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Creating value from uncertainty

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Case study: Business risks in an oil refinery

We conducted a risk assessment for the management team at an oil refinery. The primary objective was to identify risks to the refinery as a business and develop an agreed priority listing of them. A subsidiary objective was to expose the management team to the risk management process. The management team wanted confidence for themselves and their major shareholders that the main risks to the business had been identified and were being managed well.

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1 Summary

We conducted a risk assessment for the management team at an oil refinery. The primary objective was to identify risks to the refinery as a business and develop an agreed priority listing of them. A subsidiary objective was to expose the management team to the risk management process.

The management team wanted confidence for themselves and their major shareholders that the main risks to the business had been identified and were being managed well.

The assessment generated a risk register for the business, with responsibilities for follow-up review and action allocated to members of the management team. In many cases, the actions were to confirm that current risk controls and plans were in place and working as intended.

2 The refinery

The refinery was a stand-alone business. Major shareholders were an international oil company and an industrial company listed on the local securities exchange.

It was sited in an industrial precinct on the outskirts of a metropolitan area, close to wharf facilities and a shipping terminal. What had been relatively rural countryside with a low population density when the refinery was first constructed had developed to include a wide range of light industrial businesses. A local village had expanded to become a larger community and housing quality had risen. While the community was generally supportive of the refinery, community expectations had risen and the company was intensely aware of its obligations to local residents and the local environment.

3 Establishing the context

The purpose of the initial context establishment process was to develop a detailed structure and set of rating scales for the risk identification, analysis and assessment tasks to follow.

A list of stakeholders was identified (Table 1), from which a set of objectives was derived.

Table 1: Stakeholders

Group	Examples of constituents
The company	Shareholders, company Board, management, other divisions of the company
Employees	Employees, employees' families, unions, company terminal operators, contractors staff
Commercial counter-parties	Contractors, customers, electricity suppliers, emergency services, insurers, shipping agents, suppliers, water supply
Neighbours	Environmental groups, fishermen, heritage groups, local community, local industry
Government	State government, local government, politicians
Regulators	Environmental protection regulator, health and safety regulator, police, port authority
Others	Competitors in the region, media, tourists, wildlife

Ten key elements were identified to structure the risk assessment task (Table 2). They were based on two main 'issue areas': site-related operations factors and other broader and non-site-related factors. For each area, a group of 'contributors' formed the key elements. The issue areas and key elements were numbered to maintain a link to the base structure.

Table 2: Key elements

Issue area	Key element (contributor)	
1. Site issues	1.1	Wharves, loading areas, pipelines
	1.2	Hydrocarbon processing areas
	1.3	Hydrocarbon storage, tanks and bullets

Issue area		Key element (contributor)
	1.4	Fire protection and emergency response
	1.5	Non-processing buildings
	1.6	Neighbours
2. Other issues	2.1	Technical processes and standards: operations, maintenance, inspection, engineering
	2.2	People processes, training and culture
	2.3	Environment, community, licensing and compliance
	2.4	Other matters: strategic matters, company business issues, market changes

4 Risk assessment workshop

4.1 Overview

The purpose of the risk identification, analysis and evaluation process was to identify and set priorities for the major risks arising in the refinery as a business. The desired outcome was a list of key risks, with agreed priorities. This would allow the company to set priorities for examining in more detail the control systems in place to deal with major risks and for identifying the practical actions required to improve them, and hence maximise the achievement of the company's criteria for success.

A one-day workshop was used for the main identification, analysis and evaluation. It involved a facilitated brainstorming exercise, held off-site. Its purposes were to:

- Provide initial familiarisation and training in the risk management process;
- Examine briefly the first stage in the risk management process, establishing the context; and
- Address in detail risk identification, analysis and evaluation.

Sixteen participants attended from the main refinery areas (Table 3).

Table 3: Workshop participants

Function	Participant areas
Refinery operations	Production, production scheduling and economics, refinery services, engineering services, scientific services
Projects	Strategic projects, maintenance re-engineering, shutdowns
Safety and risk	Integrity and inspection, safety, risk and quality
Other functions	Business improvements, employee services, financial services, community liaison

The workshop had two passes. In the first pass, in the morning and early afternoon, the participants identified the relevant risks for each key element, assessed the consequences of the risk on the critical success measures and assessed the likelihood of that level of consequence arising. Initial priorities were derived from the consequence and likelihood assessments.

In the second pass, later in the afternoon, the participants reviewed each identified risk, confirmed its final priority and allocated risk ownership. Risks and assessments were recorded as the workshop progressed.

4.2 Risk assessment

Consequences and likelihoods were analysed in terms of simple five-point rating scales. Consequences were rated on several scales:

- Safety;
- Environment;
- Legal and compliance;
- Public perception;
- Direct costs and business interruption; and
- Notional cost.

In practice, participants referred to all the scales, but generated a single consequence rating that reflected the combined impact of all of them. The 'notional cost' scale was intended to provide a comparative base for the ratings.

Likelihoods were related to the potential for incidents to arise (Table 4). This table has a similar structure to many likelihood tables used for corporate risk assessments, but the scales are different. In particular, the scales include far longer recurrence periods, corresponding to lower frequencies, than in a routine business assessment, for two main reasons:

- The high level of controls in place in refineries means that events with large consequences are very infrequent;
- Risk assessments in a refinery invariably focus on the circumstances in which large consequences (and usually large negative consequences, particularly associated with the release of hydrocarbons) might arise, and so the focus of the risk assessment tends to be more on low likelihood high impact risks than on 'routine' risks that might dominate business risk analyses in other settings.

Table 4: Likelihood rating scale

Rating	Description	Detailed description
A	Frequent	High likelihood in the next 10 years; has occurred in the last 2 years in the company
B	Reasonably probable	Could occur at least once in the next 10 years; expected frequency once per 1-10 years
C	Occasional	Has occurred in the industry world-wide; expected frequency once per 10-100 years
D	Remote	Low probability the situation will occur; expected frequency once per 100-1,000 years
E	Very unlikely	Possible but very unlikely; less than once per 1,000 years

The consequence and likelihood ratings were used to generate priorities in a simple look-up table.

4.3 Review

During the final part of the workshop, the participants reviewed the initial priority ratings to confirm an agreed priority rating for each risk. As a guide:

- Extreme and High risks were likely to arise and to have potentially serious consequences. They usually required detailed management planning at a senior level. Extreme risks required attention as a matter of urgency.
- Medium risks may be likely to arise, or to have serious consequences, but not necessarily both. They should receive some management attention, but this may be delegated.
- Low risks tended to be infrequent and of low consequence. They were often managed by routine procedures.

Responsibilities for treating each risk were noted in the review process.

5 Workshop outcomes

The workshop participants identified 71 risks. Subsequent attention focussed on the Extreme and High risks, and those with high potential exposures (the level of impact if the controls did not work as intended when needed). Some of the main groups, listed according to the nature or source of the risk, are shown in Table 5.

Table 5: Priority risk groups

Source	Discussion
Major catastrophes (fires and explosions in the refinery area)	Major catastrophes are rare events, with potentially catastrophic consequences for all the criteria. They included fires, explosions, toxic releases, BLEVEs (boiling liquid expanding vapour explosions), lightning, and major operational errors leading to fires, explosions or unplanned releases.
Risks associated with the fire protection system	Fire protection risks are relevant primarily if there is a major incident such as a fire and the system is not capable of responding as required to protect people and assets. They included loss of the water supply, failure of the fire water system due to pump failure or pipe rupture, inadequate capacity in the system and failure of

the fire fighting vehicles that provide mobile protection and response.

Wharves, shipping, loading and unloading

Risks associated with the movement of raw materials and product into and out of the plant included spills and major leaks, pipeline rupture and ship collisions or breakaways. An assessment of the risks associated with the crude oil pipeline from the wharf to the refinery was conducted separately.

Site security

Risks associated with access to the wharves and the refinery site by people with potentially malicious intent included security breaches, vandalism and sabotage.

Local community

Risks arising through the actions of the neighbours of the refinery and its local community included restrictions on developments within the refinery, restrictions on off-site developments and changing community expectations that might restrict refinery operations.

Strategic matters

Several strategic risks were noted, including competitive pressures associated with imported refined products and changes in product quality specifications associated with changed environmental standards for vehicle fuels and emissions.

Other risks

Several other important risks were identified, including matters associated with the company's ability to change to meet new market requirements and some specific safety matters.

6 Risk treatment

Responsible managers were tasked to develop status summaries and, where appropriate, action plans for each high-priority risk identified. In many cases, risks had been recognised already and established procedures and formal plans were in place for dealing with them. This certainly applied to all of the risks associated with the safety of people, assets and the environment. The risk register that was an outcome of the workshop provided a checklist for

managers to review their plans and ensure that physical, procedural and management controls were in place and working.

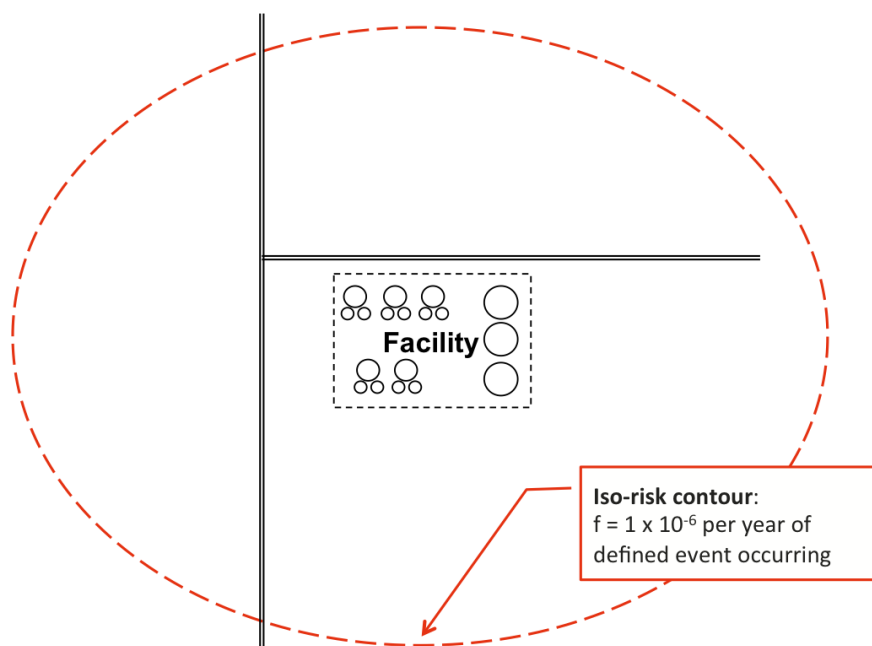
Procedures to implement the review, action planning and monitoring processes were included in the company's Refinery Risk Management Plan.

7 Subsequent events

Environmental and product quality standards did change following the initial assessment, and the company had to embark on a major capital investment programme to upgrade parts of the refinery. The company took a proactive stance on this, with the upgrade programme addressing not just the immediate requirements that were included in the new legislation, but also those requirements that were foreshadowed by draft treaties, draft legislation or community pressures that were likely in the medium-term future.

Some time after this workshop, the refinery was involved as an interested party in a land-use planning dispute between a property developer and the local planning authority. A medium-density residential housing had been proposed in a neighbouring community that had expanded since the initial construction of the refinery. The levels of risk associated with a toxic release from the refinery site, shown in the form of an iso-risk contour like Figure 1, were close to tolerable threshold values at the development site.

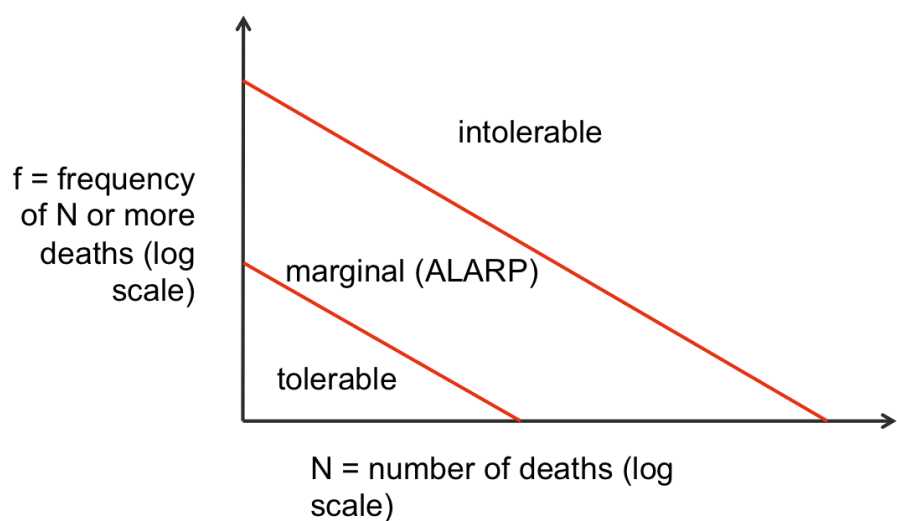
Figure 1: Iso-risk contour, schematic



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The site proposed for the new housing was in the current marginal or ALARP (as low as reasonably practicable) region under local planning regulations. The greatly increased population density proposed for the new development would have increased the societal risk significantly and may have pushed it into the intolerable level, based on a diagram like Figure 2 (sometimes called an f - N diagram).

Figure 2: Thresholds for regulatory use



Pictures like Figure 1 and Figure 2 allow the results of often-complex underlying models to be communicated in a meaningful way.

After a court appeal, the local authority's decision to refuse the development was upheld. Risk was not the only consideration in the court case. Amenity, odour, noise and light were also relevant factors in the court's decision.

8 Lessons

This case demonstrates that a simple risk assessment process can generate a valuable checklist of the major risks to the business. This, and the follow-up review of controls, processes and plans associated with the identified risks, allowed refinery managers to ensure all the major risks were being managed, thus providing confidence for the management team, the Board and the shareholders.

9 Contact

If you would like further information about this topic please contact us. We will endeavour to reply promptly.

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