STRUCTURAL HEALTH MONITORING

Use cases TNO, the Netherlands | Wim Courage

TNO innovation for life

CONTENT

- Recent Projects
- Early Research Programs
- Points of Interest

RECENT PROJECTS

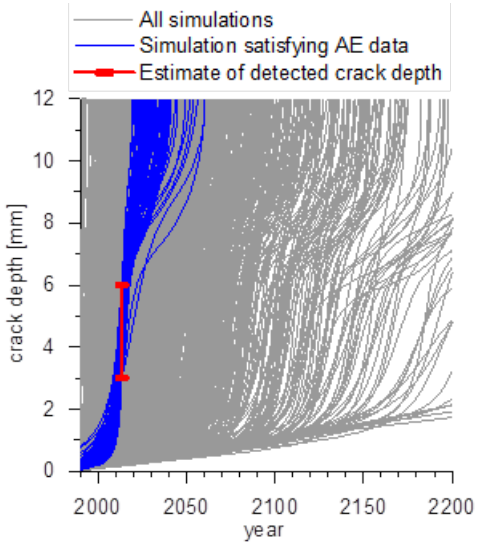
- **Bridge Life Span Demonstrator (BLSD)**
- **Tomorrow's Road Infrastructure Monitoring & Management (TRIMM)**

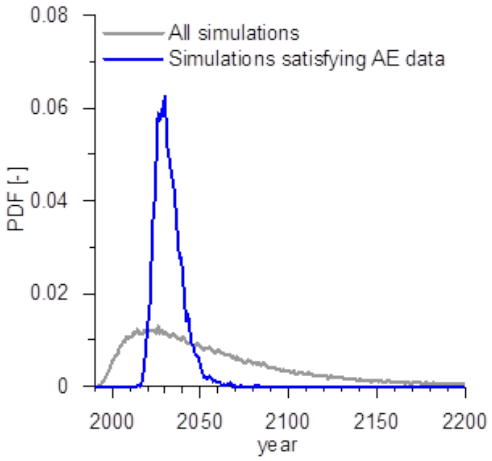
- **Among others …**

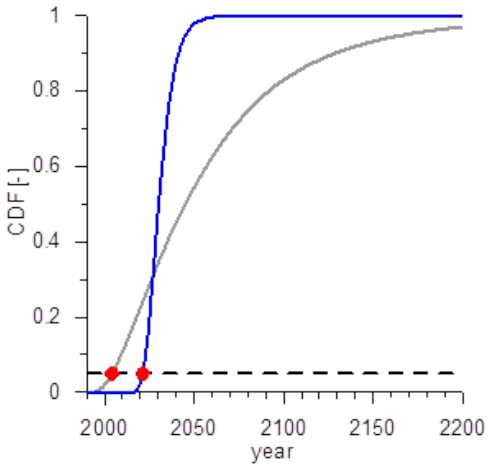
BRIDGE LIFE SPAN DEMONSTRATOR (BLSD)

- **Probabilistic Fatigue crack growth model**
- **Crude Monte Carlo method to compute crack size at $t=t_i$**
- **Updating: selecting the MC runs matching the monitoring data**
- **Residual Lifetime Estimate**

- AE system, Strain Gauges and Accelerometers
- Extrapolation to non monitored locations
- More details in accompanied COST TU1402 paper



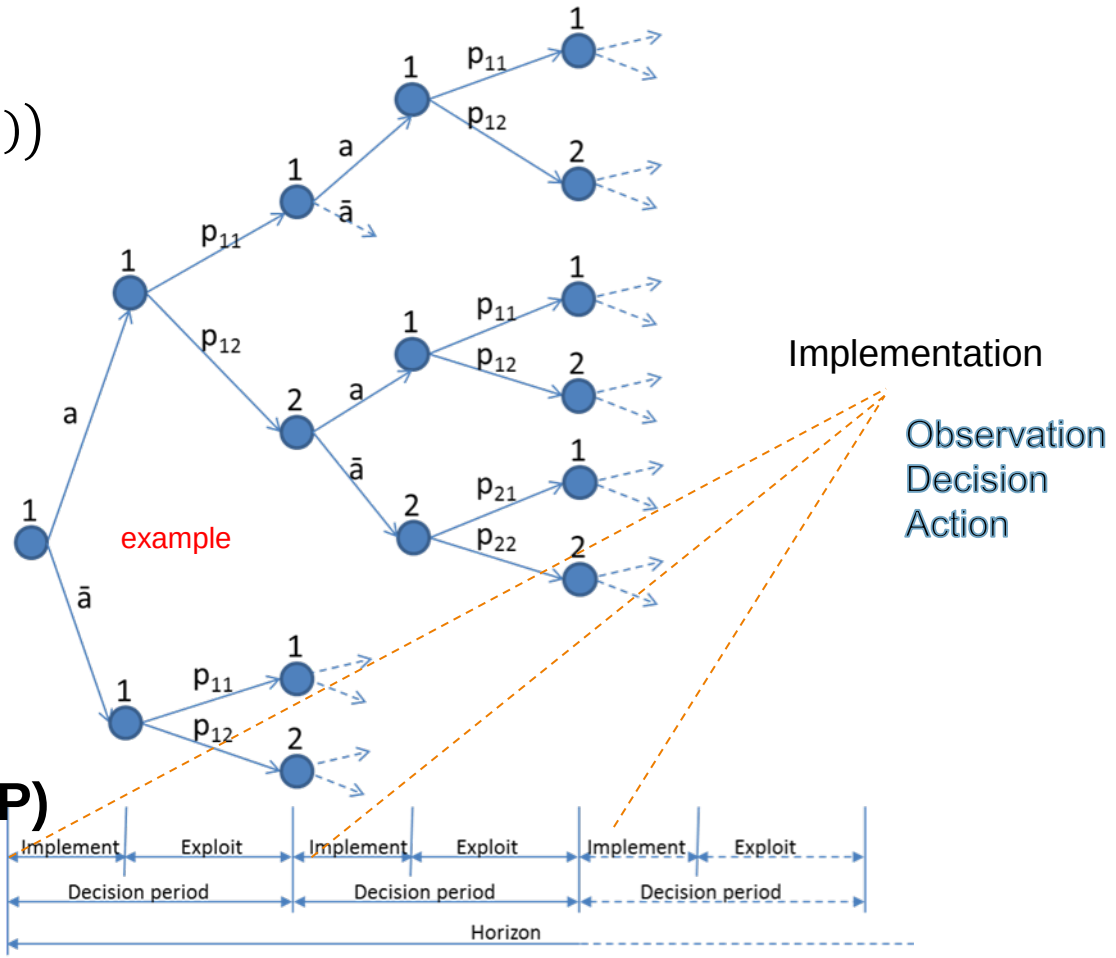




TOMORROW'S ROAD INFRASTRUCTURES MONITORING & MANAGEMENT (TRIMM)

$$V(s) = C_{implement}(a) + \sum_{s' \in S} p^{a}_{s_a s'} \left(C_{exploit}(s_a, s') + \lambda V(s') \right)$$

s condition at beginning of period
s' condition at end of period
s_a condition as a result of the action
λ discount for future costs
$p^{a}_{s_a s'}$ transition probability (after action a)
to move from state s_a to s'
$V(s)$ cost associated with a node from the tree
$C_{exploit}(s_a, s')$ costs (risk) of exploitation
$C_{implement}(a)$ costs of implementing an action a



VoI of monitoring
Markov Chains
Markov Decision Proces (MDP)

Info: http://trimm.fehrl.org

EARLY RESEARCH PROGRAM

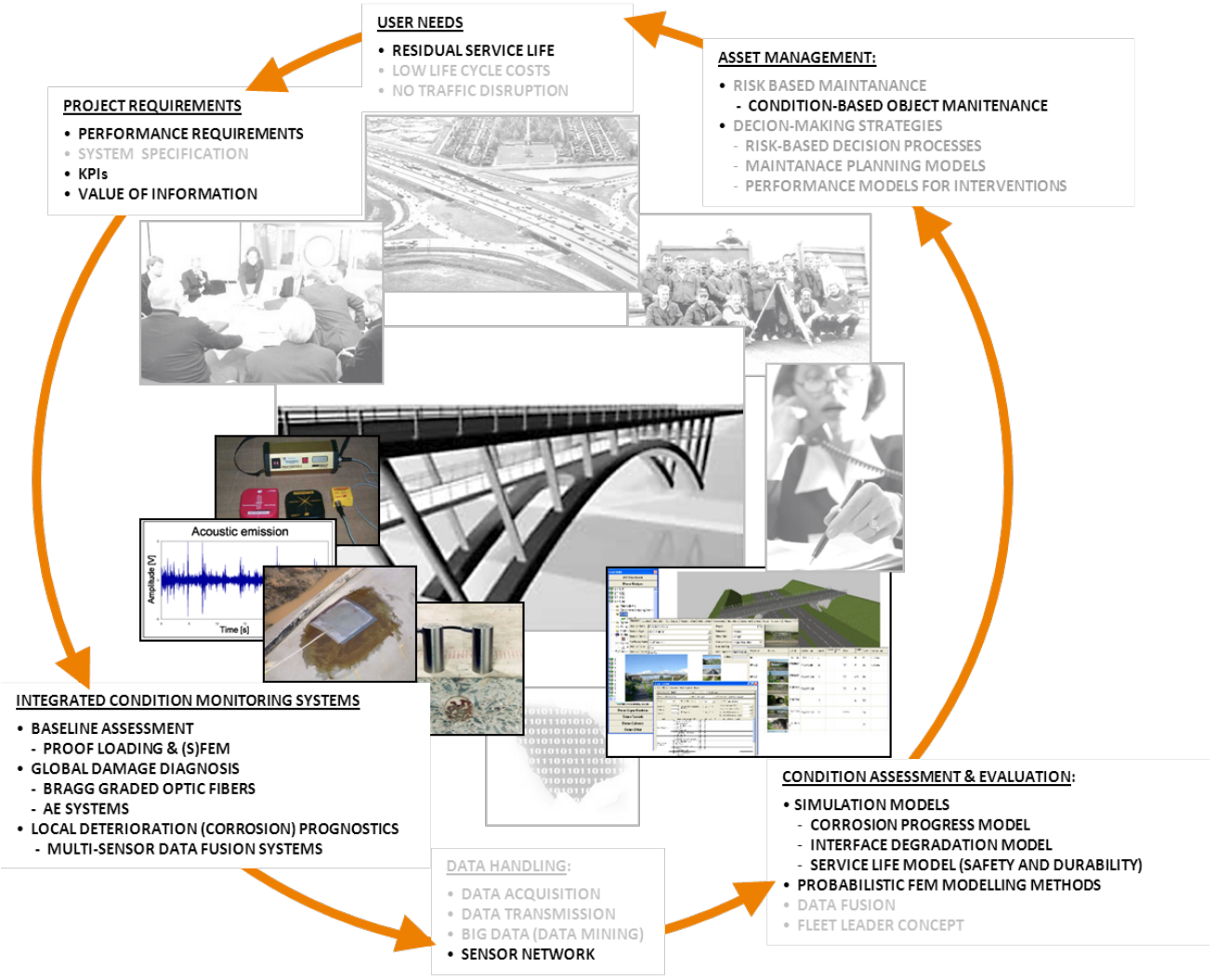
- **ERP STRUCTURAL INTEGRITY**
  - **Use cases**
    - **Concrete Bridge**
    - **Well Integrity**
    - **Offshore Wind**

- **Among others …**

EARLY RESEARCH PROGRAM

ERP SI

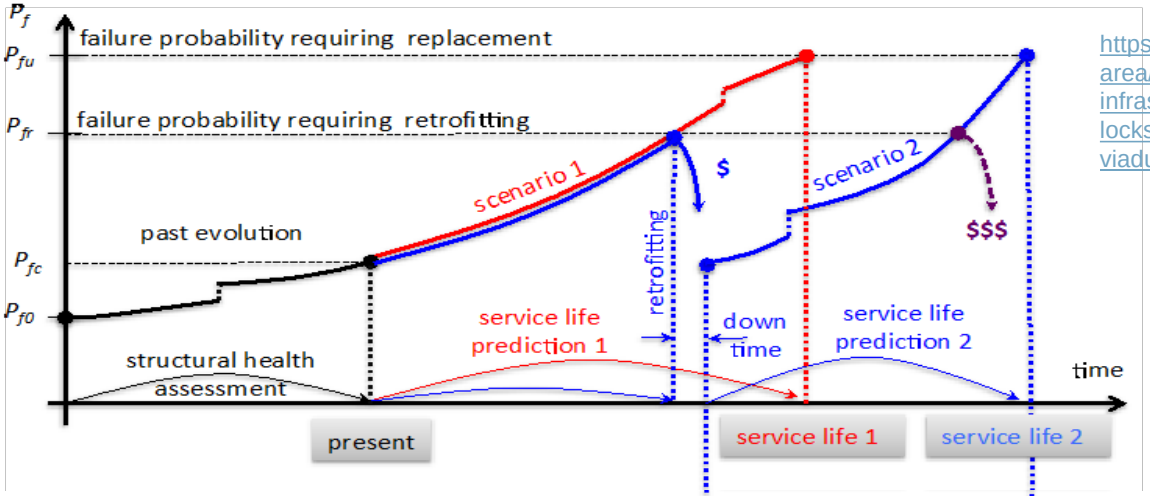
BRIDGE



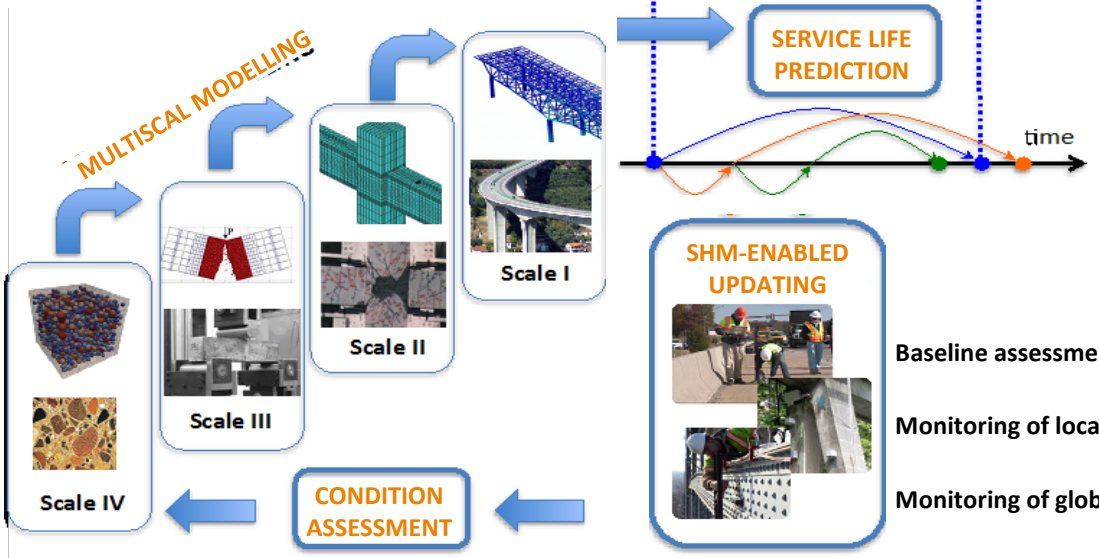
EARLY RESEARCH PROGRAM

ERP SI

BRIDGE



https://www.tno.nl/en/focus-area/urbanisation/buildings-infrastructures/infrastructure-roads-rail-locks-bridges-and-tunnels/bridges-and-viaducts/



Baseline assessment by proof loading

Monitoring of local (material) deterioration

Monitoring of global (structural) damage

POINTS OF INTEREST

- **Research questions**
  - ***Extrapolation from (confined) sensor layout to object***
  - ***Extrapolation from object to stock level***
  - ***Physics based models versus Markov Chain models***
- **Use Cases**
  - ***Concrete Bridges***
  - ***Steel Bridges***

- **Among others … :**
  - **Automatize**
  - **Data management**

THANK YOU FOR YOUR ATTENTION