I-RISK

Integrating management and technical systems

Part 2: Management Monitors

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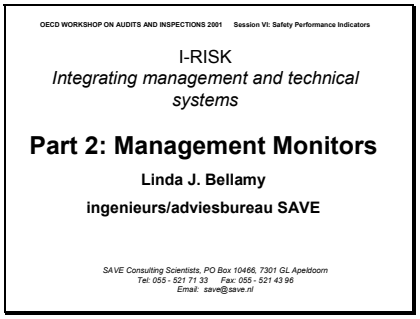
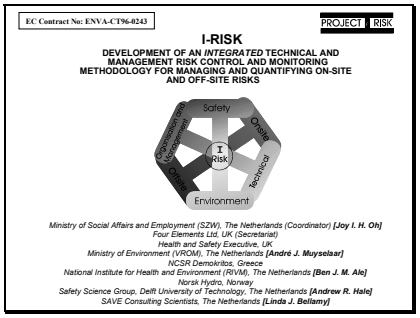
Slide 1



The second part of the I-Risk presentation (for first part see Session II) concerns the sensitivity of the technical risks of a chemical installation to the quality of the management system and how management might affect the risks over time.

Slide 2



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Overview

- Part 1 of the presentation : audit model (session II)
- Part 2 : basis for identifying key management monitors
  - the sensitivity of the technical system risks to the management system .
  - how quickly the quality of the management processes can improve or degrade (how often to monitor)

Part 2 of the I-Risk presentation concerns the identification of the important areas of the management system for managing major hazard risks on a site specific basis. These important areas we have tended to call ‘management corrosion monitors’ because it is the degredation of the quality of management, especially in areas to which the risks are sensitive, which cause concern.

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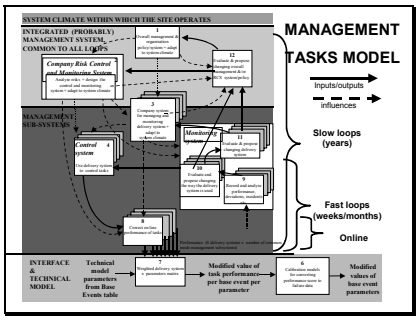

This is the management model again, emphasising the differences between the influencing effects of one management process on another (dotted lines) as opposed to the inputs and outputs to these processes. One of things we noted was that the changes which occurred in the overall system could have different cycle times. For example, a major accident which receives international attention can result in major changes at the highest level which ultimately influence the way things are done in box 8. The whole change process can take several years. On the other hand, a near miss report entering box 9 can result in a change in the procedures which are formally updated every 6 months.

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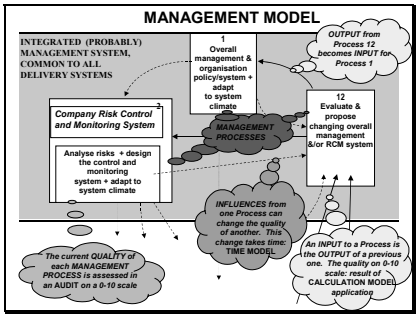

The model is as follows:
A management process takes as its input the output of another process. The quality of the output that it generates depends on two things: the quality of the input and the quality of the transformation process itself. The influences affect only the quality of a process. Processes which are influencing cannot also generate outputs. Processes which generate outputs cannot also be influencing. This means the company RCMS (box 2) can directly influence the review process (box 12) but not vice versa.
Change in the quality of the system is modelled to take place in two ways:
Through the influences of one process on another
Through a ‘natural’ process of degredation which we termed ‘management corrosion’.
A calculation model was developed to use the numerical judgement scores derived from the audit to convert the quality of inputs to outputs. The questions are:
By how much does output quality depend on input quality and by how much on the quality of the process?
How quickly might quality of the process degrade?
How quickly does an influence change the quality of a process?

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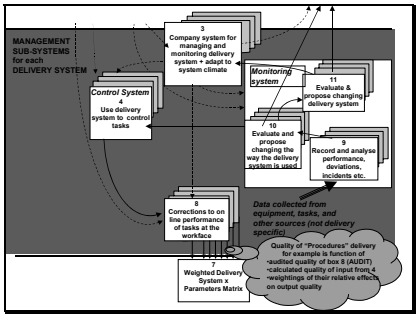

Functional boxes (4), (8), (9) and (10) represent the delivery systems providing the various controls and resources necessary to perform the tasks affecting the parameters of the technical model. A loop is made by the input/output relationships depicted in the Figure. This is a major feedback and learning group (4->8->9->10) . A faster feedback and learning loop aiming at identifying and correcting defective performance is incorporated in box 8. These are the important processes in how the management systems functions now in terms of its influence on the technical system. The input-process-output calculation model for the management system is used to generate the quality of the output of the overall system, per management delivery system (for delivery systems see part 1).

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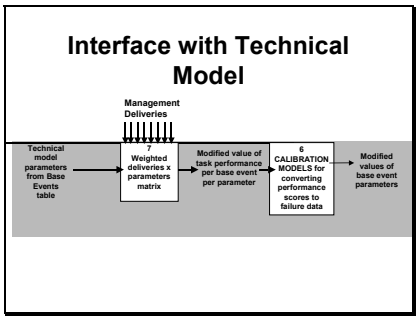

The calculated qualities of the outputs are modified by being fed into a weighting system. These modified values are used to calculate the value of a parameter for a particular base event in the technical model.

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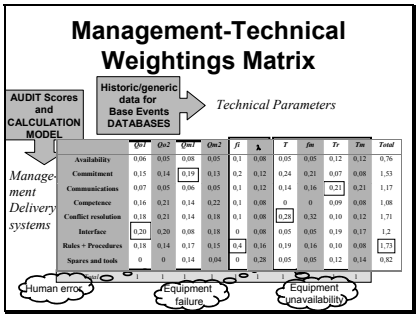

This is a model which will affect by how much the quality of the management deliveries which are output from the management system will affect the technical parameters. This weightings matrix provides the default case for what we think are the relative importances of the different delivery systems for each parameter. This was calculated by simply listing all the factors we could identify which influenced a parameter, classifying them according to which delivery system they belong to and then adding up the proportions of items in each delivery system. See Part1 for the names of the technical parameters.

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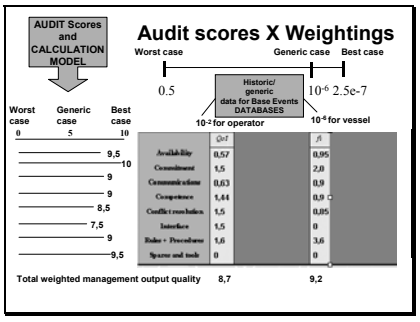

The rating for each delivery system is converted in the weightings matrix. This gives a total value for each parameter (max 10 = best quality)

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Calibration model (example)

EQUIPMENT	PARAMETER	Good Management 10	Generic Plant 5	Poor Management 0	Comments
Safety valves, remote control valves	T (inspection interval)	Plant data x 0.9	Plant data	Plant data x 5	DEMOKRITOS judgement.
Safety valves, remote control valves	Lambda (failure rate)	1,71E-06	1,25E-05	3,15E-05	OREDA, page 492
Safety valves, remote control valves	Qm1 (error in maintenance)	1,00E-03	0,01	0,1	Expert judgement based on generic data according to SAVE's suggestions
Safety valves, remote control valves	Qm2 (error recovery failure by independent check)	0,05	1,00E-01	1	SAVE/RIVM judgement based on generic data
Safety valves fail in open position.	Lambda (failure rate)	8,50E-07	1,17E-05	3,40E-05	OREDA, p. 492

The calibration model converts the weighted quality data per parameter to a specific value which is then an input for the risk assessment. The 0 and 10 values of the management system quality represent the extremes (worst and best cases)

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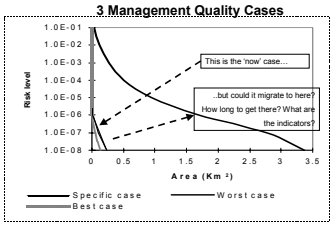
Area inside risk contours above certain risk levels (10^{-1}- 10^{-8}/yr):



The best and worse case of the sensitivity analysis can be determined from the calibration model combined with the site specific technical model. The actual case is a the state of the system now. It may be that the management system is migrating towards the worse case. How do we know which way it is going or whether it is maintaining its position.

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Now and The Future

- The 'now' system only deals with processes which produce outputs
- The 'future' depends on the influencing processes

Systems need feedback loops to maintain them. Change may occur as a natural degredation process. Change may occur as the result of an influence of the management system for better or worse.

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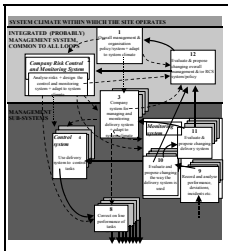

•**Process boxes (1),(2),(3) the main functions instigating changes in the safety management system.**

•**Process boxes (4), (8), (9) and (10) providing the various controls and resources necessary to perform the tasks affecting the parameters of the technical model ('now')**

The white broken arrows show 1, 2 and 3 to be the important influences. The functions of 4, 8. 9 and 10 provide the outputs which affect the technical system now.

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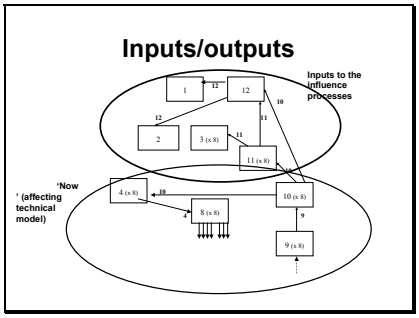

This is reinterated here showing only input/outputs.

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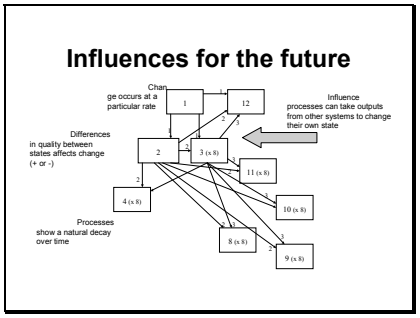

These arrows show only the influences. Certain assumptions are made about the effects of the influences on rate of change. This allows the 'simulation' of changes in management quality over time to reach a steady state.

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DELIVERY SYSTEM	BOX	INITIAL STATE
	1	9.3
	12	7
AVAILABILITY	2	8.8
	4	9.6
	8	9.9
	3	7
	10	8.8
	11	7
COMMITMENT	2	9.6
	4	10
	8	9.9
	9	9.9
	10	8.8
	11	9.6
COMMUNICATION	2	7.6
	4	8.9
	8	8.3
	9	8.3
	10	9.6
	11	7.4
COMPETENCE	2	8.6
	4	9.4
	8	8.3
	9	8.3
	10	9.2
	11	7.7
CONFLICT RESOLUTION	2	9.4
	4	9.4
	8	9.1
	9	7.4
	10	9.4
	11	9.2
INTERFACE	2	8.5
	4	8.5
	8	8.8
	9	9.7
	10	9.1
	11	8.8
PROCEDURES	2	8.8
	4	8.8
	8	9.4
	9	9.8
	10	9.8
	11	9.6
SPARES & TOOLS	2	8.8
	4	9.8
	8	8.6
	9	8.6
	10	9.7
	11	7.2

Audit ratings

The data from the audit can be fed into the simulator.

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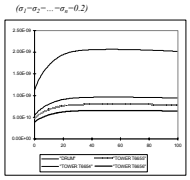
Frequency of failure versus time



Over time the frequency of failure increases but then achieves a steady state. The units of time depend on the how quickly a state can change (whether the rate is measured in months or years. We still do not know what that is because there is a need to collect some real data.

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Sensitivities: the key systems to monitor (refinery case)

Key management deliveries:

- Producing right type of spares on time for maintenance
- Existence of appropriate procedures for various tasks
- Providing the right incentives for personnel commitment
- Provisions for resolving conflicts between safety and production tasks *(could provide largest effect on risk)*

When looked at from the integrated technical-management perspective, the important delivery systems for major hazards could be identified for this specific case.

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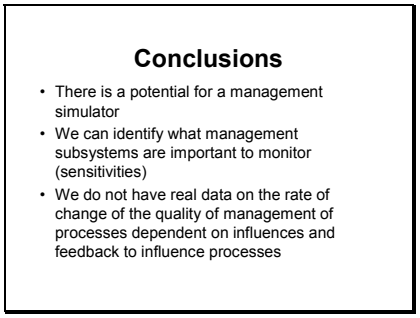

The management simulator concept is very advanced. It lacks data from the field, but the system is not a black box. Demokritos in Greece who were primarily responsible for developing the simulation have provided detailed explanations in Annex IV of the I-Risk report.

The sensitivities are particularly useful for identifying the important delivery systems to monitor for a specific site. This brings into question whether generic performance indicators are telling us anything about major hazard management.