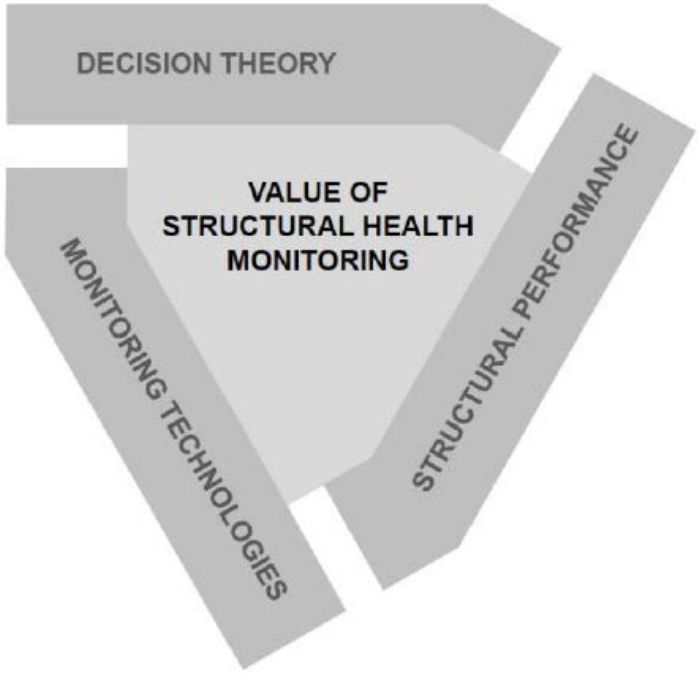
COST Action TU1402
Quantifying the value of Structural Health Monitoring



WG2: SHM Strategies and Structural Performance

MoU: Objectives of WG2

- Categorisation of available SHM technologies in regard to the measured quantity (e.g. crack length (steel), chloride concentration (concrete)) and the related structural performance (e.g. remaining fatigue life (steel component), corrosion state (concrete re-bar)) – collecting and representing best practice technologies.

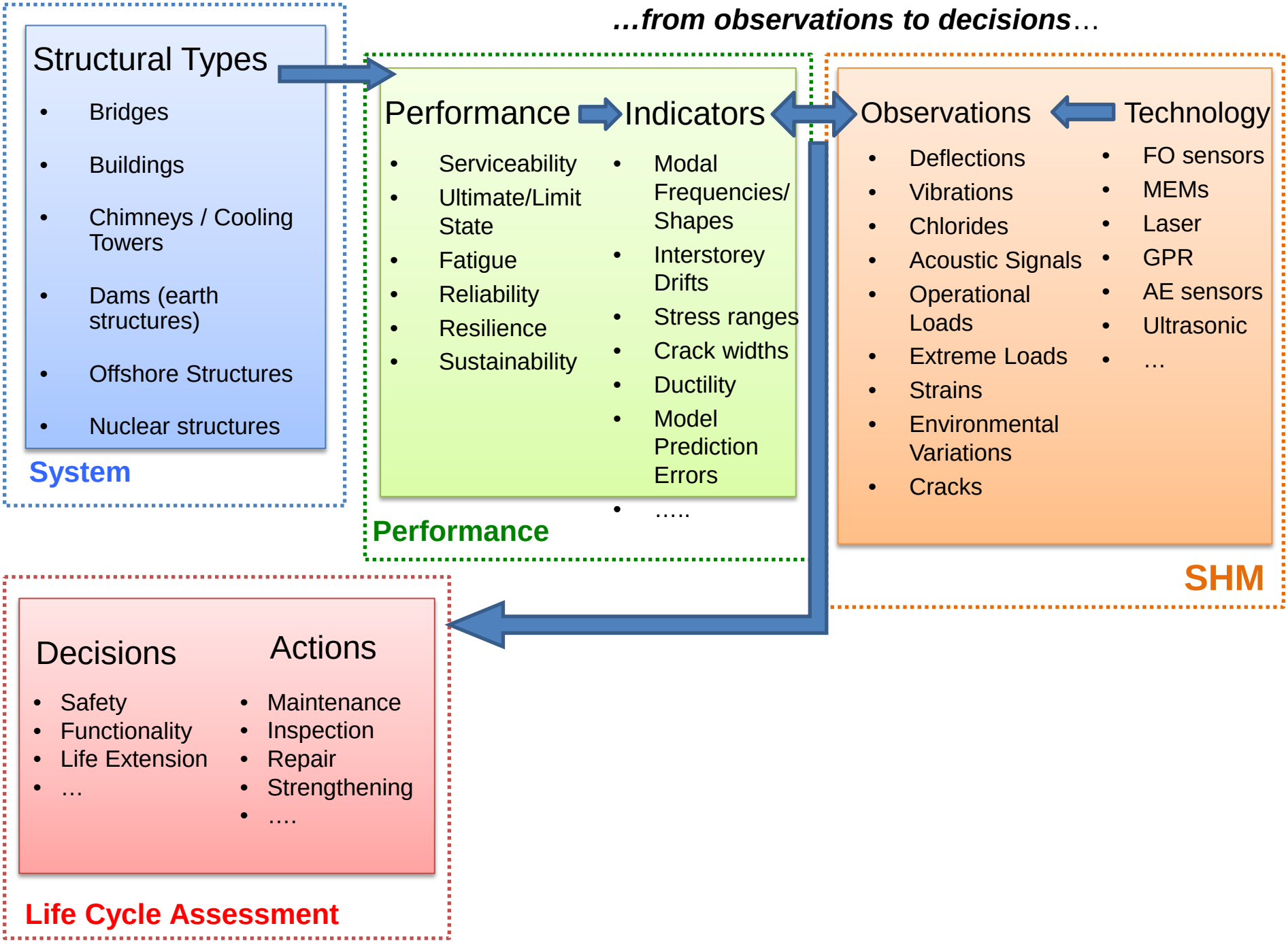
- Formulation of a link between the measured quantities and the structural performance of interest with consistent treatment of uncertainties and for the above application areas.

- **Milestone:** publication of the SHM categorisation and the SHM information modelling as a COST report until the end of year 2

Categorization of Structural Health Monitoring

- Development of a scheme to position the various aspects of SHM strategies and structural performance in relation to life-cycle asset management
  - SHM technologies and monitoring concepts
  - Performance indicators
  - … for different structural types
  - … impact on decisions and actions

- Collective view of presenting diverse work in general context, showing the different ways to link SHM with different aspects of performance


...from observations to decisions...
Structural Types
Bridges
Buildings
Chimneys / Cooling Towers
Dams (earth structures)
Offshore Structures
Nuclear structures
System
Performance
Indicators
Serviceability
Ultimate/Limit State
Fatigue
Reliability
Resilience
Sustainability
Modal Frequencies/ Shapes
Interstorey Drifts
Stress ranges
Crack widths
Ductility
Model Prediction Errors
.....
Performance
Observations
Technology
Deflections
Vibrations
Chlorides
Acoustic Signals
Operational Loads
Extreme Loads
Strains
Environmental Variations
Cracks
FO sensors
MEMs
Laser
GPR
AE sensors
Ultrasonic
...
SHM
Decisions
Safety
Functionality
Life Extension
...
Actions
Maintenance
Inspection
Repair
Strengthening
....
Life Cycle Assessment

Activities until now

- Presentations at all four workshops
  - Slides available on COST website
- Short papers and fact sheets
  - Papers from 1st workshop on COST website
  - Fact sheets from 2nd, 3rd and 4th workshop will be part of workshop report
- Organization of mini-symposium at EWSHM in July 2016 with 15 contributions from COST action participants and external contributors

Activities until now

Short papers

- *M.P. Limongelli et al:* The interpolation method for the detection of localized stiffness losses
- *F. Hille:* Subspace-based detection of fatigue damage on a steel frame laboratory structure for offshore applications
- *M. Maślak et al:* Probability-based durability prediction for corroded shell of steel cylindrical tank for liquid fuel storage
- *J. Markova et al:* Monitoring of bridges for calibration of load models
- *A. Mandić Ivanković et al:* Finding a link between measured indicators and structural performance of concrete arch bridges
- *A. Zornoza et al:* SHM with fiber optic sensors at AIMEN technology center

Activities until now

Fact sheets

- *C. Andrade et al:* On-site corrosion rate
- *C. Andrade et al:* Permanent corrosion sensors
- *A. Žnidarič et al:* Weigh-in-motion and traffic load monitoring
- *I. Farreras Alcover et al:* Outlier detection based on Structural Health Monitoring of welded bridge joints
- *K. Radzicki et al:* Thermal monitoring of leakages and internal erosion in dams and levees
- *R. Szydłowski et al:* Monitoring of the prestressed concrete slabs with unbonded tendons during erection and in service
- *W. Courage et al:* Smart structures for smart maintenance
- *M. Masciotta et al:* The value of SHM for the structural behaviour of masonry structures under varying environmental effects
- *M. Sykora et al:* Assessment of cooling towers and industrial chimneys based on monitoring
- *A. Strauss et al:* Performance indicators for road bridges
- *A. Tavares de Castro et al:* Monitoring and structural safety assessment of large concrete dams
- *P. Omenzetter et al:* A pre-posterior analysis framework for quantifying the value of seismic monitoring and inspections of buildings

Presentations today

- *Jan Winkler:* Structural Health Monitoring using digital image correlation
- *António Barrias, Joan Casas:* Concrete structures monitoring with optical backscatter reflectometry based distributed optical fiber sensors
- *Ander Zornoza:* VoI related to composite reparations
- *Herbert Friedmann:* Introduction of Wölfel-Engineering and the UnderwaterINSPECT research project
- *Rafał Sieńko, Tomasz Howiacki, Rafał Szydłowski, Mariusz Maślak, Michał Pazdanowski:* Application of distributed optical fiber sensor technology for strain measurements in concrete structures
- *Radenko Pejovic, Ivana Tesovic, Meri Cvetkovska, Prof. Milos Knezevic, Mladen Gogic:* Structural monitoring of high arch dams

Future work of WG2

Focus on uncertainties within the presented contributions

- What sources of uncertainties are present?
  - E.g., model-based, data-based, …
- How are the uncertainties best described?
  - E.g., probabilistically as random variables or random fields, worst case or interval approach, scenario based, …
- Are uncertainties currently taken into account in SHM data processing and/or the performance analysis?
- What methods are used to quantify or to propagate the uncertainties?
  - E.g., Regression error analysis, Bayesian updating, variance estimation, statistical hypothesis testing, …

Aim is to provide perspectives with respect to uncertainty quantification and modelling in the context of SHM-supported asset management, feeding into the work of the other WGs.