

Enhancing assessments to better support reaching a consensus on their sufficiency

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Outline

- Introduction
- Assessment strategy
- “The usual”
- Numerical qualification of models
- Further qualification of the assessment
- Evaluation of maturity
- Conclusions



Image: Uniconlabs / flaticon.com

Introduction

- Radiological safety of public and environment often a concern of the wider society, regardless of the actual risks
- Matters not only for new developments, but also for continued operation, waste management and decommissioning
- In addition to matters of technical importance, it is increasingly key to build ground for societal confidence and acceptance
- Myriad of details in assessments, easy to fall in rabbit holes

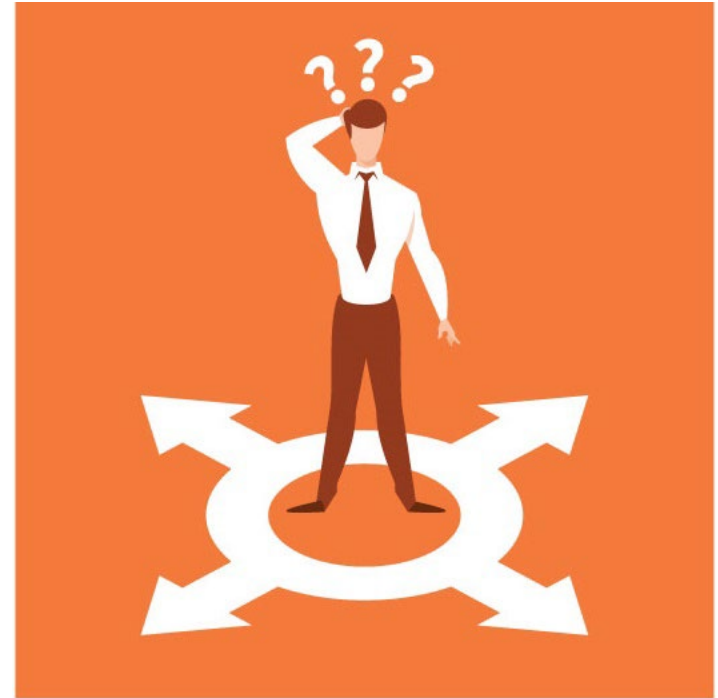


Image: vectorportal.com

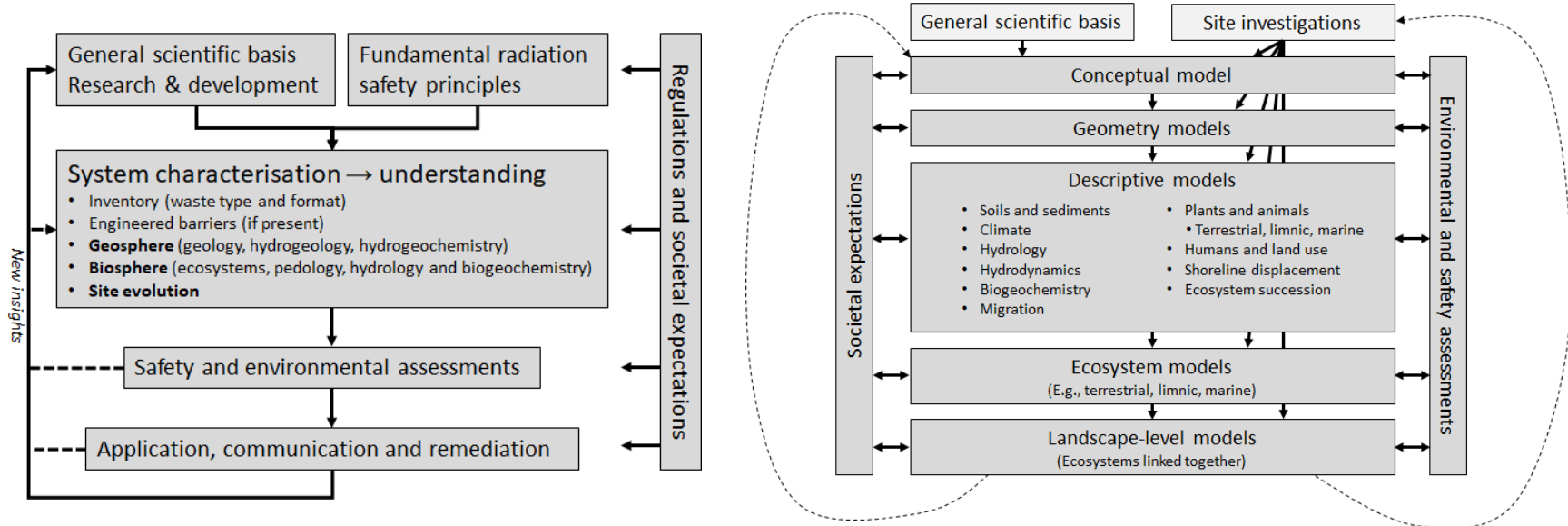
This study

- How to efficiently conduct and communicate a credible ‘radiological environmental impact assessment’ (REIA)
 - How to efficiently satisfy information needs of internal project planning, regulators, academia, local inhabitants and other interest groups
- A later-career PhD project 2023–2027
 - Co-funded by University of Eastern Finland and EnviroCase, Ltd.
- Aims at a coherent compilation of existing tools, with a roadmap
 - Focus on finding the most relevant facets
 - Holistic appreciation of a number of stakeholders and uses of the assessments
 - What do the remaining uncertainties mean to the decisions to be made
- Outline of main points presented here

Assessment strategy

- Context framing
 - Purpose, audiences, requirements, assessment endpoints, acceptance criteria, etc.
- System and site understanding
- Degree of pessimism and pluralism
- Choosing of fit-for-purpose methods and tools
- Management of uncertainties
- Reporting and communication planning
- Uncertainties-informed graded, iterative approach often found useful
 - The workload needs to be kept manageable
 - Varying focus, but also development of the assessments with the facility/activity life cycle (planning, construction, starting and continuing operation, decommissioning)
 - Helps also with communication with all audiences at all stages, but trust is built on consistent reliability!

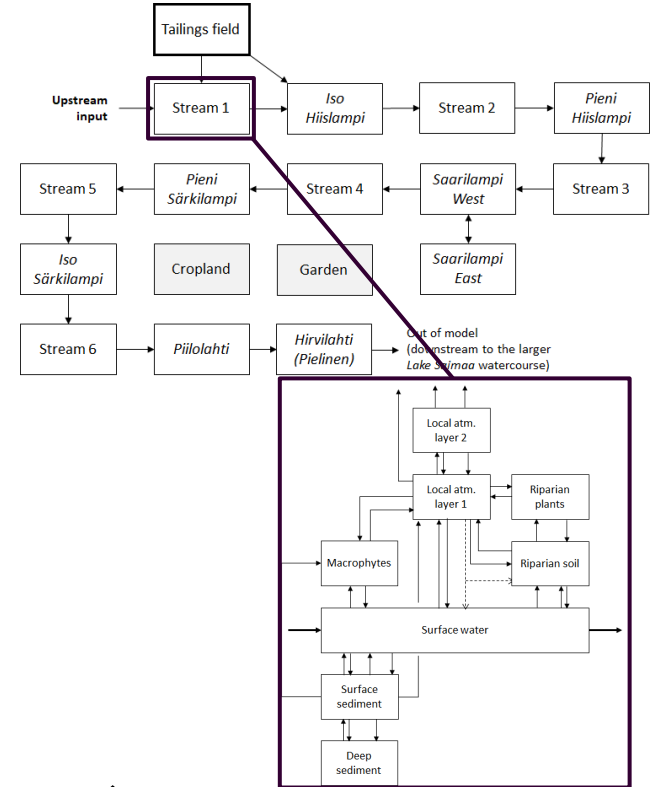
No time for the “understanding”, this time...



From: Ikonen, Lindborg & Kangasniemi 2022, **Integrated site descriptive modelling as a coherent means of step-wise enhancement of conceptual model for NORM situations** in: Management of naturally occurring radioactive material (NORM) in industry, **IAEA Proceedings Series STI/PUB/1998**, paper IAEA-CN-287/78 (p. 62 and supplements/session 3/oral)

Numerical qualification

- Sensitivity and uncertainty analysis
 - Used every now and then, in overall the most common and often the only method to explore the reliability of the models
 - Often complained computationally too demanding for larger models; our work focused on demonstrating a nested scheme (the former Paukkajanvaara uranium mine as a case study)
 - Subject to the models and data distributions used!
- Verification and (partial) validation



Further qualification of the assessment

- Numerical methods weak to capture strengths and caveats in comprehensiveness or insufficient understanding
 - But can help identifying critical aspects
 - A higher numerical sensitivity matters most where knowledge/data basis is weak
 - Acknowledgement of the difference in aleatoric and epistemic natures of uncertainties
- Further qualification of the process should aim to evidencing reliability of the overall assessment
 - Correct conclusions based on appropriate methods and knowledge basis
- A range of methods usually employed for a balanced, pluralistic overall view
 - Audits for comprehensiveness (e.g. 'FEP lists', expert review of interaction matrices and other conceptual models, serious games finding scenarios important to stakeholders)
 - Strength of knowledge basis (e.g. pedigree scoring that can be used also for parameterisation and input data of mathematical models)
 - Complementary indicators, scoping calculations, independent methods

Example of a pedigree scoring scheme

Score	Theoretical quality of model	Empirical quality of model	Social quality, degree of acceptance
4	Established theory, many validation tests, causal mechanisms understood	Experimental data, statistically valid samples, controlled experiments	Total, all but cranks
3	Theoretical model, few validation tests, causal mechanisms hypothesised	Historical/field data, some direct measurements, uncontrolled experiments	High, all but rebels
2	Computational model, engineering approximations, causal mechanism approximated	Calculated data, indirect measurements, handbook estimates	Medium, competing schools
1	Statistical processing, simple correlations, no causal mechanism	Educated guesses, very indirect assumptions, 'rule of thumb' estimates	Low, embryonic field
0	Definitions/assertions	Pure guesses	None

Costanza *et al.* 1992 *Environ. Manag.* 16: 121–131

Supported statement of maturity

- Synthesis balancing uncertainties and evidence in the assessment context
 - Systematic approach to evidence supporting the case
 - Overall uncertainties and their meaning, would further work help?
 - From “what if” to “so what”
- Demonstration of meeting the context needs
 - Stage in the decision-making process and ‘assessment history’
 - “Are we confident in that we do know enough”



Photograph: Ari Ikonen

Conclusions

- Aim at collecting a repertoire of conventional and novel approaches and tools
- A roadmap for project-specific application
 - Emphasising focus, needed to manage the workflow and to communicate understandably
- Expected to considerably enhance focus, understandability and traceability of radiological environmental impact assessments



Photograph: Ari Ikonen



Thank you

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