



COST Action  
TU I402

Quantifying the Value of Structural Health Monitoring



# Risk-based Design of an Offshore Wind Turbine Support Structure using Vol

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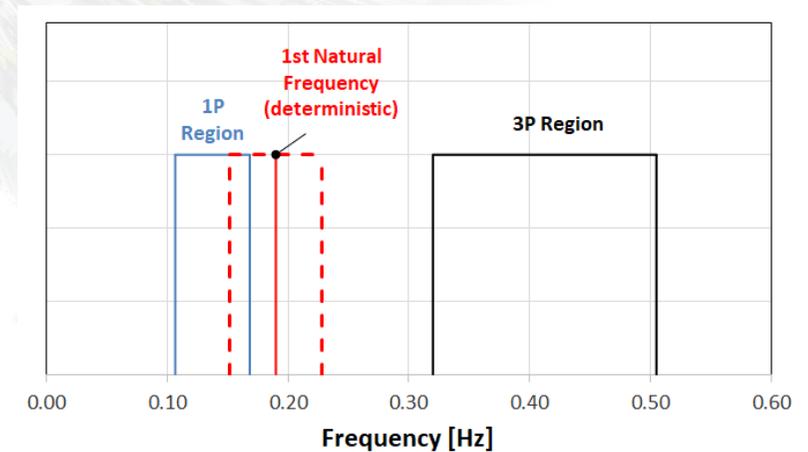
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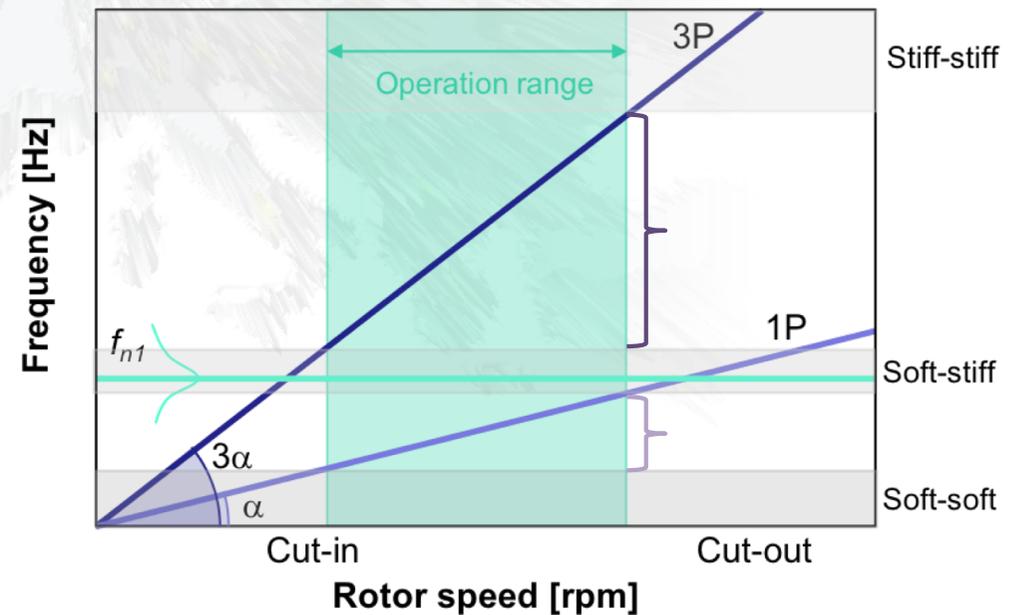
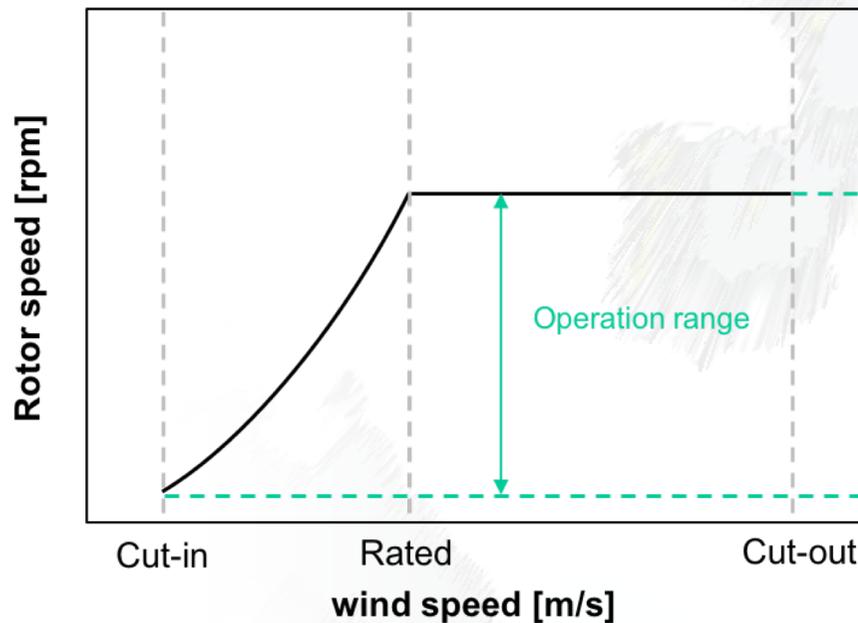
## 1. Decision scenario

- The **monopile** to support an OWT is **to be designed**.
- A modal analysis is performed to assess the **resonance hazard** with the **1P** and **3P** regions.
- Large uncertainty in the soil-structure interaction exists.



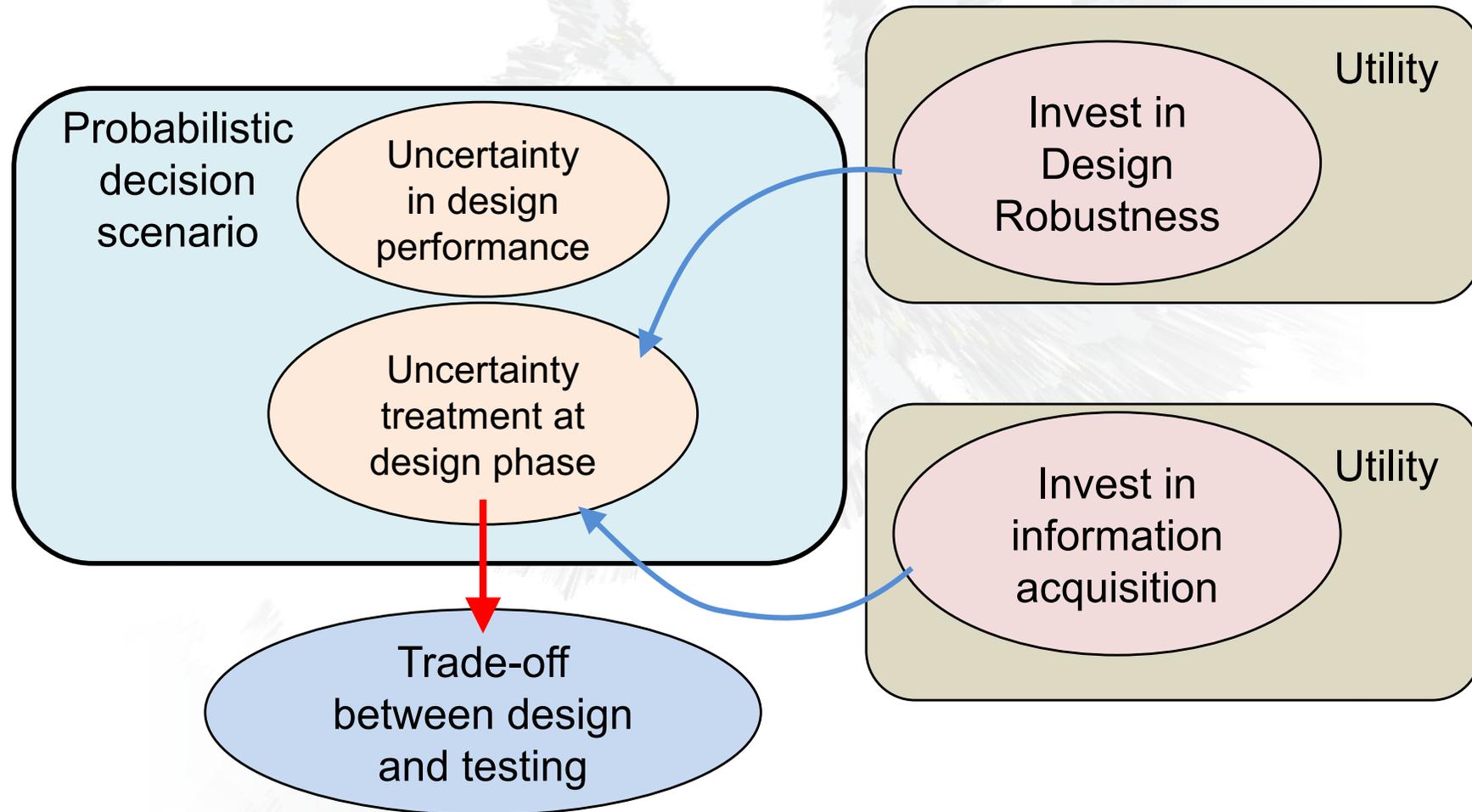
## 1. Decision scenario

- Designs in the soft-soft region not feasible due to excessive flexibility
- Designs in the stiff-stiff region are not cost-effective solutions
- For increasing rotor diameter, soft-stiff region becomes narrower  
 E.g. Siemens 3.6 MW:  $\omega_{min}=5$  rpm;  $\omega_n=13$  rpm. Soft-stiff  $\in\{0.21$  Hz,  $0.25$  Hz}

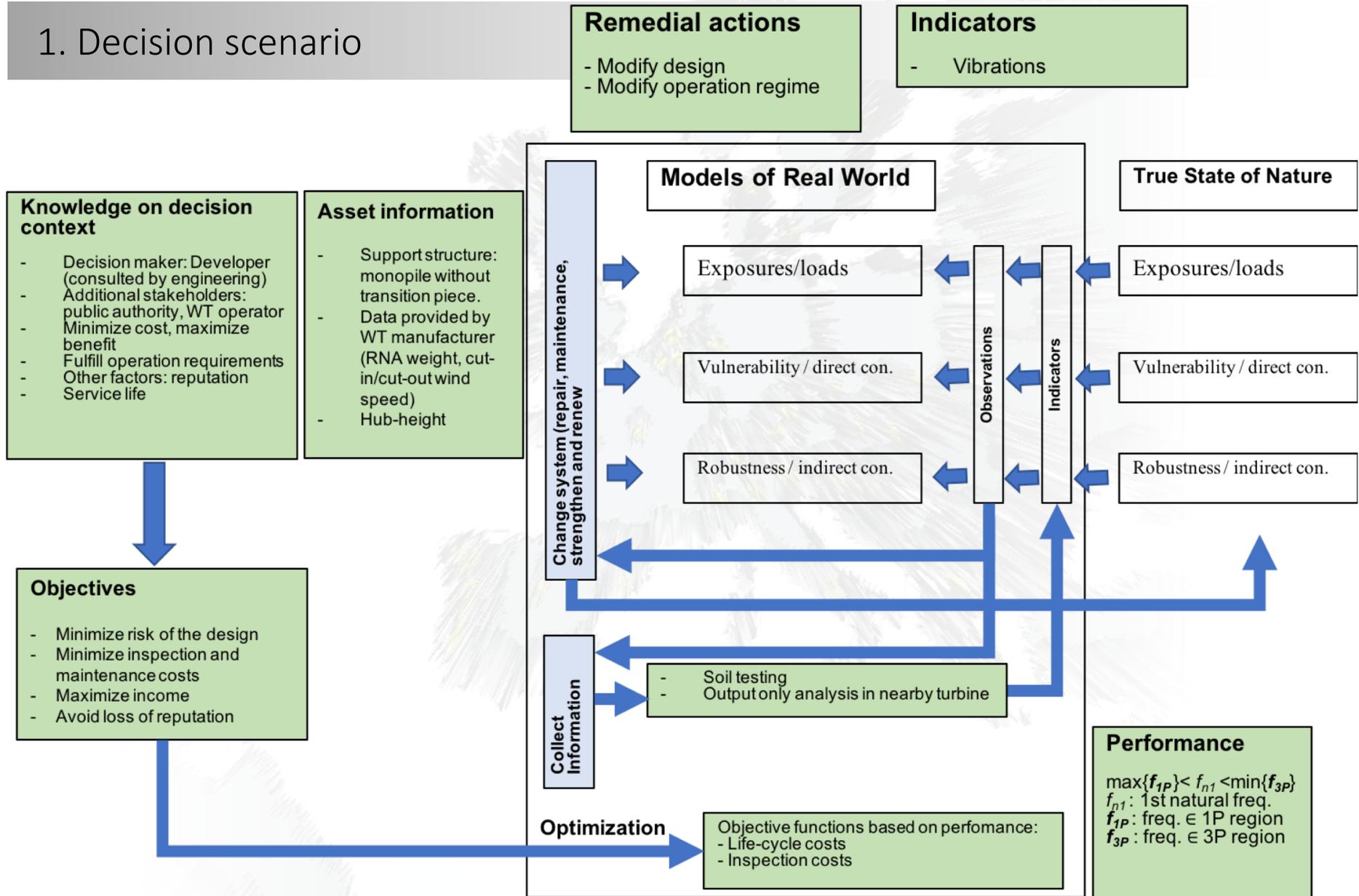


# 1. Decision scenario

- Vol Analysis can be used during the design phase



# 1. Decision scenario

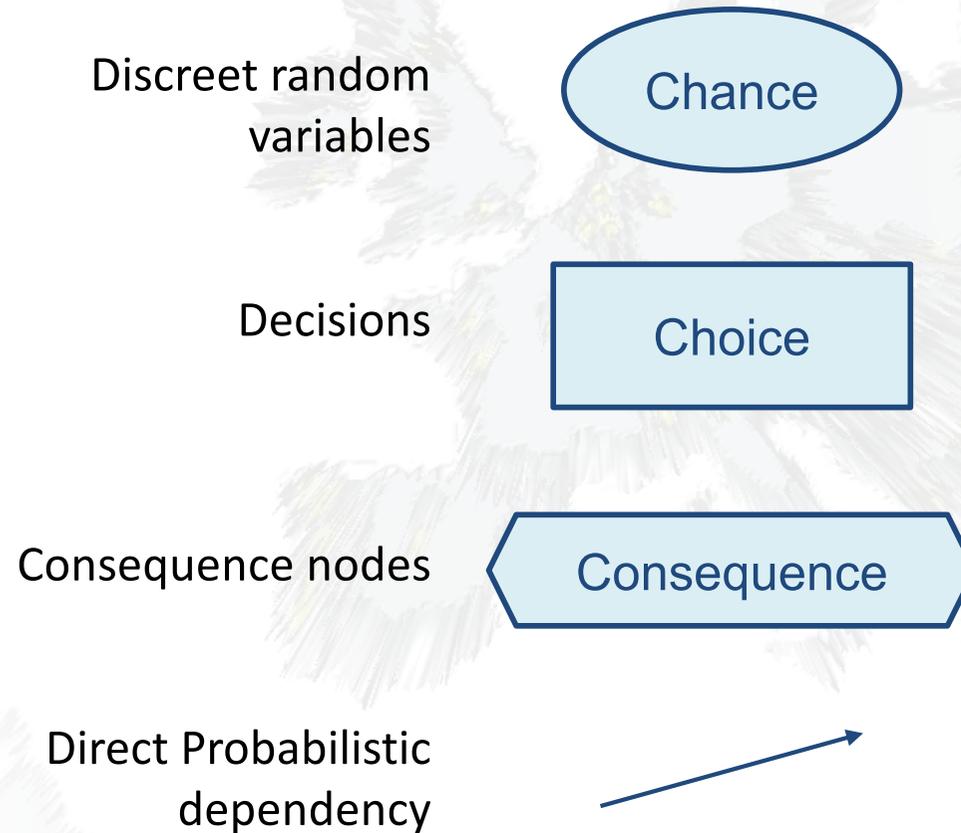


# 1. Decision scenario

		Description	
<b>Decision scenario</b>	Decision maker	Developer	
	Decision point in time	Design	
	Life cycle phase	Design/Operation	
	Objective	Minimize cost and risk and maximize profit	
	Decision alternatives	Remedial actions	Modify design and/or operation range
		Information acquirement strategies and parameters	Do not test/Soil test/OMA nearby turbine

## 2. Methods applied

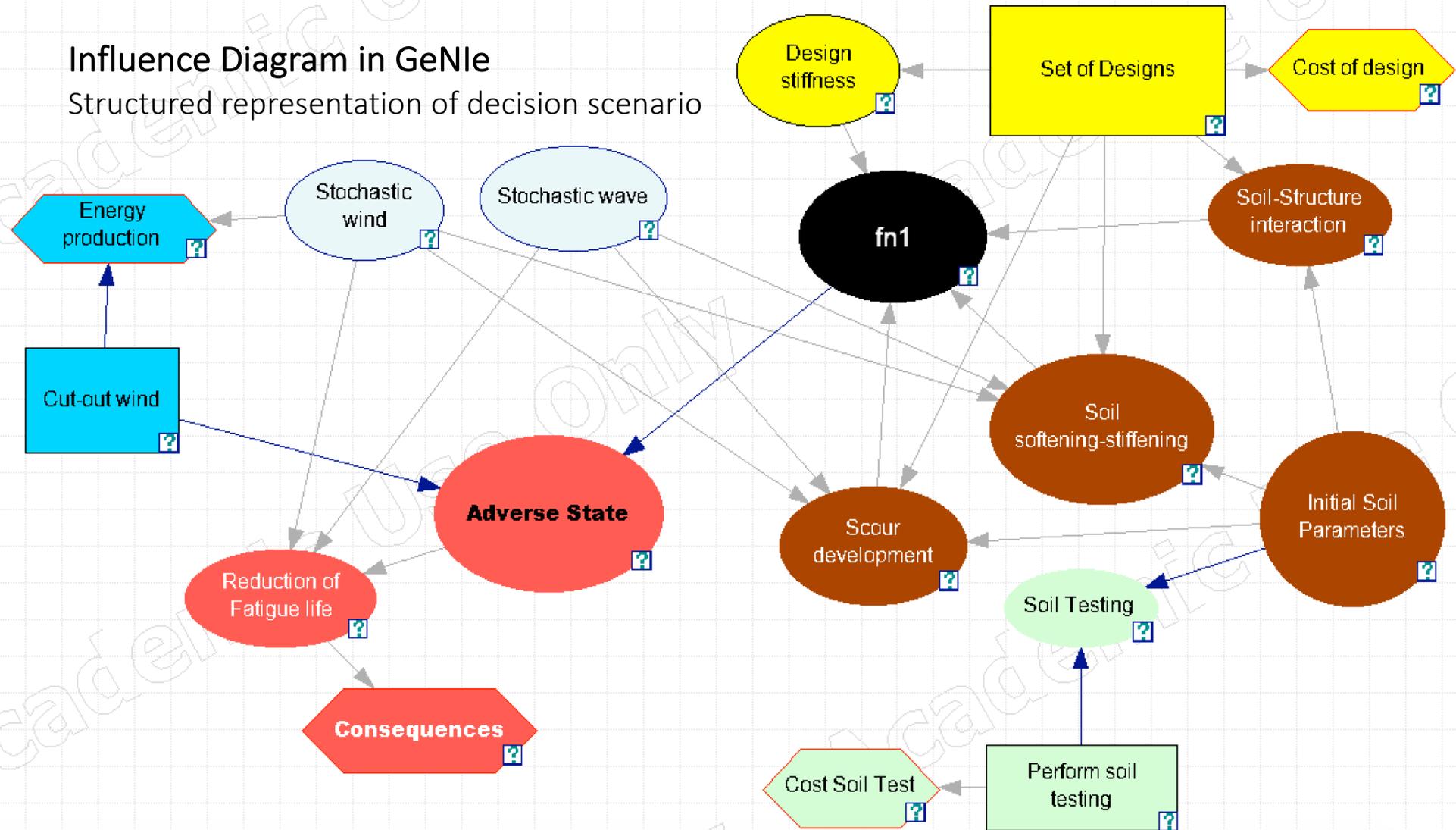
### Influence Diagrams (IDs) in GeNle



## 2. Methods applied

### Influence Diagram in GeNIe

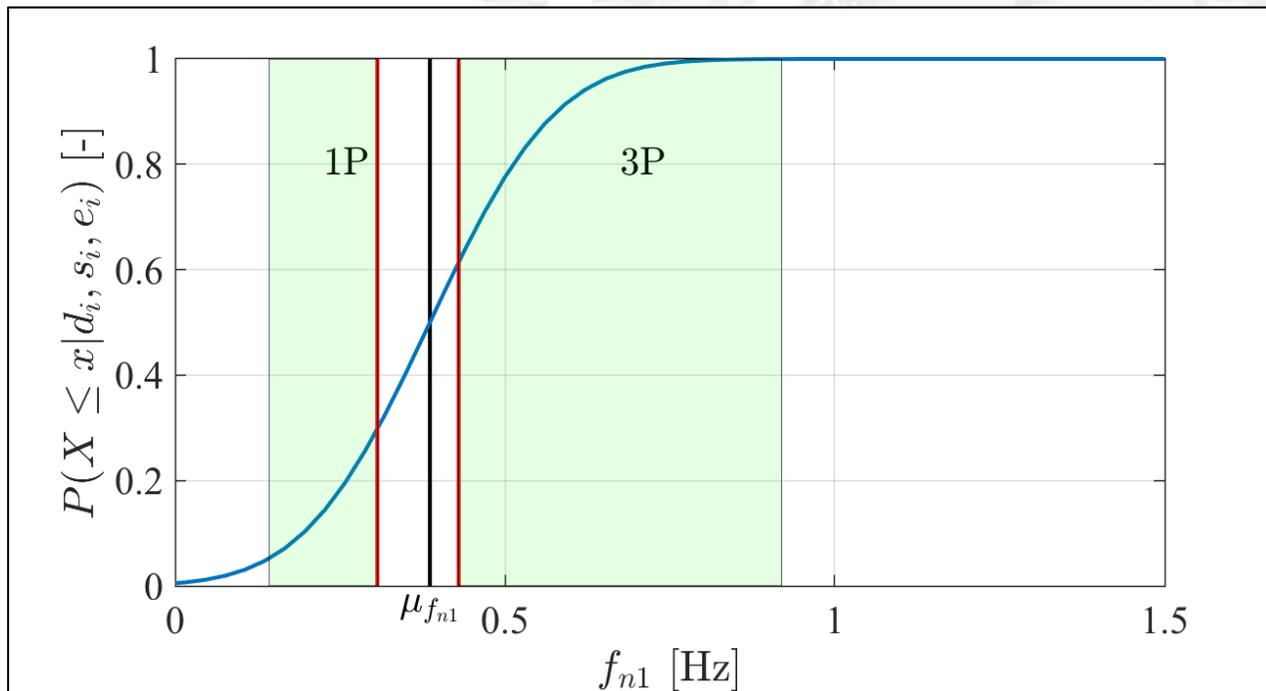
Structured representation of decision scenario



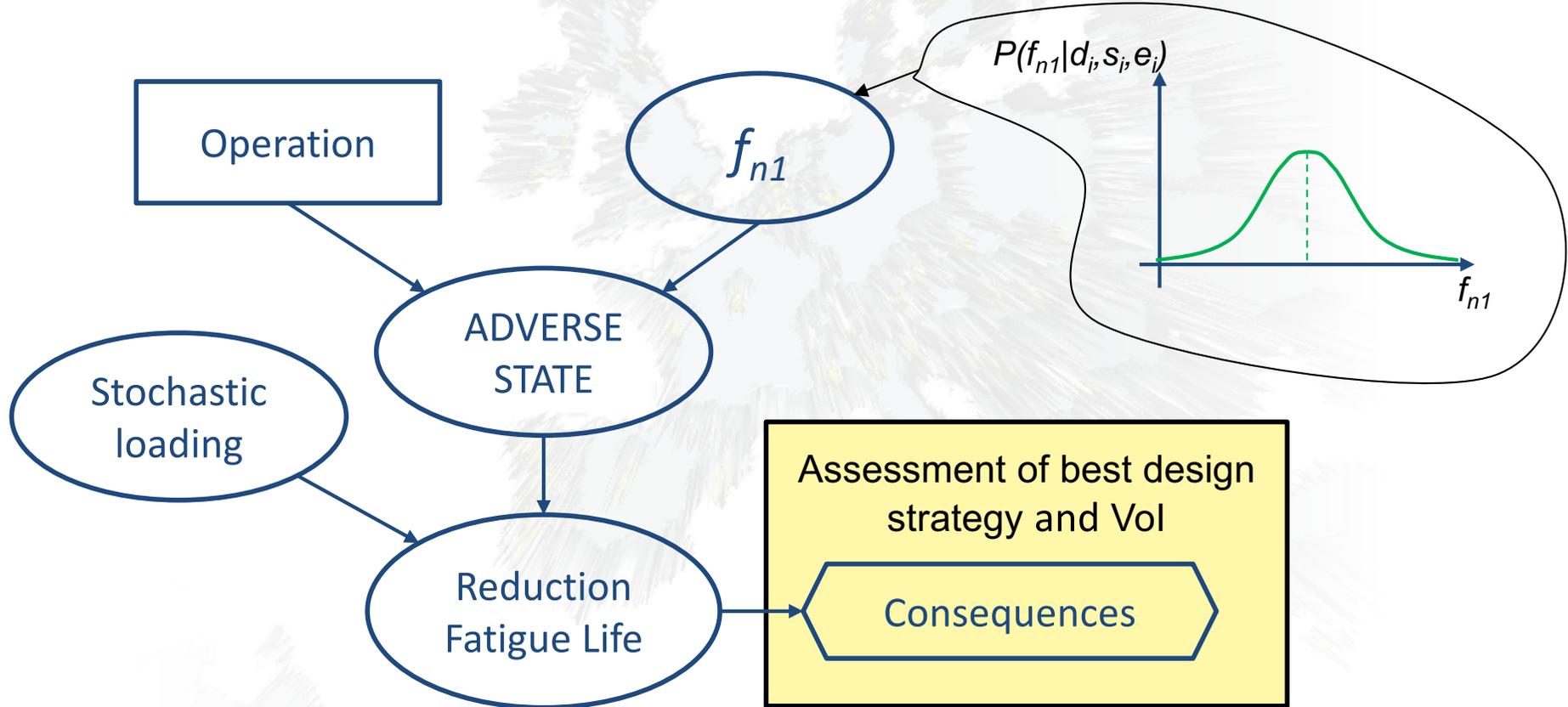
## 2. Methods applied

### Bayesian Network in GeNle

Conditional Probability Tables (CPTs) are computed for each design, each realization of soil parameters, each test choice



## 4. Value of the SHM information for the owner/concessionaire



## 4. Value of the SHM information for the owner/concessionaire

### What is the value of the Vol?

- We can map the complex interdependencies between elements in the decision scenario
- We are able to assess how the system ‘responds’ to evidence (Bayesian updating)
- It is easy to trace the sensitivity of input variations/uncertainty modeling



## 5. Open question addressed to decision makers

Any Questions?



See [fact sheet](#) for more information and updates on the case study.

Thank you for your attention

<http://www.cost-tu1402.eu/>

