

Business from technology



EcoWater Webinar

Risk management and Water

12.3.2013

Liisa Poussa, Research Scientist, Team leader
Risk Management

VTT Technical Research Centre of Finland

Risk management for safe, undisturbed and efficient production over the lifecycle

**System
definition**

**R&D
planning**

**Installation &
commissioning**

**Operation &
maintenance**

Disposal

Raw water

Process water

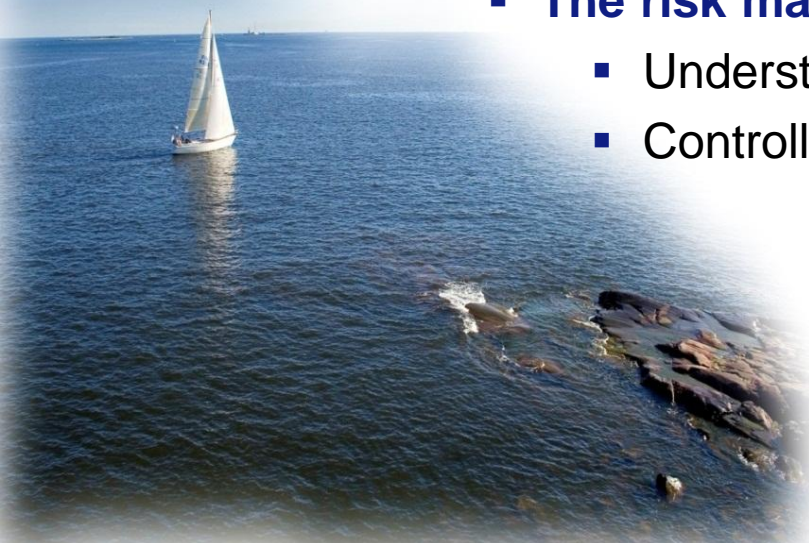
Water recycling

Waste water

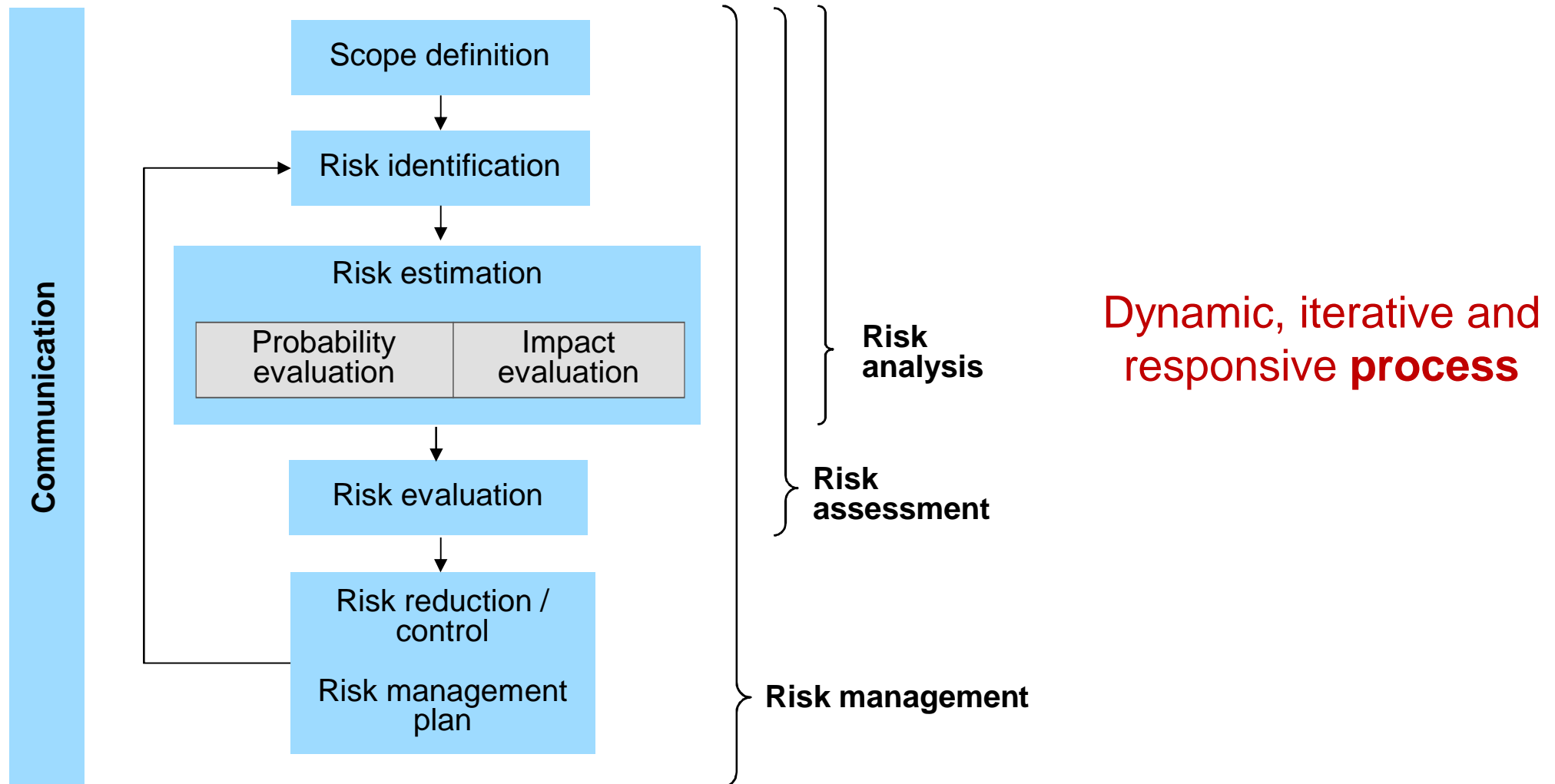
Risk management – what and why?

- **Risk management** refers to a systematic and explicit approach used for identifying, analyzing and controlling risk.
- **Risk** is the chance of something happening that will have an impact on objectives e.g. product and process safety or quality.
 - **Risk management methods** can be applied to any stage of a product life cycle, process or function, having focus e.g. on
 - Production, risks on people, environment and property
 - R&D, design, investment decisions, business continuity, global supply network
 - **The risk management process produces two main outputs:**
 - Understanding about risks, their root causes and consequences
 - Controlling actions based on risk assessment and prioritization.

Risk management establishes a base for proactive decision making and management



Risk management process – the basic approach



Adapted from standards:

IEC 60300-3-9:2000 Dependability management. Section 9: Risk analysis of technological systems

ISO 31000:2011 – Risk management. Principles and guidelines

Risk analysis methods

Hazard identification methods, e.g.

Checking lists, Potential problem analysis (POA)
Hazard and Operability Study (HAZOP)
Reaction matrix
Action Error analysis (TVA)
Failure mode, effect and criticality analysis (FMECA)
Hazardous scenario analysis (HAZSCAN)
Environmental risks due to accidental releases (SARA)

Accident modeling and Consequence assesement, e.g.

Cause-effect chain,
Event tree analysis, (ETA)
Fault tree analysis, (FTA)
Influence diagrams
Layer of protection analysis (LOPA)

Brainstorming methods, e.g.

Workshop techniques,
Nominal group technique (NGT)
Group Decision Support Systems

Simulation based methods, e.g.

Area-specific simulation methods
e.g. gas dispersion models
Monte Carlo based methods

**Suitability of a method depends on the objectives and scope of analysis,
one method can not cover everything!**

What kind of risks may be encountered?

- ✓ **Preventable risks**, are internal risks, like malfunction of machines, occupational injuries, human errors, leakages, which are controllable by the organization.
- ✓ **Strategy risks**, which are accepted and taken voluntarily in order to gain benefits that are valued greater than possible losses.
- ✓ **External risks**, are caused by the external events which cannot be controlled or influenced by the organization. Risk needs to be prepared for.



Effective Strategies



Examples of preventable risks related to water



- Risk related to water quality (pH, temperature, pressure, ...) and water quantity in the process (too much, not enough, availability, ...)
- Occupational hazards
 - Drowning accidents
 - Boiling water leakage, steam release, explosion due to compressed water
- Process hazards
 - Water as reactive substance (e.g. with strong acids)
 - Freezing of pipelines, cooling water temperature
- Environmental hazards
 - Abnormal waste water releases
 - Extensive water releases (e.g fire extinction waters)

Examples of strategy risks related to water



- Reduction on raw water use or implementation of process modifications (e.g. water recycling) despite of disadvantages in production processes
- Establishment of industrial sites close to ground water areas or surface water intake area
- Investment to new waste water treatment method
- Outsourcing of maintenance and operation of water treatment processes



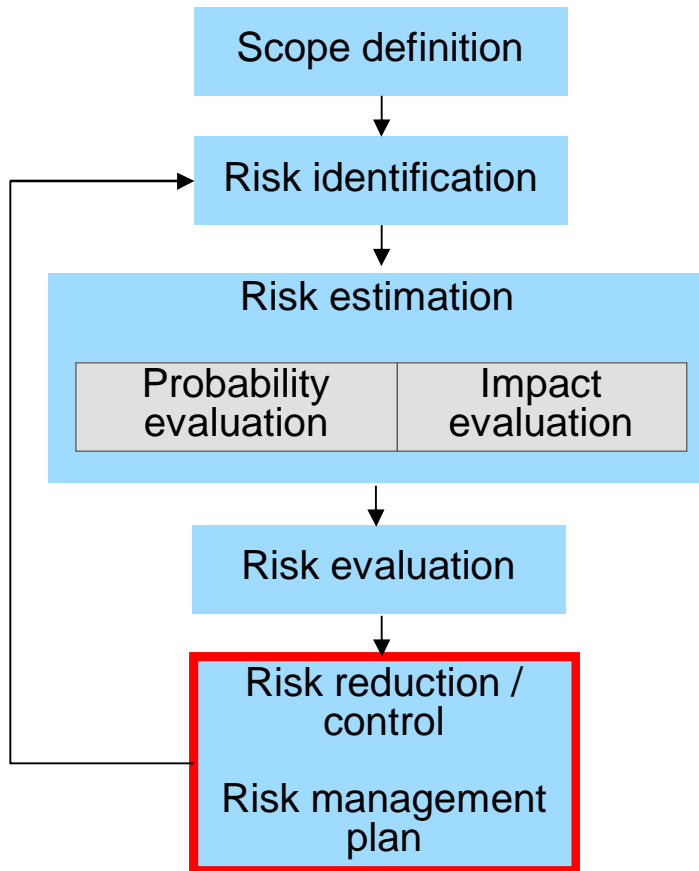
Examples of external risks related to water



- Risk related to climate change and extreme events; heavy rains and snow, storms, hot and cold waves, ...
 - Quality or amount of raw water changes due to flooding or aggressive algae growth
 - Abnormal precipitation leads to excessive amount of process water causing process problems
 - Milder and rainy winters caused damage risk of water turbines due to supercooled water.

- Risk related to political changes
 - Restrictions on water use due to political decision (demand of two-usesystems)

What to do? - Risk control



Consequence	Probability				
	Negligible	Seldom	Possible	Probable	Very probable
Minor < 10 k€					
Moderate 10 k€ - 100 k€		21, 41	12, 16, 20, 35	8, 10, 24, 27, 28, 29, 32, 36	2
Serious 100 k€ > 500 k€	11	14, 15, 22, 23, 26, 31, 39, 43, 44, 45, 48, 52	3, 5, 6, 7, 13, 17, 18, 54	34	
Catastrophic > 500 k€	46	4, 9, 37, 38, 42, 55, 56	19, 25, 30, 47, 49, 57, 58, 60	1, 53, 59	

Consequence	Probability				
	Negligible	Seldom	Possible	Probable	Very probable
Minor < 10 k€					
Moderate 10 k€ - 100 k€	2, 8, 12, 16, 20, 21, 41	24, 27, 28, 29, 32, 35, 36	10		
Serious 100 k€ > 500 k€	11, 13, 14, 18, 22, 23, 26, 31, 34, 39, 43, 44, 45, 48	3, 5, 6, 7, 15, 17, 52, 54			
Catastrophic > 500 k€	1, 4, 9, 19, 38, 42, 46, 53, 55, 56	25, 30, 37, 47, 49, 57, 58, 59, 60			

Adapted from standards:
 IEC 60300-3-9:2000 Dependability management. Section 9: Risk analysis of technological systems
 ISO 31000:2011 – Risk management . Principles and guidelines

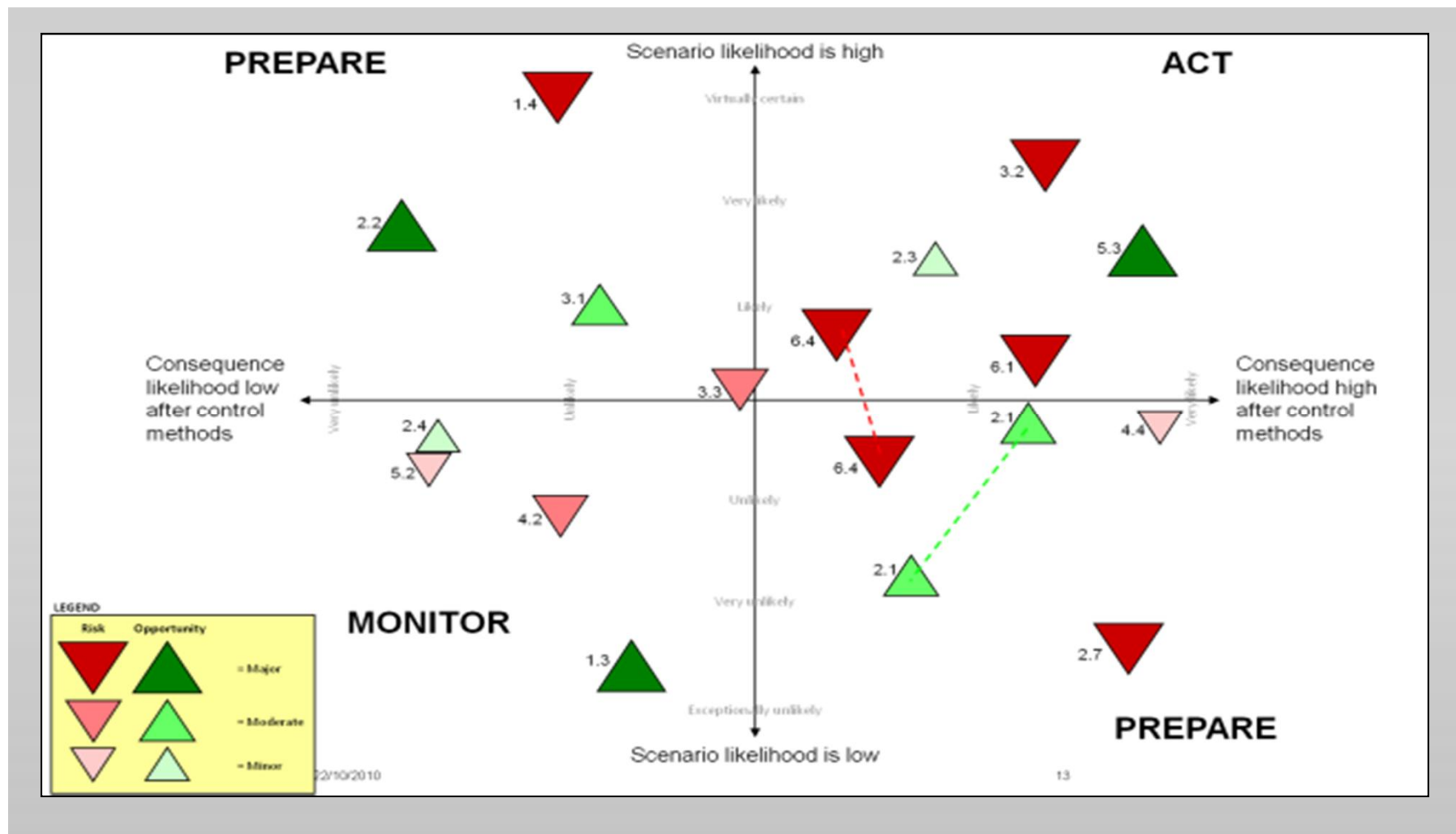
Risk may be positive i.e. opportunity

Example: Effects of climate change on power and heat plants

- Tool developed for assessment of climate change related risks and opportunities; What are the risks? Are there opportunities to be exploited?
- Consists of
 - Functional model
 - Seasonal plan based on climate scenarios
 - "What if" based risk analyse
 - Result shown in tables and diagrams

Climate scenario / phenomena	Likelihood of the phenomena	Effects (+ / -)			Risk reduction control	Likelihood of the consequences
		Energy source	Power plant	Distribution network		

Effects of climate change on power and heat plants - results



Ref: Jaana Keränen, Riitta Molarius, Jari Schabel, Jenny Gode, Edward James-Smith, Noora Veijalainen, Kirsti Jylhä : The effects of climate change on power & heat plants – assessing the risks and opportunities. In Thorsteinn T. & Björnsson H. (eds.) *Climate Change and Energy Systems - Impacts, Risks and Adaptation in the Nordic and Baltic countries*. Copenhagen (2012), 195 - 215



Thank you!

Contact information:

Liisa Poussa

liisa.poussa@vtt.fi

+358-40-689 1513