



# Sound construction of risk indicators

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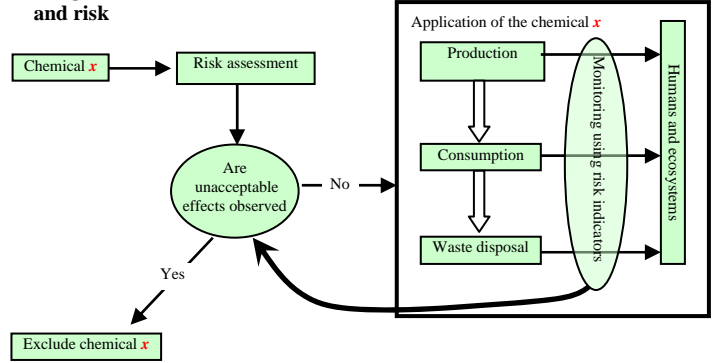
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## 1. Risk assessment is highly uncertain due to e.g.

- Ill definition of worst case, -The assessment may not analyze true worst case
- Highly simplistic calculation of exposure, -The true level of exposure may be far away from the calculated level
- Highly simplistic understanding of effect types, -The way the chemical can induce adverse effects is described by simple measures like e.g. mortality
- Only a few organisms are used for toxicity assessment. - It is unlikely, that the few organisms tested for toxicity protect all the organisms that should be protected
- Each chemical is assumed to be the only one that is present, - Mixture effects that is likely under some circumstances are neglected
- Organisms are only tested at one set of environmental conditions, - The organisms are assumed not to be stressed by other factors than the chemical exposure
- The value of the input data is assumed valid, -The test data for toxicity and other needed input data that governs exposure and effect calculations are often highly uncertain, but is applied as valid in the assessment

**Postulate: Risk assessment is uncertain, why monitoring is needed**

## 2. Integration of risk assessment and risk



## 3. Similar protection goal for assessment and indicator

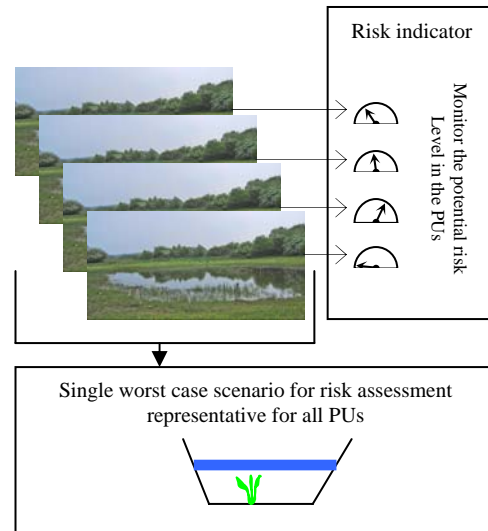
The purpose of the risk assessment is to avoid adverse effects on specific targets of value.

A real existing target that potentially can be subject to adverse effects is denoted a Protection Unit (PU)

### Examples of PU's:



## 4. The integrated risk assessment and indicator approach based on PUs



### The risk indicators need to:

- Consider the same PUs that are used to define the worst case scenario for risk assessment
- Include the same scale in time and space as the risk assessment
- At least include the same governing factors for the risk level as in the risk assessment

### The challenge of integration

- The complexity is to high to determinate the risk level for all PUs
- All the PUs need to be governed by the risk indicator

**A suggested strategy is to focus on relativistic indicators having focus on risk hot spots for the PUs**

**Thus**, every PU needs to be analyzed using risk indicators. In most cases more than one indicator are needed to describe different aspects of the complex risk problem. This yields **multi criteria analysis**, where each PU is an object and each indicator is a criterion.

### The multi criteria analysis needs to support:

- The concept of risk that governs the risk assessment: Avoid adverse effects in cases where several factors together induce enhanced risk level, **hotspots of risk**.
- The high complexity of the problem, that again sets up demands in relation to:
  - Inclusion of many different indicators for each PU to describe different aspects of risk
  - Prevent aggregation of information that violates the concepts of risk hotspot

### Example of a poor risk indicator that are used

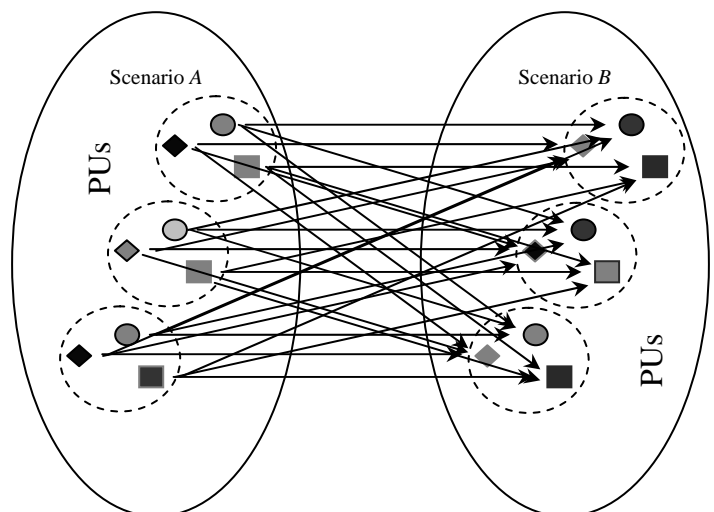
The production volume is used as risk indicator to limit the number of chemicals that needs risk assessment. The production volume is obviously a poor indicator of risk because:

- No considerations about risk hotspots are applied.
- The production volume is the only criteria for risk neglecting many other important aspects

**Development of risk indicators that are integrated with the risk assessment is lacking and new more sound indicators thus needed**

## 5. The Hotspot Driven Aggregation of risk indicators (HoSDARI)

Which one of the two scenarios A and B is related to highest risk, when the relative risk level is assumed described by several indicators?



### Reference

Sørensen, P.B.; Brüggemann, R.; Thomsen M.; Gyldenkerne S.; Kjær C (2008). Aggregation of risk indicators for time trend analysis and risk minimization. In prep