Pilot Study: Feasibility of uncertainty handling og ERA Acute

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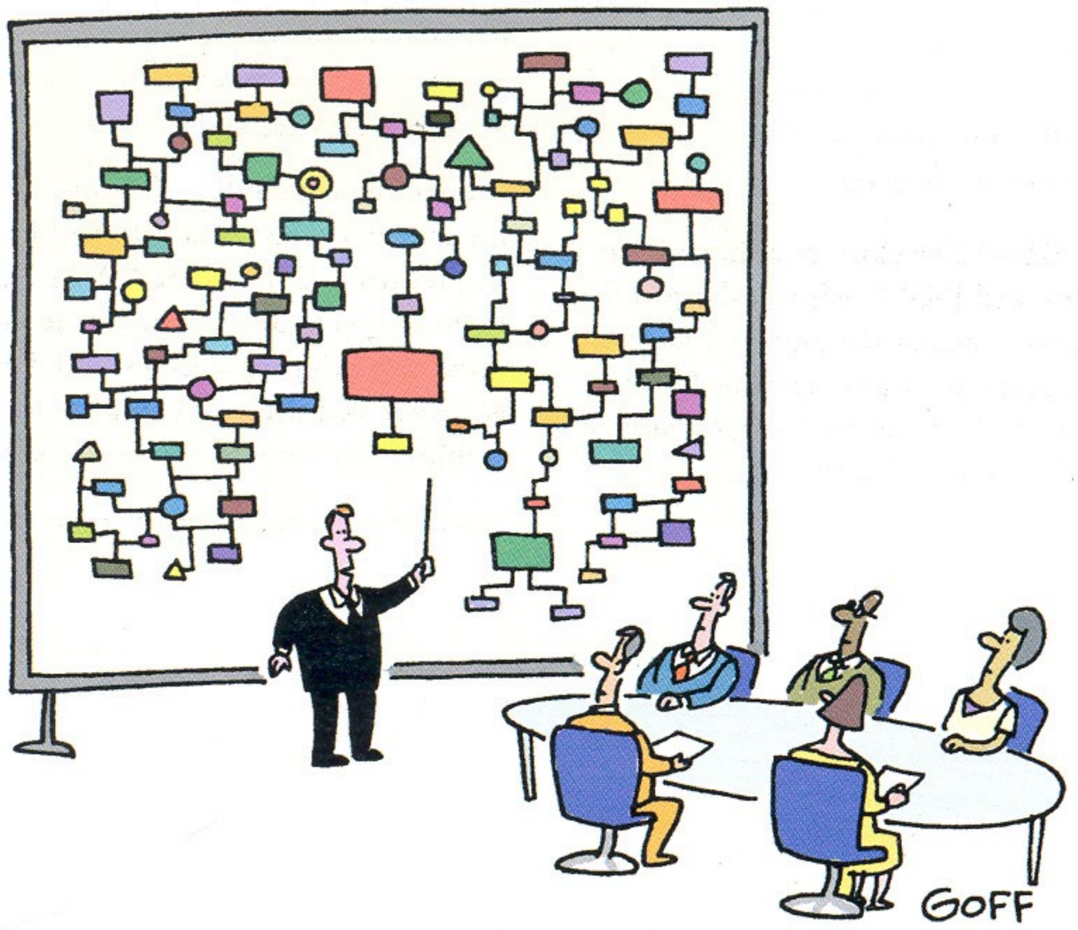
Uncertainty handling in ERA Acute



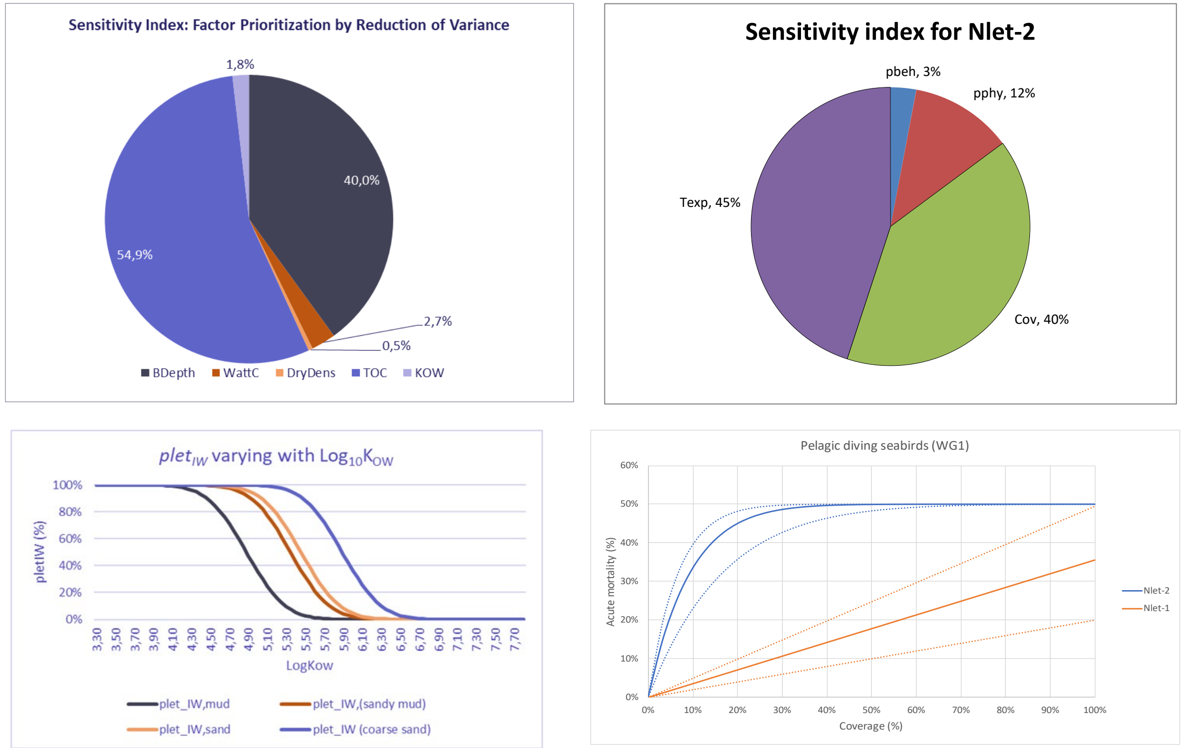
- Complex, multi-compartment model
  - vs. simpler models (PEC/PNEC, thresholds etc.)
- Complex impact, lag and restoration time functions
- Many parameters
- Risk “number” vs. safety margins
- Uncertainty studies “could go on for ever” if to be accurate

Feasibility study

- Goal: *Ensure that ERA Acute does not under-estimate risk*
- Simple solution: Multiply with a "safety factor" to account for uncertainty
- But what is the correct factor?
- Many factors in several functions for each compartment, summarizations
- All factors have varying degrees of:
  - Natural variability
  - Uncertainty in measurements/assessments/analysis/modelling
  - Importance in the functions with respect to sensitivity

Narrowing it down to scope and budget

- Phase 4 had carried out sensitivity studies of the functions
  - Extensive: Surface and Sea floor
  - Less extensive: Shoreline and water column
  - Deterministic and Stochastic testing
- Had knowledge of which factors the functions are most sensitive to, but:
  - Actual sensitivity results are dependent on the boundaries chosen (stochastic testing results)
  - Boundaries of testing based on literature values
- Increasing the accuracy of the sensitivity evaluations and finding «exact» uncertainty estimates would require much more work than budgets allowed
- Decided for a pragmatic approach possible within budget.
- Use results of Phase 4 sensitivity quantification and score using additional qualitative assessment



Examples of results from Phase 4 sensitivity testing of parameters

Scoring system

- Utilize the results of the sensitivity testing as much as possible
- Use a scoring system made available by DNV GL for input data to MIRA
  - Same scoring still applies for the inputs that are common between MIRA and ERA Acute
  - Score the ERA Acute-specific parameters using the same approach
  - (Settings I-IV not used, recommendations for improvement/handling given (not underestimate risk))

ERA Acute

Table 4-2 *Evaluation of variables/parameters in the environmental risk analysis.*

Def par/var	Parameter/variable	Strength of knowledge	Belief in deviation from assumption	Sensitivity with respect to assumption	Setting (I-VI)
	Input from customer				
Parameter	Rates/durations – numbers and size	**Moderate/weak** Not all four conditions are fulfilled. The method for estimating rates is well documented and acknowledged in the industry, however often based on assumptions made regarding a rather unknown reservoir.	**Moderate** The values might deviate from its base case values if new well specific information is obtained.	**Moderate** Relatively large changes are needed to alter the end risk results. Change of durations seems to have greater influence on the results than rates.	IV
Parameter	Longest duration (time to drill relief well)	**Strong** The assumption is conservative to take into account the possible time to drill a relief well if a blowout occurs.	**Low** The longest duration is a conservative number and it is unlikely that it will vary much.	**Low** Large differences are necessary to change the end risk results.	I
Parameter	Spill frequency (generic vs. well specific frequency)	**Moderate/weak** The frequency does not fulfill all conditions to become strong.	**Moderate** Can deviate some if a new event is included or a more specific WRA is performed.	**High** Small changes may result in an altered environmental risk.	VI
Parameter	Oil type	**Moderate/weak** The oil type is rarely well known before an actual weathering study has been performed. Often reference oil is used to describe the oil in the reservoir, however this oil type is chosen based on limited available information. By having more information one will have a more solid base for choosing the most accurate oil type	**Moderate**. The deviation depends on the available information regarding the expected oil type. Given a change in some of the parameters that characterize the oil, a different oil type might be more applicable.	**Low** Oil characteristics affect the weathering of oil in the environment which will affect the end results. Minor differences in oil characteristics will give limited impact. However, are the oil characteristics very different from what assumed, the differences may be profound.	IV
Parameter	GOR	**Moderate/weak** The GOR is based on the available data; however these data might not be well understood. If several reservoirs are included in the analysis, this may not be reflected in the modelling.	**Low** New or adjusted information about the well may alter the calculated value.	**Low** Large changes required in order to alter the end risk results.	II
Parameter	Well location	**Strong** The drilling location is chosen as the modelling location. Small changes in the well	**Low** The well location may vary some if the input data received was not accurate	**Low/Moderate** If the location is offshore the answer would be low, however if the location is	I

Scoring of the parameters

- Strength of knowledge:
  - Moderate/weak or strong
  - Based on scientific evaluation of the parameters’ place in the function (correctness of functions)
- (Belief in) deviation from recommended parameter value
  - High, moderate or low
  - Natural variability of the parameter value
  - Uncertainties
- Sensitivity of function to the parameter
  - High, moderate or low
  - From sensitivity testing in Phase 4
- All four compartment parameters were scored

- ***Strength of knowledge (function where it is used):*** How strong is our confidence in that the risk function in which the parameter is used is a valid mathematical representation of the mechanism of impact/restoration?
- ***Belief that the value may deviate from the average assumption:*** Natural variation of parameter. Do we believe that the values have a high natural tendency to vary from the base case (mean). E.g. if a (standard deviation) (SD) is quantifiable, this can be used to assess.
- ***Sensitivity of function to parameter (sensitivity index):*** How sensitive is the model/function to variation in this parameter?

Tables like this for each compartment

Table 9. Summary of assessments or calculations used as basis for classification in the sea surface.

Function	Main parameter	Strength of knowledge (*function where it is used*)	Belief that the value may deviate from the average assumption (Natural variation of parameter)	Sensitivity of function to parameter (sensitivity index)	Comments/recommendations on handling to ensure risk is not under-estimated
Impact & Impact time	p_{beh}	Moderate/weak. Due to limited data and large natural variation it is difficult to assign a specific *pbeh* value. The assumption that behavioural factors will affect p_{exp} is strong.	Moderate	Moderate	A higher value is conservative. Each VEC have three estimates (low, intermediate, high), this using high is most conservative. Alternative, use all to obtain larger credible interval.
	Cov	Moderate/weak. The parameter depends on other parameters evaluated as Moderate/weak. The assumption that that exposed area will affect p_{exp} strong.	High	Moderate	A higher value is conservative. Coverage is calculated by the oil drift model. Use Best Practice for ODS set-up to ensure comparable and reliable predictions of the statistic.
	Texp	Moderate/weak. The parameter depends on other parameters evaluated as Moderate/weak. Based on stochastic result (i.e. estimated over the whole simulation period). The assumption that the exposure time will affect p_{exp} is strong.	High	High	A higher value is conservative. Exposure time is calculated by the oil drift model. Use Best Practice input data and setup for the ODS to ensure comparable and reliable predictions

Issues for making recommendations

- Using a safety factor to account for uncertainty deemed unfeasible at this point
  - Finding the right factor not possible at this point
  - Recommended choice of conservative factors amplifies conservativeness throughout summarized risks
  - Adding factors to this could make all activities high risk and reduced decision-making value of ERA Acute
- Probability distributions of each parameter commonly used to illustrate uncertainty (95 % sure the parameter value is 1-100 000…)
  - 49 parameters in total, calculation of values with high and lowestimates for each increases calculation time, unfeasible.
- Scoring system gives a qualitative overview of the uncertainty associated with each parameter
  - Important for transparency of the methodology
  - Documentation of the results
- Scoring system gives a ranking of the most important parameters for improvement of data.

Recommendations

1. Use reasonably conservative parameter values.
2. Continuous improvement of parameter certainty
   - Use scoring system to identify and prioritize parameters for which more accurate values would reduce uncertainty (value for money)
3. Industry regional standards
   - Reduces variability between analysis (all equally wrong…)
   - Data sets, input data, best practices, common recommendations for parameter values etc.

Input to guideline

- Use the *conservative* values included in the method reports and current guideline
- Use the conservative “QSAR” approach to estimate larvae losses in water column impact calculations, not THC-time-weighted average
- Use *quality* data sources from acclaimed institutions
- Seek *improved* data for the factors to which the model is most sensitive to where possible
- Use *standardised* data sets and input parameters for analyses that are to be compared

Thank you!

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