Assessing systemic risks for new generation offshore wind farms on the basis of expert judgment

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Expert Judgment Workshop
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Outline

- Problem setting & motivation
- Model conceptual framework
- Protocol for Expert Judgment
- Insights and lessons learnt

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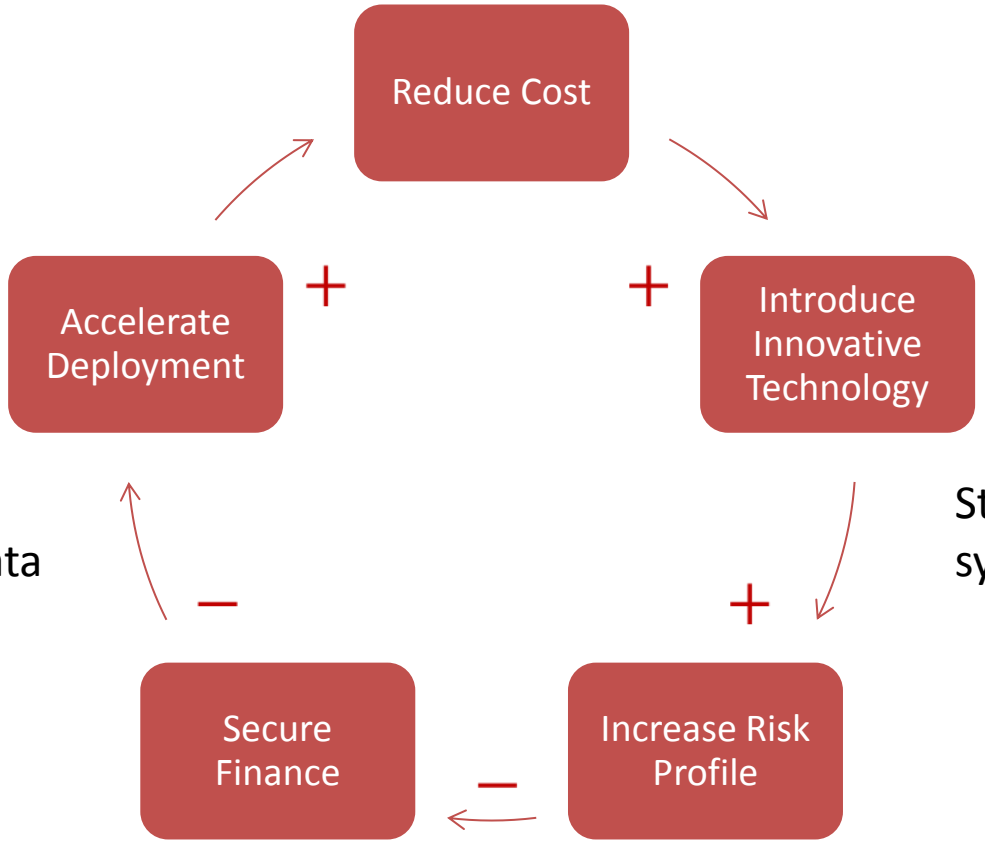
Project background

The Offshore Wind Paradox

Ambitious Renewable Energy Targets



Early life phase
No operational data

State-of-knowledge on systemic risks

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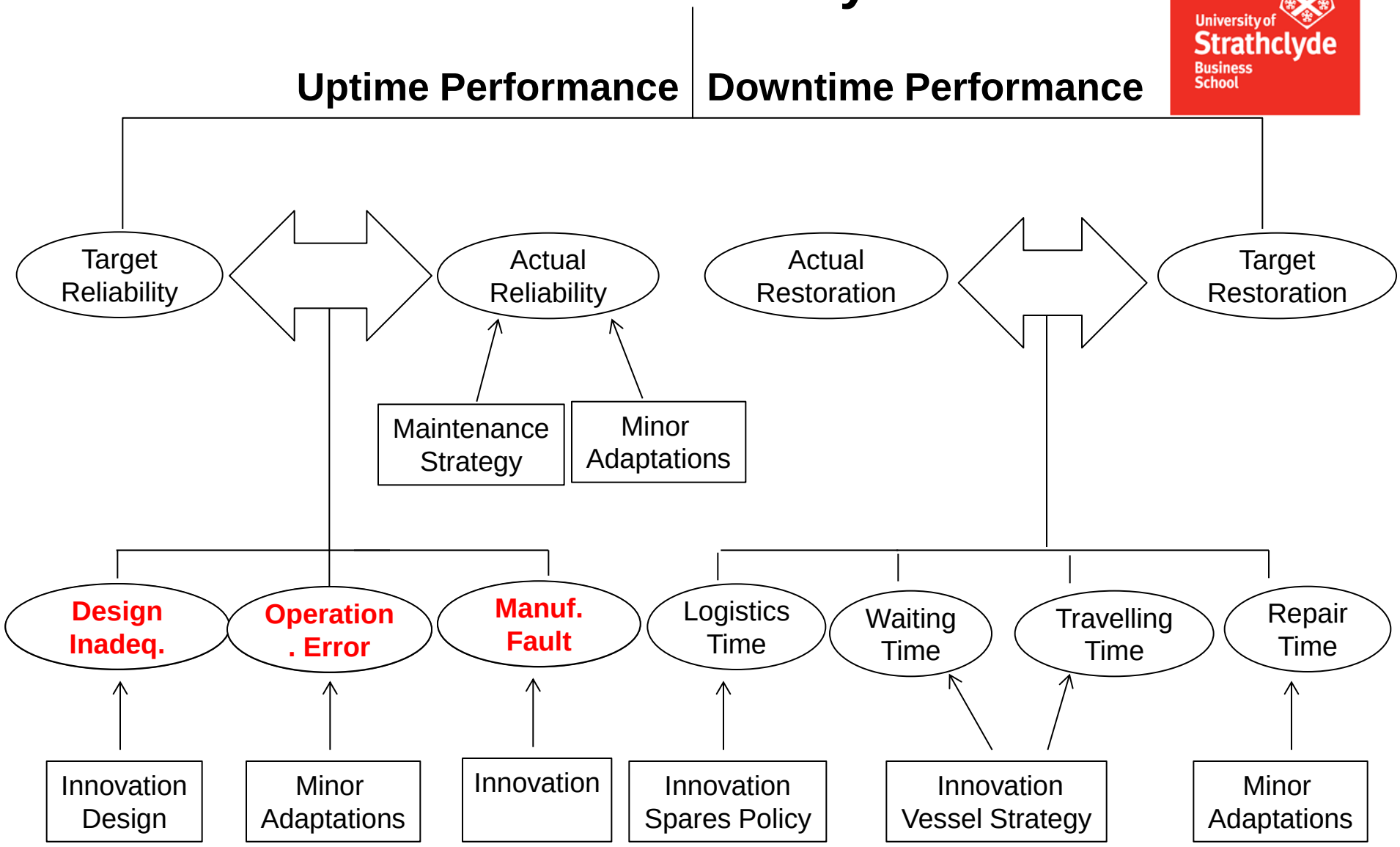
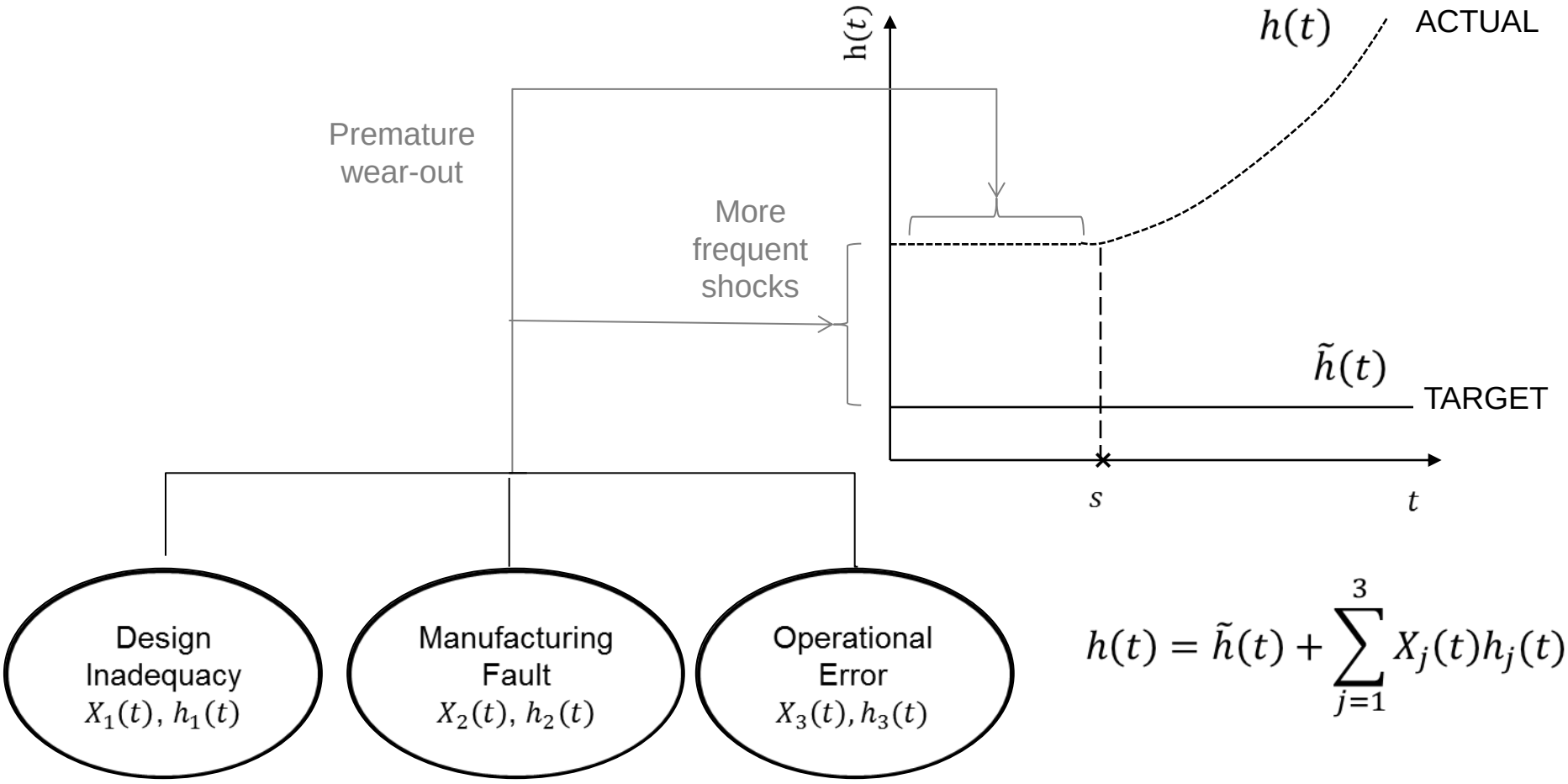
Conceptual Framework

Availability



Modelling Uptime Performance

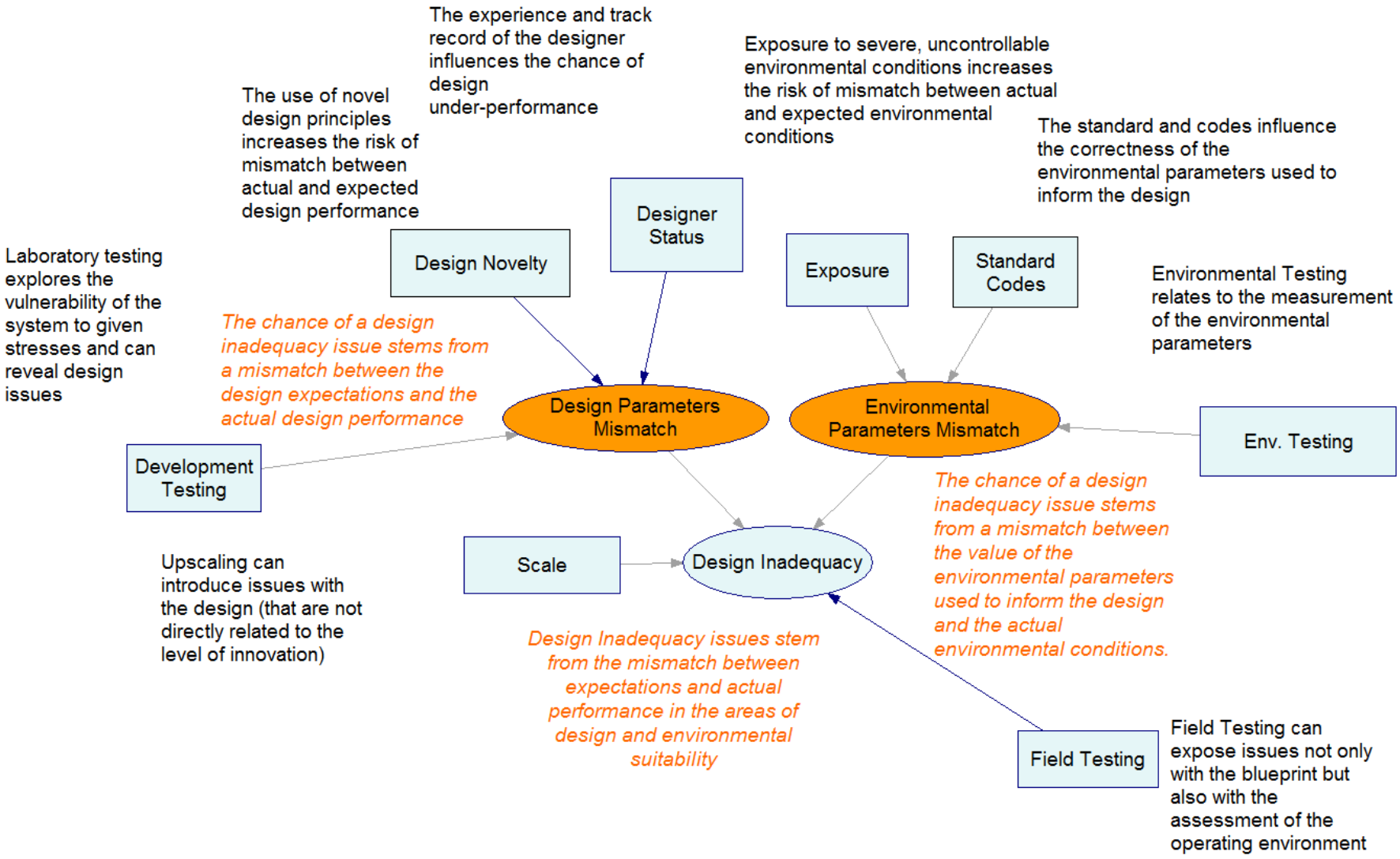


$$h(t) = \tilde{h}(t) + \sum_{j=1}^{3} X_j(t) h_j(t)$$

$X_j(\cdot)$: indicator variables for trigger j

$h_j(t)$ added hazard due to trigger j

Design Inadequacy



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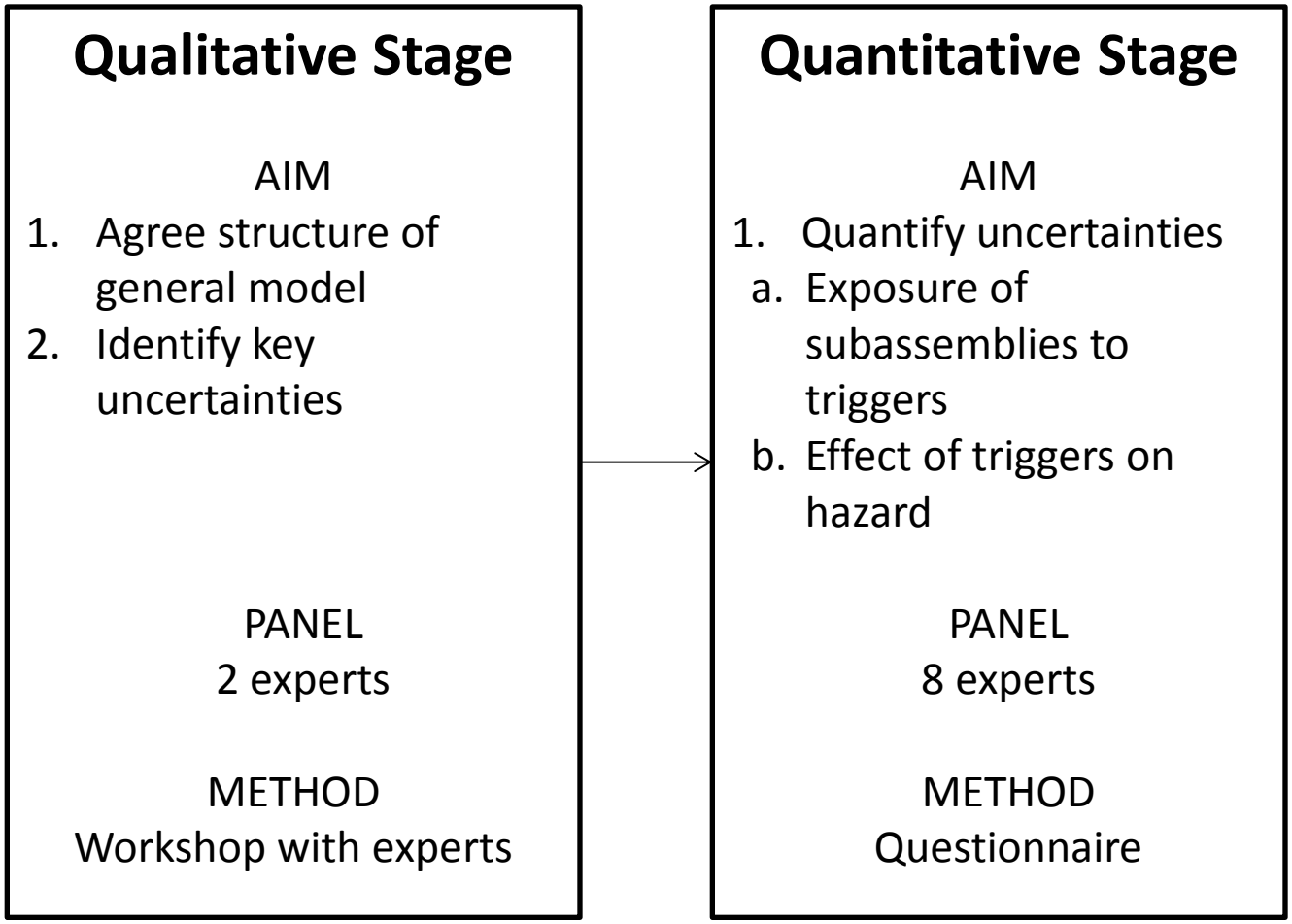
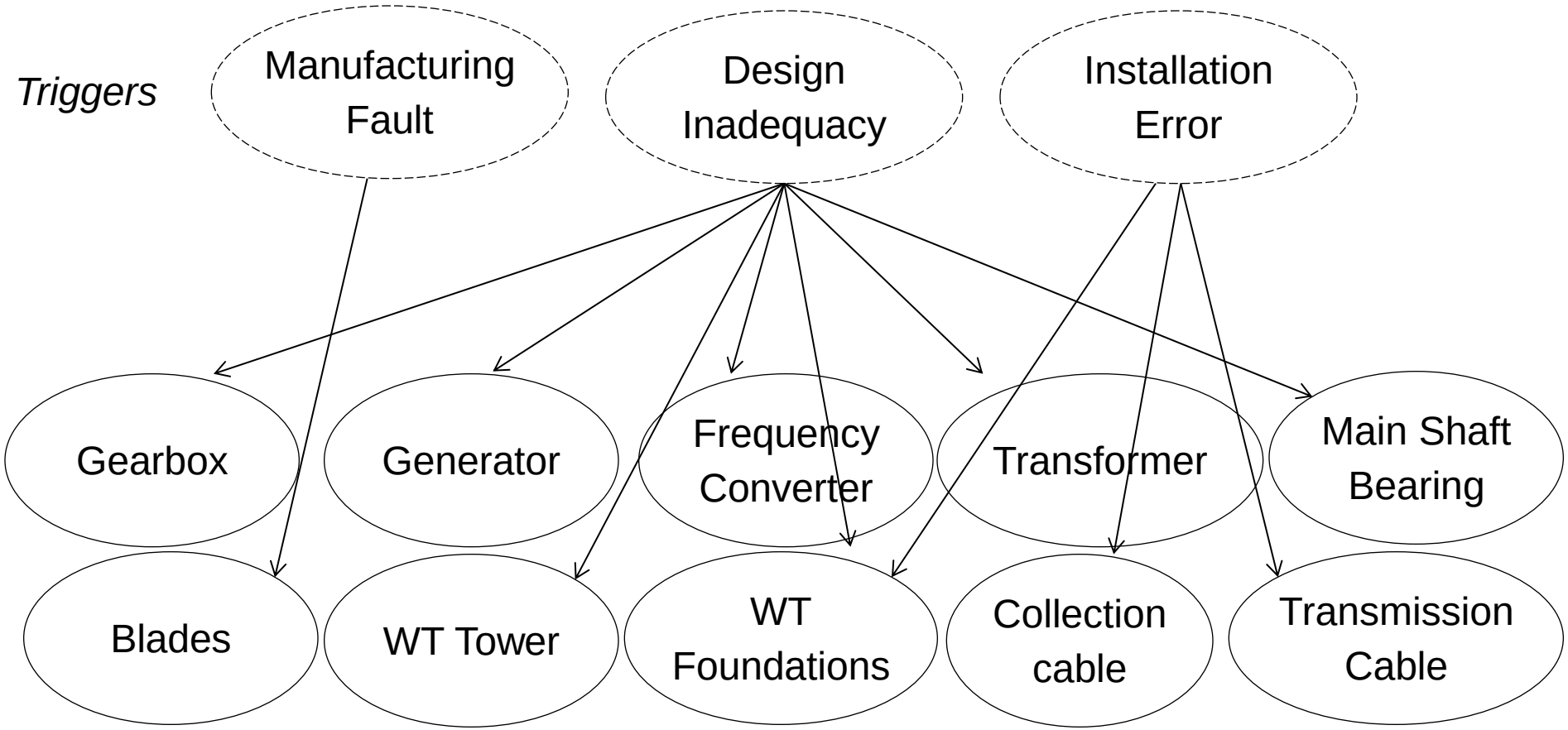
Expert Judgment Elicitation

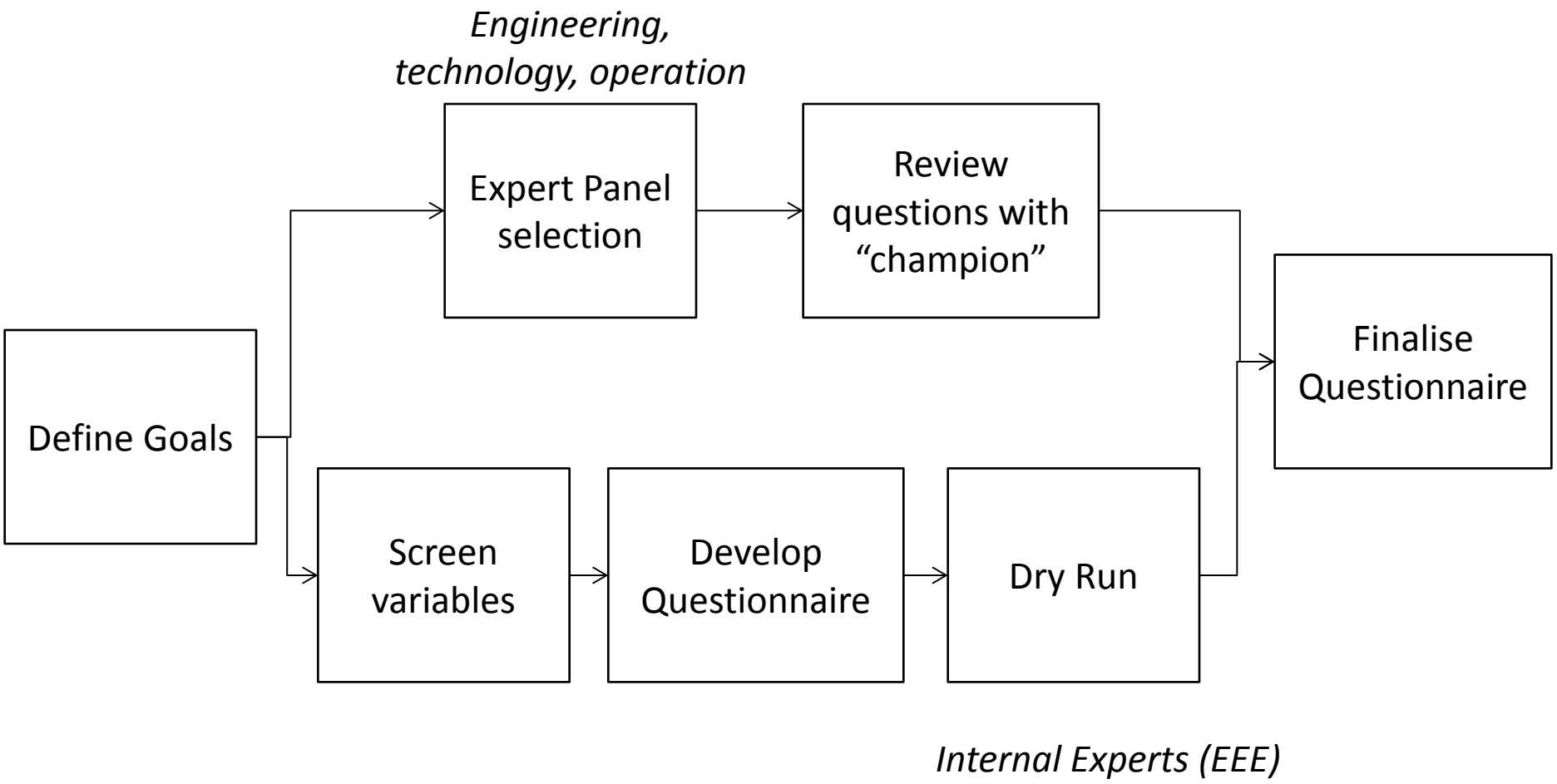
Elicitation Protocol



Qualitative Stage



Quantitative Stage



Example Question (1)

Consider a turbine that operates under normal conditions. Assume that the turbine is affected by **a design inadequacy** in the gearbox but by no other triggers. The design inadequacy causes the gearbox to age prematurely (over early life).			
After how many months of operation (since installation) will initial signs of degradation be observed?	**Lower Value** (5%-ile)	**Upper Value** (95%-ile)	**Central Value** (50%-ile)

Example Question (2)

Suppose that the subassembly receives the worst possible configuration across attributes (A, A) - i.e. **design upscale has an effect, no field testing**. This configuration results in the highest probability of a **design inadequacy**. Please provide your assessments of this probability.	
Please provide your assessments of this probability.	**Central Value**

Example: Design Inadequacy Trigger

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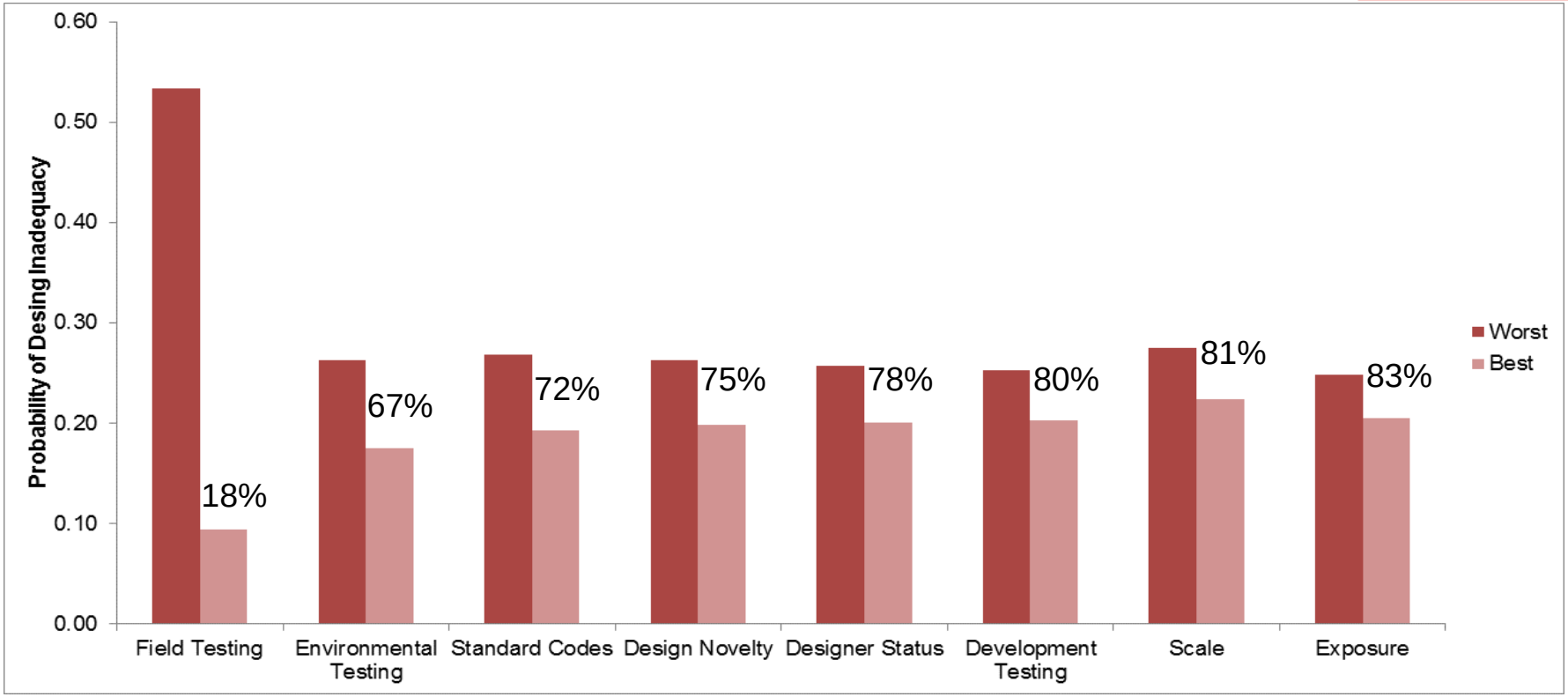

For example: Improving the configuration of a subassembly across **Field Testing** from *No Field Testing* to *Extensive Field Testing* will decrease the likelihood of Design Inadequacy from *0.53* to *0.1*, i.e. will reduce risk to 18% of its value.

Data: expert judgment

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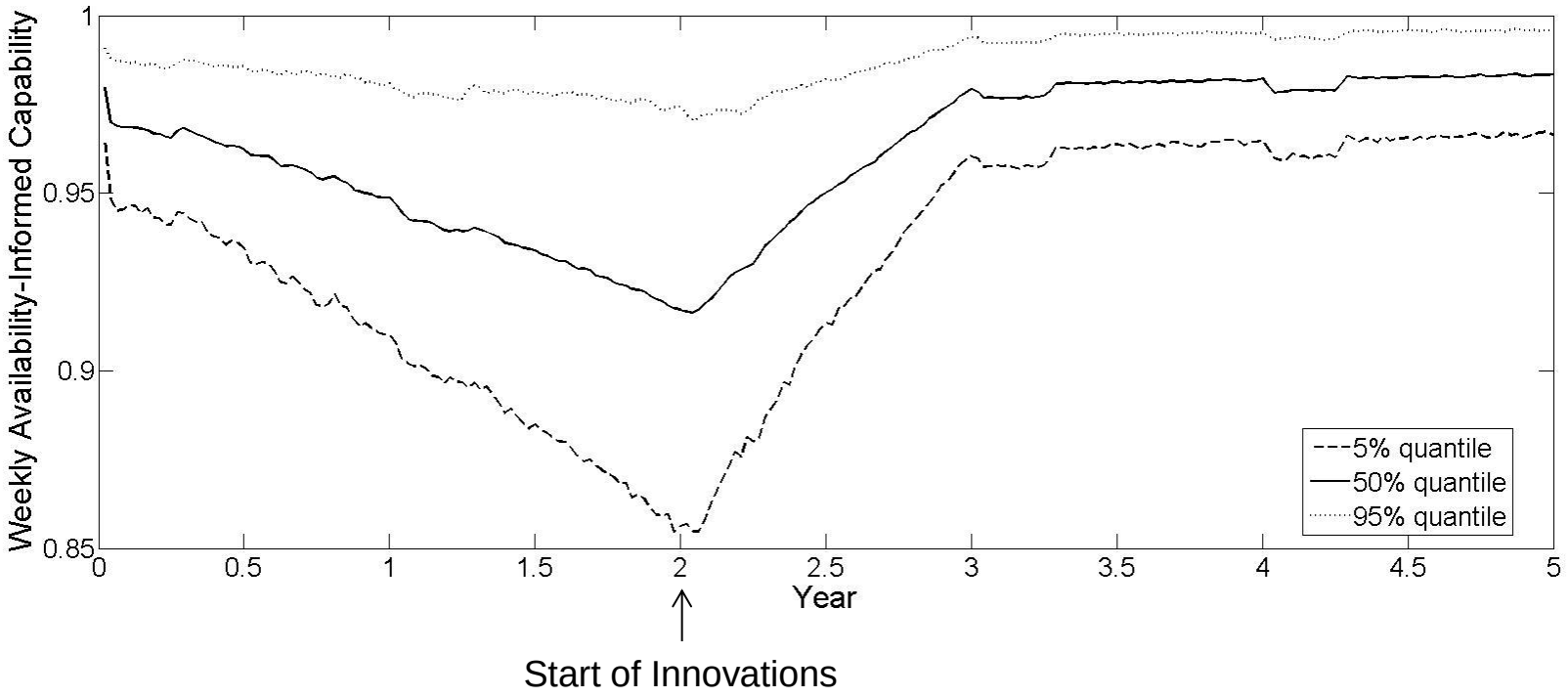
Availability Model Outputs

Availability-Informed Capability

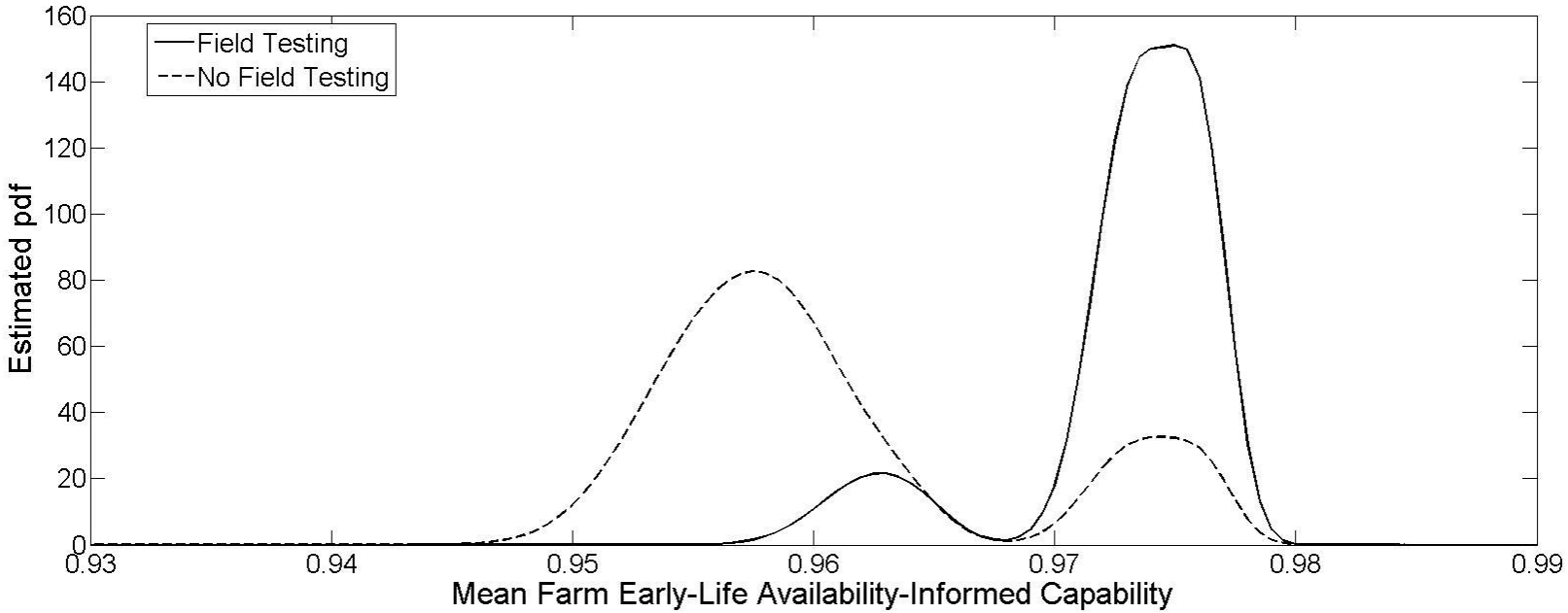
Epistemic and Aleatory Uncertainty



***Quantiles**: determined on the basis of all iterations (outer and inner loop)*

Compare Scenarios

Epistemic Uncertainty



Insights & Conclusions

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- Insights
  - Aleatory vs. epistemic uncertainty
  - Increased complexity vs. informed modelling choices
  - Consistency checking (ranking)
  - Meaningful quantities (relative risk reduction formulation)
- Conclusions
  - Provide quantitative indication of current state of knowledge regarding offshore wind risk
  - Model quantified for particular case