INNOVATIVE DECISION SUPPORT TOOLS FOR RISK BASED ENVIRONMENTAL MANAGEMENT IN HUNGARY

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MOKKA (2006–2008) aims and tasks

- Developing innovative **Risk Assessment** methods
  - **biological, ecological and chemical early warning systems**
  - **in situ measurement of site specific effects of chemicals**
  - **testing partition, bidegradation, etc.**
  - **in situ testing of environmental parameters, like redoxpotential and pH.**
- Developing innovative Remediation technologies for **Risk Reduction**
  - **modern bio/eco-engineering methods for prevention and remediation**
  - **in situ measurement and remediation methods.**
- Control, verification and **validation** of the the new methods.

- Better chance for **Risk Based** En**vironmental** Mana**gement in Hungary.**
- Making information available for wider public through an electronic **database.**
- Co-operating with the relevant **European projects** (EUGRIS, EURODEMO, TESTNET, NICOLE)
- Collecting all existing information on modern **Decision Support Tools.**
- Establishing a user friendly **DST** for Hungarian and European endusers.
- Increasing **trust** towards innovation.
- Supporting the **market entry** of innovative methods/technologies.
- Establishing the basis for continuation of the MOKKA database.

Participants

- **Aqua Concorde Water Analysis and Water Technology Ltd., *HU***
- **Budapest University of Technology and Economics, *HU***
- **Research Institute for Soil Science and Agrochemistry, *HU***
- **VITUKI Kht. Water Research Institute, *HU***
- **VITUKI CONSULT Co. , *HU***
- **CycloLab, Cyclodextrin R&D Laboratory Ltd., *HU***
- **DigiKom Ltd., *HU***
- **Association of Environmental Enterprises, *HU***
- ***TNO Built Environment and Geosciences, The Netherlands***
- ***r³ Environmental Technology Limited, United Kingdom***

Introduction

During the last ten years the basic components of Environmental Risk Management Tools have undergone revolutionary changes. The environmental decision makers tend to substantiate their decisions on the quantitative risk values based on the predicted environmental concentration and the predicted or measurable effects of the pollutants. The two main facets of Risk Management include Risk Assessment (RA) and Risk Reduction (RR). Comparing the assessed and the risk based target values, the risk will be reduced to the acceptable levels. Both RA and RR use innovative integrated methodologies and technologies, including early warning systems, testing of effects of high environmental relevance and remediation based on natural processes. To get a better view on the risk of chemicals in the environment, additional information are necessary on the physical and chemical form of the pollutant and its interactions with the environmental matrix and the members of the ecosystem, including Humans. The Risk Based and Effect Based approach is essential not only for Risk Management itself, but also for its main supporters; environmental monitoring and legal background. (Figure 1)

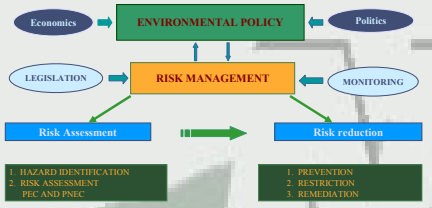

Figure 1 Tasks of Environmental Risk Management

Innovation and practice

The practical implementation of the innovative testing methods and remediation technologies is slow. A deep virtual gap exists between the scientific-technical opportunities and the actually practiced methodologies (Figure 2). The „Death Valley" is even more unbridgeable in Hungary. MOKKA supports 1. the complete innovation process for a few new RA and RR methods of the consortium members and 2. the market entry of all Hungarian and relevant European innovation in the field of RA, RR and RM by collecting and integrating them into an electronic database supported by a DST (Decision Support Tool).

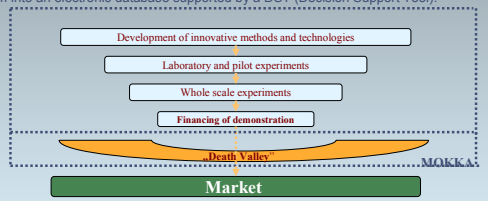

Figure 2 Innovation and practice

Most innovative methods/technologies are not put into practice, but disappear in the „Death Valley" after funding and demonstration.
MOKKA aims to support the survival of innovative Risk Assessement and Risk Reduction methods and their utilisation by the potential endusers.

Practical development: overview

1. RA: **Risk Assessment methods**
- ecotoxicity tests and other bioassays
- refinement of transport modeling by partition, biodegradation, food chain
- integrated monitoring (integration of physico-chemical and biological methods)
- (biological) early warning systems
- new possibilities and use of physico-chemical analytical methods

2. RR: **Risk Reduction methods**
- prevention
- soil and sediment remediation, mainly innovative, in situ bio- and ecotechnologies
- new methods in technology-monitoring of in situ remediation and NA
- new methods for the cost-benefit evaluation and SWOT analyses of the alternatives

3. Methodology for the **long term risk management**
4. Methodology and criteria setting for the **verification** of the RA and RR methods
5. New Risk Management (RM) methods with DSTs and databases

RA methods to be developed in MOKKA

Methods for measuring the concentration of pollutants in the environment
Physico-chemical methods for the characterization of pollutants and the environment
- Quantitative and qualitative analysis of pollutants in soil and sediment
  - Extraction and analyses of organic pollutants (new solvent mixtures, solubilising agents)
  - Different methods for metal extraction and speciation
    - total metal content
    - mobile metal content
    - metal content available for plant uptake
    - sequential extraction
- Determination of partition coefficients (Kd, Kp, Koc, Kow) between environmental phases
- *In situ* instrumental measuring methods: pH, redox, conductivity, XRF, IR for soil and sediment
- Innovations in sampling: soil moisture, suspended solids
- Remote sensing and its use in pollution and effect (toxicity) mapping
- GIS based transport models on regional and local scale
- Use and interpretation of measured env. parameters and pollution data in RA and DST

Biological methods for measuring the actual effect of the contaminants
- Quantitative and qualitative characterization of the soil microflora, diversity, resistant species
- Early warning systems using chemical and biological methods
- Determination of characteristic enzyme activities
- Biodegradation tests with high environmental relevance
- Rapid bioaccumulation tests for the characterisation of mobility and food chain effects
- Direct contact toxicity tests for whole soil and sediment (bacterial, plant, animal testorganisms)
- Microcosm tests (harmful effects, biodegradation, food chain)
- Mutagenity tests for whole soil and sediment
- New, more sensible endpoints of the biological and toxicity testing methods
- The efficient use and better interpretation of measured effect data in RA and DST

RR methods to be developed in MOKKA

Remediation methods to be developed by the consortium members of MOKKA
- In situ flushing of soil polluted with apolar pollutants: the application of cyclodextrin a new availability-enhancing agent:
- Ex situ biodegradation combined with soil flushing with cycylodextrin
- Integrated chemical and phytostabilisation by using stabilising additives and selected, not accummulating and resistant soil species.
- Revitalising and revegetating dead soils.

DSTs and Databases

The Decision Support Tools (DST) intend to help various endusers, like politicians, managers, owners, authorities, consultants and vendors, but it also serves as basis for education and self-education. It will be Hungary-specific considering its legal aspects, contents and users. Different DSTs will support the decisions on 1. different problems (inherited pollution, not known contaminants, identified source, point and diffuse sources, secondary sources, complex pollution, etc.), 2. levels (problem characterisation, site assessment) and 3. selection of risk reduction measures, finding the BAT or an even better innovative technology. The database will be bilingual and integrated part of the EUGRIS database. The innovative RA, RR and RM methods will be in focus but all the available traditional methods will also be present and available for the DST.
The experience of EUGRIS and EURODEMO projects will be utilised.
The DST knowledge base will be stored in a relational database. The involved expert system will utilize fuzzy logic besides the strict yes/no decisions.

Expected results

As shown on the research & development scheme in Figure 3 the project tasks start from a complete individual basis: development of methods and technologies. They extend to innovative Hungarian and European techniques and technologies, that are collected into databases, then passed through multi-criteria screening, evaluation, verification and input into the WEB based decision support engineering tool, where the stakeholders, legislators, managers, authorities, contractors and first of all the owners could easily access and understand the information. The user-friendly decision support tool will contain verified techniques and technologies with 2D animation, references and decision support „recipes" based on which one could choose the Best Available Technology, (BAT) alternative or even a solution that is better than BAT (given that innovative methodologies have not been considered so far).

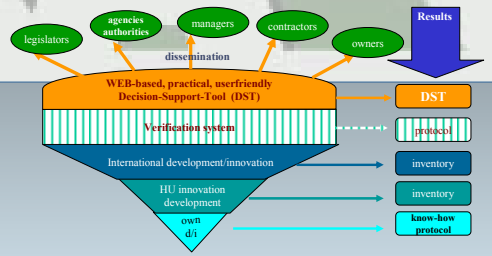

Figure 3 MOKKA R&D scheme and expected results

The fundament of MOKKA is the development of the consortium-members.
Development on Risk Management Methods and Decision Support Tools
Development on Risk Assessment and Risk Reduction methods
Creation of the database of methods/technologies: fully HU and selected EU
Integration of the database into the WEB-based Decision Support Tool (DST)
Integration of MOKKA into EUGRIS

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