedures and practices. A Standard Operating Procedure (SOP) is a useful training tool for workers. It sets out the importance of the procedure, how the job is done step-by-step, the various hazards a worker is exposed to during the procedure and the controls in place to protect them. The equivalent counterpart for practice is known as a Standard Working Practice (SWP).

It should be noted that there is a difference between procedures and practices. A procedure is a step-by-step guide of how and why each job step is undertaken. But, it is not always possible to produce a step-by-step guide to every job. Therefore, a practice is more of a guideline of how to undertake a job.

Maintain/Update

Once a JSA has been completed for a task, it should never be treated as 'set-in-stone'. Effective risk management is dynamic and has to reflect that the working environment is equally dynamic. JSAs need to be regularly reviewed, as part of the risk management process, as shown in Figure 3-3.

The wind industry is a relatively mature technology now, in that there has been a convergence on the typical design of three blade horizontal axis turbines. The changes to the technology are more to do with refining the technology, rather than any fundamental changes to design. As such, as older turbines are maintained or updated and new models are introduced in some of the new offshore wind farms, there is the potential for new equipment within the turbines. As with any new equipment, there may be variations to the way the equipment is safely operated. Therefore, if ever there is a change to a particular task, be it through a physical change or administrative change, then the JSA for that task needs to be reviewed and repeated.

When an accident has occurred, it highlights that there was a shortfall in the risk management. However, the accident does not initially reflect on whether it was a shortfall in the risk assessment, the standard operating procedure or a worker ignoring their training. Therefore, as part of the accident investigation, the JSA associated with

outcomes. It will highlight that either the JSA was not adequate in that it failed to protect the worker or that the worker was not following the correct procedure. If it was a problem with the JSA then new controls need to be identified. If it was not the JSA, then it needs to be established why that worker deviated from the correct procedure. It is important that, in this scenario, it is identified whether this was a shortfall in their training or whether or not they were not using the correct procedure because it was not appropriate. For example, a worker was not using their harness, for working at heights, because the harness impeded their work.

4.2.4 Failure Modes and Effects Analysis

As the name suggests, a Failure Modes and Effects Analysis (FMEA) is a process whereby a system can be analysed to understand how its components can fail and to what effect these failures can result in. There is also an extended technique known as a Failure Mode, Effects and Criticality Analysis (FMECA). The difference between the two methods is the 'criticality' component which effectively ranks and priorities the risks. This document will focus on the methodology of FMEA.

A FMEA is an effective tool for developing a maintenance plan for a device. It allows the assessment team to identify the need for predictive or preventative maintenance for the various system components. However, for the purpose of this guideline, it is only being considered for the purpose of risk identification.

The FMEA follows a similar approach to other risk assessment methodologies, as shown in Figure 4-7.

Figure 4-7: Failure Mode Effects Analysis Process

Scoping

It is very easy for a FMEA to become a lengthy and complex. However, as previously discussed, the key to a successful assessment starts with proper prior planning. By

taking the time to define the assessment and gather all the relevant information, it is possible to keep the task on track.

The first step is to define the system that is being studied. More importantly, the boundaries of that system need to be well defined. Note that it is not easy to conduct a FMEA on a multi-layered system. The system needs to be broken down into its components so that it is possible to identify what needs to be assessed.

Once all the components have been identified, the next step is to gather all the relevant information on the system a6.28.4( )]T[(y9)-3.5(c-5.7(a)-5.9(5.62.4(ion6.2(on.7(a.-6.229)-3.5(T)-677.7(t)8((t)

The first part to the form, which documents the pre-assessment stage, is shown in Table 4-5.

Identification Number	Item/Functional Identification (Nomenclature)	Function

Table 4-5: Pre Assessment Component of FMEA Form

It is vital to identify all the functions of all the components, in order to identify all the possible way in which a component can fail. When considering the function of a component, it is important to recognise that there may be multiple functions. The function can be categorised in three ways:

- Primary Function
- Secondary Function
- Parasitic Function

The primary function of a component is usually quite obvious because they usually have only one primary function. For example, a pump is required to maintain a flow rate of x amount.

Once the primary function has been identified, the next step is to determine, does this component have any other functions? The primary function of anti-fouling paint on a wave buoy is to stop the build-up of marine life, but maintaining the condition of the buoys aesthetics, i.e. the paint, could have a secondary function of maintaining the public perception of wave energy. If the public see 'run down' looking device when its brought to shore, they may question its long term suitability regardless of how it is actually performing.

Parasitic functions are those that are not necessarily required for the function to be completed and may have a detrimental effect on the performance. Parasitic functions can be divided into active and passive functions. Active parasitic functions are functions that are not necessary to the design but necessary for the function to be completed.

Passive parasitic functions are functions that are not required and could potentially be removed.

Assessment

There are a number of steps for the assessment component of the FMEA process. To help understand the process, the assessment component of the FMEA form is shown in Table 4-6.

Failure Modes and Causes	Failure Effects			Failure Detection Method	Compensating Provisions	Severity Class
	Local Effects	Next Higher Level	End Effects			

Table 4-6: Assessment Component of FMEA Form

The first step is to identify how a component fails. It may be possible that a component has a number of ways in which it fails to perform its function. A component can fail in two possible ways: functionally and physically. For example, take a wind turbine in cut-out wind conditions. A functional failure would be the anemometer failing to signal or indicate that the wind speed has reached the cut-out speed. A physical failure would be the brakes failing to stop the blades rotating.

The next step is to identify the characteristic of that failure. It is important to understand not just how a component is failing but also the nature of that failure. This will help later in the process when identifying means of identifying failures.

The next step is to identify the causes of failures. As there is the potential for multiple failure modes for one component, there is also, therefore, the potential for multiple causes. Rather than identifying generic causes, it is best to methodically work through each of the failure modes and identify causes to the specific failures.

It can be seen in Table 4-6, that when considering the effect of a failure, it should be considered in three areas:

- Local Effects
- Next Higher Effects

- End Effects

As an example, consider an attenuator wave device with a hydraulic power take off system. If a valve in the hydraulic system develops a leak, then the local effect would be a loss of hydraulic fluid. The next level effect would be a reduction of fluid in the accumulation reservoir. The end effect would be a reduction of power generation as less fluid is being pumped to the generator.

The first four columns of Table 4-6 provides the core information of the assessment. The remaining three columns further document key information. It is important to understand how a failure is detected. In the event of an incident, one of the outcomes of an accident review may be that the effects of a failure could have been prevented earlier in the timeline had the failure detection method been situated somewhere different. Therefore, by documenting the failure detection method, it allows the assessment team to consider whether the detection is ‘fit for purpose’ in its function and location

As with every risk assessment, once all the hazards have been identified, the next step is to identify the controls. The controls, or also referred to as compensating provisions in the Military Standard, should reduce the risk to ‘as low as reasonably as practicable.

The final step of the assessment is to determine the severity of each consequence. This is different to the effect of a failure. The severity is a qualitative measure on the effect on aspects such as equipment, the overall system, people and the business. Table 4-7 provides a summary of Failure Mode Severity Class according to the British Standard BS5760 Part 5:1991.

Severity Class	Effect on Equipment	Effect on System	Effect on People	Effect on Business
5	Definite or presumed destruction of equipment.	Complete loss of system capability.	Loss of life.	Major plant and production losses. Survival of business doubtful.
4	Complete failure of equipment and damage to associated systems.	40% to 80% loss of capability.	Severe injuries and long term damage.	Moderate plant losses. Total production loss until repaired.
3	Significant degradation of performance or substantial increase in operator workload.	10% to 40% loss of capability.	Moderate injuries with full recovery.	Minor plant loss but significant production losses.
2	Minor degradation of performance of equipment under consideration.	Less than 10% loss of capability.	Minor injuries.	Minor production loss. No plant losses.
1	No effect on equipment performance, usually unrevealed until strip down for other performances.	No effect on system.	No injuries.	No production losses.

Table 4-7: BS5760 Category of Failure Mode Severity Class

Post Assessment and Implementing

After the assessment has been completed, the final stage is to report the findings. During the post assessment, the assessment team should produce a draft report of their findings. The content of the report should follow a similar structure as set out in the WRAC process in Chapter 4.2.1.

It is important that any data used, for example with regard to failure rates, should be verified before the final report is submitted. The report as a whole should be reviewed and accepted by the entire assessment team.

The final report should be submitted to the relevant people in management. It is then the responsibility of management to implement the recommendations and findings of the report.

4.3 Risk Analysis

Risk analysis is defined in ISO31000:2009 as the process to comprehend the nature of the risk and to determine the level of risk. Risk evaluation is similarly defined as the process of comparing the results of risk analysis with risk criteria to determine whether the risk is acceptable or tolerable. In legislation this level of acceptability is determined by the requirement to reduce risk to a level that is “as low as is reasonably practicable” or ALARP. It is important to note from these definitions that risk analysis and risk evaluation are not the same, they are different questions, although in practice they are often done at the same time.

Risk Analysis involves determining the way to evaluate risk considering “how often” (probability or likelihood) and the consequences (or severity). As with the selecting the right risk assessment method, it is important to match the risk analysis method to the objective and expected deliverable.

4.3.1 Matrices

There are two types of risk analysis methods; qualitative and quantitative. In many industries, qualitative risk analysis, using a risk matrix approach, has historically been the most common method. In a risk matrix, a subjective evaluation is made on the two dimensions of risk to give a “risk score” that provides gross priority but not accurate risk acceptability guidance. An example risk matrix is shown in Figure 4-3.

4.3.2 QRA

Quantitative risk analysis, which is common in the petrochemical and nuclear industries, allows the probabilities of particular undesired events to be calculated. This offers a more objective identification of acceptability, but only if somebody (such as the Regulator) defines a level of acceptable risk (e.g. 1x10-6) that this probability can be

compared to. The objective and intended outcome of the analysis should determine which method is appropriate. Fault trees allow for the qualification of risk.

4.3.3 Control Assurance

There have also been recent developments in using control effectiveness techniques to analyse risk. This involves determining acceptability by demonstrating that controls in place provide an adequate level of protection for the inherent level of risk or consequence. An example of this is the Control Rating Code Method or Major Accident Control Analysis [16] where controls are considered as to whether they are “pre” or “post” event controls, where they sit on the hierarchy of risk control, and their effectiveness. An example of such as control effectiveness matrix is shown in Figure 4-8

EFFECTIVENESS MATRIX

CONTROL TYPE	LOCATION	EFFECTIVE	COMPETENCE	COMPLY	RATING
Design Control	On the Hazard	Total control of energies	All employees are conversant	Comply all the time	4
Engineering Control or Safety Device	In between	Proper control of energies	Most employees are conversant	Comply most of the time	3
Signs & Signals	On the target	Partial control of energies	50% of employees are conversant	Comply 50% of the time	2
Administrative Controls or Personal Protective Equipment	Remote	Little control of energies	Few employees are conversant	Most of the time they do not comply	1
None	None	No control of energies	Employees are not conversant	Do not comply at all	0

FORMULAE

Control type + Location + Appropriate rating + Competence + Compliance = Effectiveness Rating

EFFECTIVENESS RANKING

Ineffective	Limited effect	Partially effective	Effective	Highly effective
0 - 4	5 - 8	9 - 12	13 - 16	17 - 20
0 – 20%	24 – 40%	44 – 60%	64 – 80%	84 – 100%

Figure 4-8: Example Control Effectiveness Matrix

[16] Lawson S, Formal Safety Assessment Methodologies utilising Control Effectiveness Evaluation, in MineSafe International 2003, Perth, Western Australia, 12-15 October, Perth:Chamber of Minerals & Energy of Western Australia

5 Reviewing a Risk Assessment

As previously discussed, reviewing a risk assessment is an integral part of a proactive risk management strategy. The outcome of the review process is twofold: to firstly help identify any shortcomings in the risk assessment process and secondly improve the approach to future risk assessments. By achieving these to outcomes, it in turn helps promote a proactive risk environment.

The mining industry has a long history in developing risk management, with many of the latest risk assessment techniques coming from that process. The NSW Department of Primary Industries developed a guide to reviewing risk assessments of mine equipment and operations in conjunction to their corresponding guide to risk assessment. The following is a summary of that process[17].

Each person who reviews a risk assessment tends to develop his or her own approach. However, a sound approach has at least three phases:

1. a brief reading of the full report, with the aim of becoming familiar with the nature and scope of the assessment;
2. a more detailed study of the main requirements;
3. an assembly of the observations to form a balanced view of the assessment as a whole.

Two documents are set out in Tables 5-1 and 5-2, as an aid in the review.

- The Checklist (Table 5-1) is an aid both to checking that the essential requirements have been met, and to recording in summary form your impression of the standard of the various features of the assessment. The scoring system on the Checklist, while subjective, provides an explicit way of recording your impressions.

[17] NSW Guide to Reviewing a Risk Assessment of Mine Equipment and Operations, MDG 1014, 1997

- The Worksheet (Table 6-2) is a structured way of assembling and recording your impressions about each of the important features of the assessment while studying it, as a basis for preparing your reply to the author of the assessment report. It becomes your record of your review, which you can refer to in the future if you ever have the need.

Risk Assessment Review Checklist	
The Report Answer: Yes/No	• Is there a description of the operation or equipment being assessed? • Is there a summary of the strategic, corporate and risk management context? • Is there a list of the people involved in the risk identification step, together with their organisational roles and experience relevant to the risk assessment topic? • Is there an adequately detailed outline of the approach used to identify the risks? • Is there an outline of the method used for assessing the likelihood and consequences of the risks? • Are there two lists of identified risks, ranked by: o risk magnitude? o consequence magnitude? • Is there discussion of the basis for defining either the safety standard to be achieved, or the level of risk management expenditure? • Is there a list of the main actions to be taken to reduce risks and to manage risks? • Is there a timetable for implementing the main actions? • Does the report specify a requirement for a working audit required after completion of all implementation stages?
The Process Used Rate: 1 2 3 4 5 (Poor to Good)	• The range of expertise of team which did the study • The appropriateness of the degree of detail of the study • The comprehensiveness of the systematic approach • The identification of the key risk scenarios to be addressed • The bases for deciding the required safety level or effort • The method for assessing likelihood and consequences • The thoroughness of consideration of planned *risk reduction actions* • The thoroughness of consideration of *existing or planned risk controls* • The objectivity and balance of the study (i.e. not unduly optimistic or pessimistic)

Table 5-1: Risk Assessment Review Checklist

Risk Assessment Review Worksheet	
Comments on the adequacy of the following features of the report	• The description of the operation or equipment being assessed • The summary of the strategic, corporate and risk management context • The list of the people involved in the risk identification step, together with their organisational roles • The detailed outline of the approach used to identify the risks • The outline of the method used for assessing the likelihood and consequences of the risks • The two lists of identified risks, ranked by a) risk magnitude, and b) consequence magnitude • The discussion of the basis for defining either the safety standard to be achieved, or the level of risk management expenditure • The list of the main actions to be taken to reduce risks and to manage risks • The timetable for implementing the main actions
How do you rate the following?	• The range of expertise of team which did the study • The appropriateness of the degree of detail of the study • The comprehensiveness of the systematic approach • The identification of the key issues to be addressed • The bases for deciding the required safety level or effort • The method for assessing likelihood and consequences • The thoroughness of consideration of planned *risk reduction actions* • The thoroughness of consideration of *existing or planned risk controls* • The objectivity and balance of the study (i.e. not unduly optimistic or pessimistic)

Table 5-2: Risk Assessment Review Worksheet

6 Pitfalls in Safety Risk Management

Whilst it is the intention that the entire risk management process is implemented effectively, it is too often not. The aim of this chapter is highlight some of the common areas in which the risk management process can fall down.

6.1 Pitfalls in Risk Assessment

6.1.1 Identifying Hazards

One of the main issues associated with identifying hazards is a failure to understand hazards and only then identify their related unwanted events. Where events are identified they are all too often not dangerous events in the true sense of the word, or the description is either too vague, too general and/or unclear to be understood by all concerned. Examples are shown in Table 6-1, below.

Documenting general hazards: *These are very general and it is not clear to the person reading the form what the RA Team means. For example, there are many ways that 'moving machinery' could hurt someone, each with different controls, shortcomings and recommendations.*	e.g. Moving machinery Chemical Health Hazard Electricity
Documenting relevant conditions that affect the hazards: *It is not clear how the hazard could cause harm*	e.g. Night
Documenting failures or shortcomings *These are not potential hazards, but control shortcomings that are associated with the hazard.*	e.g. Samples taken incorrectly. Sub standard support. Poor communication.
Documenting consequences *These are not hazards but possible consequences of the hazard arising. In such cases it is not clear to the person reading the assessment what the hazard is and how it could hurt someone.*	e.g. Fatal Head Injuries Arms Back

Table 6-1: Issues with Hazard Identification

Health and safety standards of new operations cannot be assured if pre-emptive risk assessments are not undertaken. The need for pre-emptive risk assessment should be identified for smaller items or changes to operations as these are still capable of introducing significant potential hazards.

6.1.2 Evaluating Risk

Risk matrices, which are commonly used for this type of evaluation, are not without their problems. Arguably, they can be used at any of the layers in the 4 layer model as long as the scope of the assessment is about defining priority of remedial actions. There are two main issues with using a risk matrix approach:

- Where in the assessment the matrix is used
- The exact definitions of the dimensions of risk and their subjectivity.

Reviews of past routine risk assessments have shown that risk scores from a matrix are used in up to three different places in an assessment. These are:

1. before current controls are considered, thus representing a “worst case” scenario with no controls in place;
2. after consideration of current controls representing the status of the risk at the present time
3. after the addition of further risk reducing measures representing the residual risk.

Opinion is divided among practitioners about this, with those who believe that risk scores should be undertaken pre-current control to filter out the major hazards, and those who believe that the residual risk is important as represents acceptability (incorrectly). As matrices determine priority of action, scores that consider current controls are the key ones as priority is determined based on the current status of the risk at the time of the assessment.

It is also unlikely that current risk matrices provide the required guidance to establish the impact of adding new controls to a current situation. Therefore the use of a matrix for anything other than a judgement of current risk with existing controls (as in (2) above) may be undesirable.

Another important issue is related to the dimensions of risk (Likelihood and Consequence) and the subjective nature of this type of assessment. Although the definitions of likelihood and consequence may seem quite straight forward, then unless they are defined during the assessment there can be some confusion on what the

dimensions actually represent. For example, some of the different dimensions used are shown in Table 6-2, and depending on what combination is used, can produce significantly different scores for the same hazardous event

Dimensions of “Likelihood”	Likelihood of the event Likelihood of the consequence
Dimensions of “Consequence”	Worst Case Maximum Reasonable Most Likely

Table 6-2: Dimensions of Risk

The only way around this is to be consistent and to ensure that the Facilitator at the start of the assessment is clear about the definitions used. Arguably, as long as the team is consistent in these definitions within risk assessments then the order of the levels of risk for each identified hazardous event is unlikely to be significantly different. The majority view is that the dimensions that should be used are “Most Likely Consequence” and “Likelihood of the Event”.

Interpretation within these dimensions is also another problem particularly with assessing “likelihood”. For example, in a risk matrix the likelihood dimension will be on a subjective scale ranging from 1 (remote possibility) to 5 (everyday occurrence). In such assessments one team member’s view of “remote possibility” might be another person’s “likely” and although definitions may be given in the matrix to counter this problem, it can still lead to confusion. Such issues can be overcome by definition and good facilitation rather than taking an average between the two debated values.

6.1.3 Treat the Risks

One of the key issues noticed here is that where teams have identified control shortcomings in their assessment then they simply try and fix them at this stage and assume that by doing this the risk will be acceptable. It is important that they go back and use the hierarchy. Making a recommendation that addresses a shortcoming that has been identified, as opposed to considering the hierarchy of control will not result in a suitable and sufficient risk assessment.

Experiences of risk assessment in practice show that one of the key issues relating to the effectiveness of risk management as a whole is a failure to implement the findings of risk assessments. One of the main reasons for this is that the risk assessment exercise is viewed as very much a paper exercise, and the assessment ends up sitting on a shelf in the safety department only to be brought out as proof that an assessment was done following an accident. Other reasons for failing to implement actions include:

- Too much emphasis on risk assessment documentation as opposed to the implementation of remedial actions
- Lengthy consultation processes can stall the implementation of remedial actions.
- Line management challenging the findings of the Team and the content of assessments;
- Inability to cope with too many assessments at the task level as a result of poor planning and/or progress being measured in terms of quantity rather than the quality of assessments.
- Trivial recommendations made the Team as a result of a failure to understand the process

6.1.4 Consider the Controls

In a routine risk assessment it is important to consider what controls measures are currently in place to reduce the risk of that hazard occurring, and the effectiveness of those controls in practice. This should be done regardless of the level that the assessment is undertaken in the 4 layer model.

The importance that control effectiveness plays within risk assessments can be shown by the "Swiss Cheese Model" of accident causation [(18)] shown in Figure 6-1, where the blocks of Swiss cheese represent the different layers of controls, and the holes in the cheese represent shortcomings in the effectiveness of those control measures. All too

[18] Reason J (1997), Managing the Risks of Organisational Accidents, Surrey: Ashgate Publishing.

often these shortcomings are readily identified following an accident, but should be identified proactively in risk assessment. Therefore it can be considered good practice to identify and document “control shortcomings” that exist when undertaking a risk assessment [19].

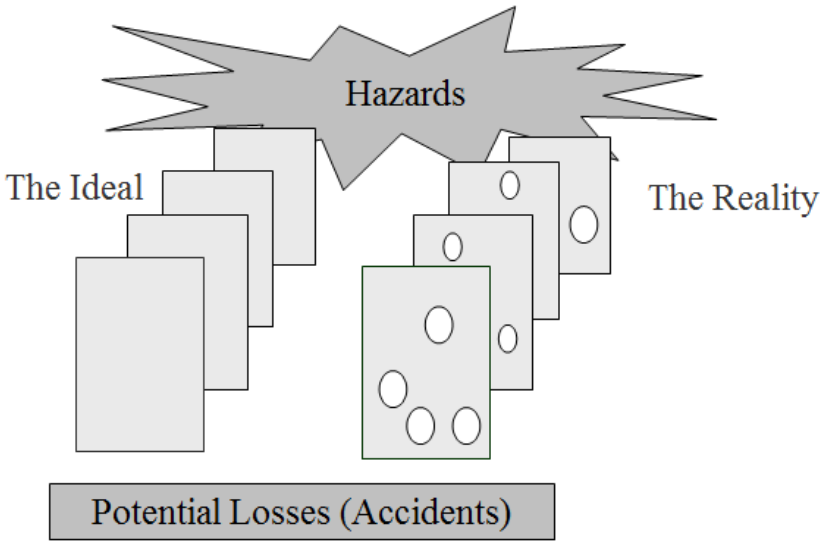

Figure 6-1: Swiss Cheese Accident Model

Problems associated with the identification of controls and control shortcomings are shown in Table 6-3. For each significant hazard identified, the Team needs to identify and document any ‘control shortcomings’ that exist in relation to the control measures that have been identified.

[19] Foster PJ, Rose, HJM & Talbot CF, Risk Assessment: An Opportunity to Change Health & Safety Performance. Journal of the South African Institute of Mining & Metallurgy,1998; 98(7):333-338.

Controls must be relevant to the Hazard and Unwanted Event Failing to have access to control information (such as procedures, training programmes etc.) and to investigate control measures in detail, can lead to incorrect assumptions being made about control measures and their relevance to the hazard. For example, if information on control measures is not available or studied, it is all too easy to assume that there are control measures in place, when in practice such controls either: • do not exist; or • if they do exist they may not address, and therefore control, the hazard or event in questions
Documenting 'One-Word' Controls Documenting 'one word' controls will not lead to a suitable and sufficient risk assessment. Common examples of 'one-word' control descriptions are: • Procedure • Training • Maintenance At sites there are many procedures, training programmes and maintenance schedules. Such descriptions make it impossible to distinguish between them. It can also give an impression to the inspectors or auditors that assumptions have been made. For example, on past audits it was found that 'one word' control descriptions such as a 'procedure' were used but on closer examination, such a procedure did not exist.
Documenting Legislation Documenting sections of legislation as control measures can be time-consuming and is ultimately meaningless. No references should be made to sections of legislation. Although legislation is technically a control measure, such requirements should be interpreted and implemented at the Operation locally through standard procedures, codes of practice, training etc. Employees at the Operation are more able to relate to local control measures than sections of legislation.

Table 6-3: Issues with Identifying Current Control Measures

When identifying control shortcomings, the experience of the Team is necessary to identify what really happens in practice by asking questions along the lines of:

- Are the procedures practical or is the control reliable?
- Does everyone know the rules?
- Has everyone been trained?
- Is the training effective? etc.

Control shortcomings must exist in practice and be associated with a control measure that has been identified. Teams should not waste time trying to identify possible control shortcomings if none exist. By identifying control shortcomings that could exist (but don't in reality), Teams will create additional and unnecessary work by rectifying problems that do not exist.

Once a control shortcoming has been identified, it is important to identify the reason for the shortcoming whenever possible as this will help focus on the true cause of the problem.

Examples of documented control shortcomings that do not help address the cause are:

- *PPE not used.*
- *Lack of self discipline*
- *Non-adherence to standard.*

For example the description '*PPE not used*', is common on a great number of risk

6.1.6 Planning for a risk assessment

A failure to plan for risk assessment will result in reduced control and accountability over the process, and risk assessments not being undertaken.

A ‘top down’ approach using the four layer model should be adopted when planning a risk assessment programme. Risk assessment plans that concentrate solely on individual tasks and operations will lead to increased paperwork, increased bureaucracy, and a great deal of repetitiveness across assessments.

If risk assessment progress is measured in terms of numbers of assessments produced, as opposed to quality or physical implementation then risk assessments will be done at this level and add to the problems identified above.

6.2 Pitfalls in Reviewing a Risk Assessment

6.2.1 Reviewing risk assessments

Failing to effectively review assessments will lead to:

- a failure to encourage a process of continual improvement in health and safety standards
- a loss of continuity and eventually the need to repeat the whole risk assessment process from scratch.
- an indication of poor management commitment to maintaining the process and loss of workforce involvement and participation

6.2.2 Implementing actions from risk assessments

- Too much emphasis on risk assessment documentation as opposed to the implementation of remedial actions will not improve health and safety standards.
- Lengthy consultation processes can stall the implementation of remedial actions. These can occur as a result of:

- Line management challenging the findings of the working group and the content of assessments;
- Inability to cope with too many assessments at the task level as a result of poor planning and/or progress being measured in terms of quantity rather than the quality of assessments.
- Trivial recommendations made the working group as a result of a failure to understand the process

Failing to effectively control the implementation process will reduce workforce commitment to risk assessment, and health and safety standards are unlikely to improve.

6.3 Pitfalls in Risk Management

6.3.1 Risk Assessment Training

- A failure to formally identify training needs is likely to result in key learning points being omitted and training provisions that are both disjointed and inconsistent;
- Without a means to monitor the effectiveness of training, it is not possible to ensure standards are maintained, demonstrate the effectiveness and value of the training being provided or ensure a process of continual improvement.
- Members of risk assessment teams who have not received any effective training in the process will contribute very little and as a result of a failure to understand what is going on may severely disrupt progress;
- Training employees too far in advance of any practical involvement with the risk assessment process is likely to result in a loss of any enthusiasm or interest that they may have gained with respect to the benefits of risk assessment.

Appendix 1: Risk Assessment Training Content.

Risk Assessment Sensitisation

For **Risk Assessment Sensitisation**, the primary training objectives should be to provide employees with an understanding of:

- The ideas and concepts behind risk assessment and how they are used.
- How risk assessments are used to help ensure health and safety during the project and the associated legal requirements.
- Their responsibilities for health and safety and the need for continuous risk assessment.
- The roles and responsibilities of management and employee representatives in the projects risk assessment process.

The primary training objectives above can be met using the two example training modules outlined below:

Module 1: An introduction to risk assessment

By the end of this module the employee should understand the basic principles of risk assessment. These should be framed in simple everyday terms such as:

- Hazards are anything that can harm you or someone else.
-

- Risk assessments are used to help ensure you are safe at work, you can use the same ideas to help you and your family be healthy and safe at home.

Module 2: How risk assessment is used at the site.

By the end of this module the employees should understand how risk assessment is being used within the organisation. They should understand:

- The law requires an assessment of risk to health and safety
- Risks are assessed for all of the jobs during the project and for any new equipment or operations.
- How the results of risk assessments are used to improve health and safety and support the company's safety policy.
- Everyone during the project uses risk assessments. It is not just the job of safety professionals. Employees and their colleagues may also be asked to help by being part of a risk assessment team.
- Risk assessment teams look for hazards, assess risks and help to decide if any more can be done to improve health and safety.
- The findings of the risk assessment teams will be discussed with their respective health and safety committee and communicated to them
- They also have a duty to continuously assess the risks to themselves and their workmates when they are at work.
- What they should do if they see anything that may be risky or dangerous.
- The roles and responsibilities of management and employee representatives in the risk assessment process.

Throughout the course the primary emphasis should be on the employee's role with respect to risk assessment, particularly continuous risk assessment (at layer 4 of the four layer model). The aim of this course is to try and develop the mental process in all employees to look and recognise hazards in all situations (at work and at home) and deal with them before they become risks. It is good practice to use of videos of accident scenarios or pictures/cartoons depicting various hazards as this will greatly enhance and add to the value of the course and it gives practical examples of hazard spotting.

Working Group Training

For the **Working Group Training** the overall objective of this training is to provide employees who are about to participate in a risk assessment working group with a sufficient understanding of the risk assessment process to enable them to make a positive contribution towards the production of a 'suitable and sufficient' assessments of risk. The primary training objectives will include providing team members with an understanding of:

- The ideas and concepts behind risk assessment and how they are used.
- The definitions of hazards, controls, control shortcomings and risk and how they will be identified.
- The project risk assessment process and recording form(s).
- The boundaries of the risk assessment they are about to undertake and the hazards that may have already been addressed by previous generic assessments
- The roles and responsibilities of management and employee representatives in communicating their assessment findings and implementing action plans.

These objectives can be met by using the following example training modules outlined below:

Module 1: An introduction to risk assessment

- The ideas and concepts behind risk assessment and how they are used.

This introductory module is in essence a re-cap of the Sensitisation Training. The Sensitisation Training should not be repeated in full as this would be both time consuming and inappropriate. However, briefly reviewing this material will ensure all of the participants start the learning process from a common base. This re-cap session can also be used to provide feedback on the effectiveness or otherwise of the participants earlier sensitisation training.

Module 2: Hazards, controls, control shortcomings and risk

- Definition of hazards
    - the need to provide brief descriptions of hazards rather than the single words on the checklist
- Definition of control measures
    - practical examples of controls
    - use of the control checklist
- Definition of shortcomings
    - No one is not looking to allocate blame
    - It is essential to consider what does go wrong rather than what could go wrong.
- Definition of ALARP.
    - Can we do any more to control the risk to health and safety
- Definition of risk
    - Risk depends on likelihood and severity of harm
    - Using a risk matrix

Module 3: Communicating findings and implementing actions.

- The projects risk assessment recording form(s).
    - Describe how the process works using the forms
- Recommending remedial actions.
    - The hierarchy of controls
    - roles and responsibilities of management and employee representatives
    - action plans and how they are put into practice.

Module 4: Risk assessment boundaries

- The four layer model and how it is used
- Define the boundaries of the risk assessment they are about to undertake
    - Need to focus on the boundary
    - For generic assessments – need to consider all sections during the project not just were you work.
- Describe health and safety information prepared for them

- hazards that have already been covered by previous generic assessments
- rules and procedures currently in place
- past accidents and incidents

Advanced Training

The **Advanced Training** should be designed to meet the needs of project management and members of the safety team, and other personnel who require a more detailed understanding of the process such as, full time health & safety representatives and members of any health and safety committees. The objectives of the Advanced Training are to provide senior staff with a detailed understanding of the whole risk assessment process as used during the project in particular:

- the roles and responsibilities of persons with respect to risk assessment.
- organising and undertake 'suitable and sufficient' risk assessments
- evaluating and managing the information produced in risk assessments
- facilitating risk assessment working groups

These objectives can be met by the following example training modules outlined below:

Module 1: The essential elements of risk assessment

This module should address and instil an understanding of:

- definition of hazards
- definition of risk
- definition of control measures
- definition of shortcomings
- examples of all the above likely to be encountered during a project

Module 2: Corporate Risk Assessment Process

This module should address and instil an understanding of:

- Identifying and prioritising risk assessment boundaries during the project.

- Different risk assessment methodologies and where they can be used
- Identifying hazards, controls and shortcomings using the respective checklists
- Assessing whether the associated risk is controlled to a level that is as low as is reasonably practicable
- The hierarchy of controls
- Selecting sensible remedial actions.
- Estimating values of risk using the risk matrix

Module 3: Risk Control Process

By the end of this module the employees will understand:

- The risk assessment consultation process during the project
- Risk Assessment Action Plans
- Managing the implementation of remedial actions during the project
- Over-inspecting remedial actions
- Communicating the findings of risk assessments to the workforce.

Module 4: Risk Assessment Facilitation

This module should be a practical exercise that allows the trainees to undertake risk assessments.

Appendix 1 – WRAC Example Form

Project Number: _____ Project Title: _____

Operation Description: _____ Relevant SOP's:_____

Team Leader: _____ Date Conducted: _____

Team member Name:	Position:	Team member Name:	Position:
1.		4.	
2.		5.	
3.		6.	

Risk Exposure							Action Plan				
No.	Phase in Project	Unwanted Event	Current Controls	Likelihood	Consequence	Risk Rating	Improvements/Additional Controls	Acceptable?	Agreed Action	By Whom	By When

Comments_____

Signed: (Team Leader): _____

Appendix 2 – JSA Example Form

Job / Task Title: _____ Job / Task Description: _____

Date Conducted: _____ Department: _____

Team Facilitation: _____ Position: _____

Team member Name:	Position:	Team member Name:	Position:
1.		4.	
2.		5.	
3.		6.	

Job/Task Step	Unwanted Events arising from or associated with the job / task step or equipment usage	Requirements (controls) to protect people from the identified Unwanted Events

Comments:

_____

Signed: (Team Leader): _____

Appendix 3 – FMEA Example Form

System Indenture Level: _____ Date/Sheet: _____ of _____

Reference Drawing: _____ Compiled by: _____

Mission: _____ Approved By: _____

Team member Name:	Position:	Team member Name:	Position:
1.		4.	
2.		5.	
3.		6.	

Identification Number	Item/Functional Identification (Nomenclature)	Function	Failure Modes and Causes	Failure Effects			Failure Detection Method	Compensating Provisions	Severity Class
				Local Effects	Next Higher Level	End Effects			

Comments:

_____

Signed: (Team Leader): _____