Fact Sheet No. WG3-##

Framework and Categorization for Value of Information Analysis

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I. Scope of the fact sheet

This factsheet summarizes the outputs of the workshop held at TU München, March 20-21, 2017. The aim of the workshop was the identification of unified concepts for organizing and categorizing a value of information (VoI) analysis. The resulting VoI analysis flow chart shall support and unify the different case studies performed within the COST action.

Contributions to this factsheet come from the 16 participants of the workshop.

II. Abstract

A set of framework and classification schemes for VoI analysis are presented in the form of flow charts. The different flow charts represent different takes on the VoI analysis, and serve distinct purposes. The different schemes culminate in an integrated VoI analysis flow chart, which should serve as a starting point for specific VoI case studies to be implemented as part of the COST action. This VoI flow chart is outlined through two example applications: (i) the management of a bridge that is potentially subject to excessive deflections and (ii) the asset integrity management of support structures of an offshore wind park.

1 Proposed classification charts – first versions

A set of key questions were addressed during the workshop, in order to achieve a common terminology and understanding of the VoI analysis, mainly:

- how to communicate the strategy to the decision-maker?
- which are the common parameters and categories that define a problem?
- what are the dependencies in the flow of information?
- which terminology is more appropriate?

On this basis, different classifications for structuring and organizing the VoI analysis process were developed in break-out groups. Figures 1 to 3 show VoI classifications that resulted from these individual groups in two iterations. They were developed with different perspectives and goals. The chart of Figure 1 focuses on the definition and classification of the problem and the overall work-flow, whereas the chart of Figure 2 focuses on the modeling of the system life-cycle and the role of SHM within this sequential decision process. This chart is based on the influence diagram [see also Straub et al. 2017] and highlights the analysis flow and the updating process in time. The cloud at the top of the graph reflects the decision context. Finally, Figure 3 provides a chart for a more high-level perspective, including both the context and the system definition as well as a basic outline of the decision process

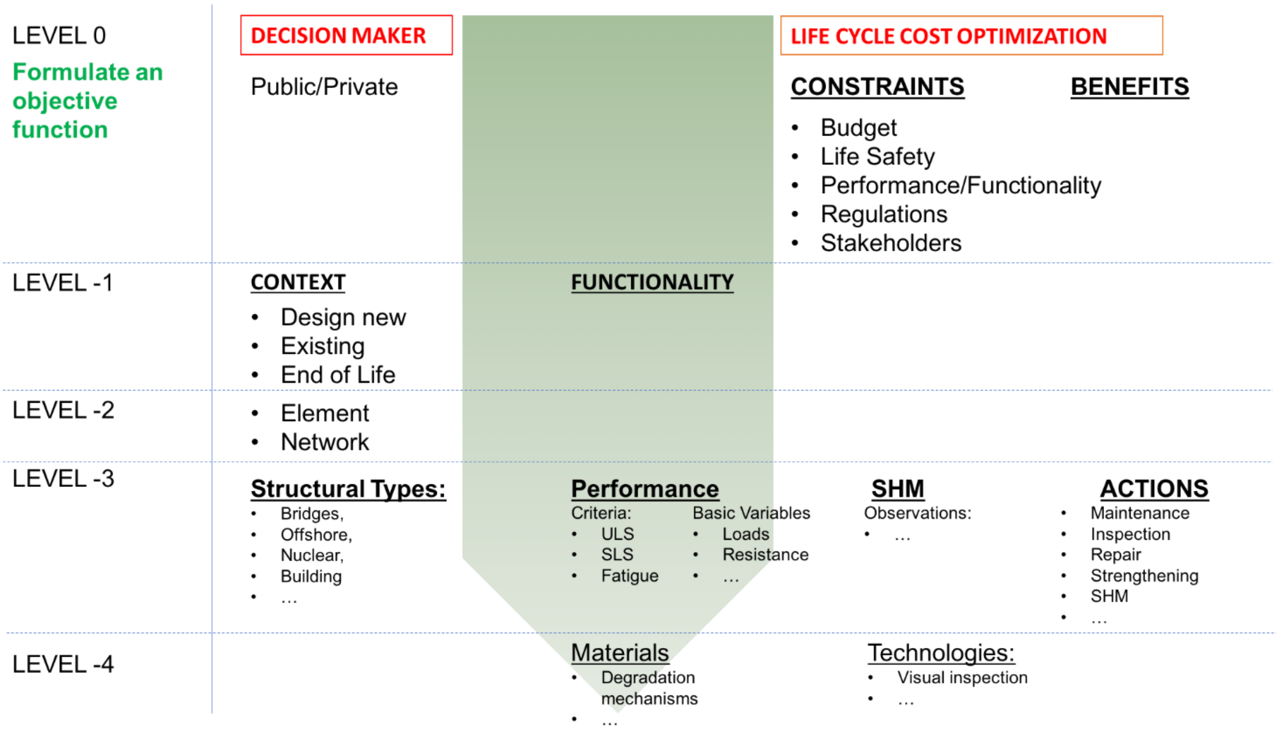

Figure 1: Hierarchical flow chart focusing on the procedural aspects of the VoI analysis (outcome from break-out group 1).

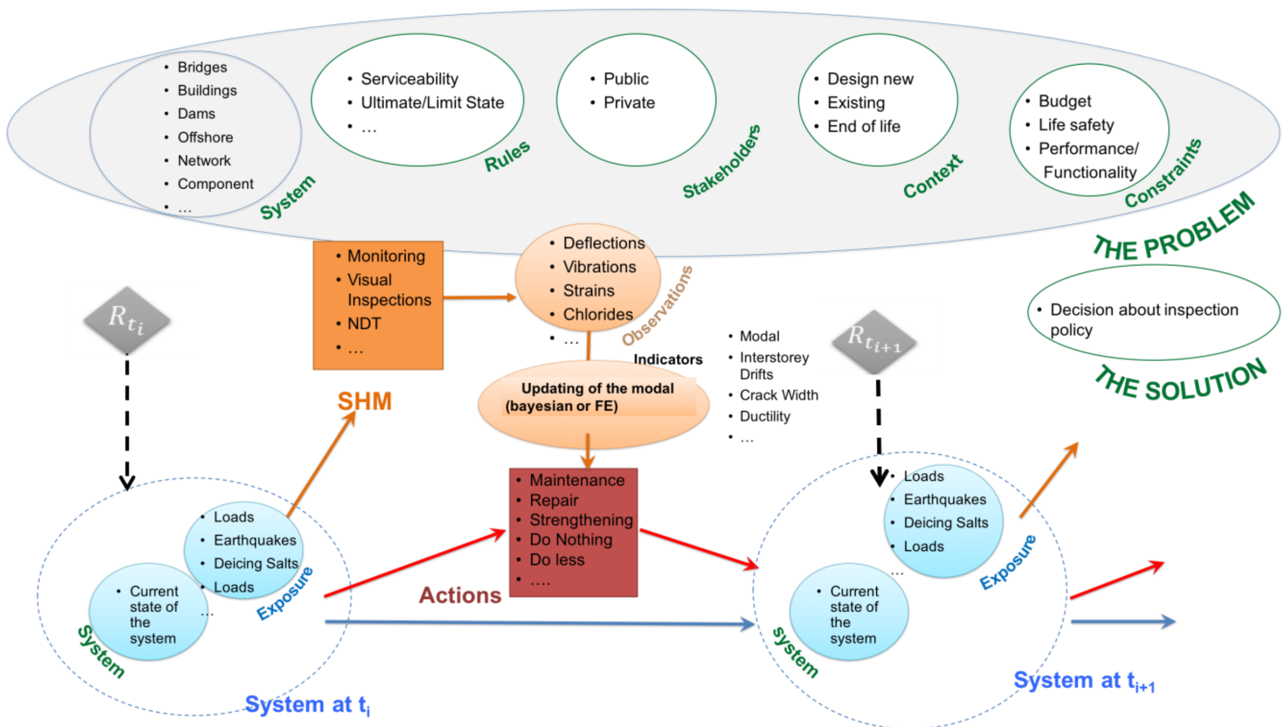

Figure 2: A VoI chart highlighting the decisions over the system lifetime, based on the influence diagram (outcome from break-out group 2).

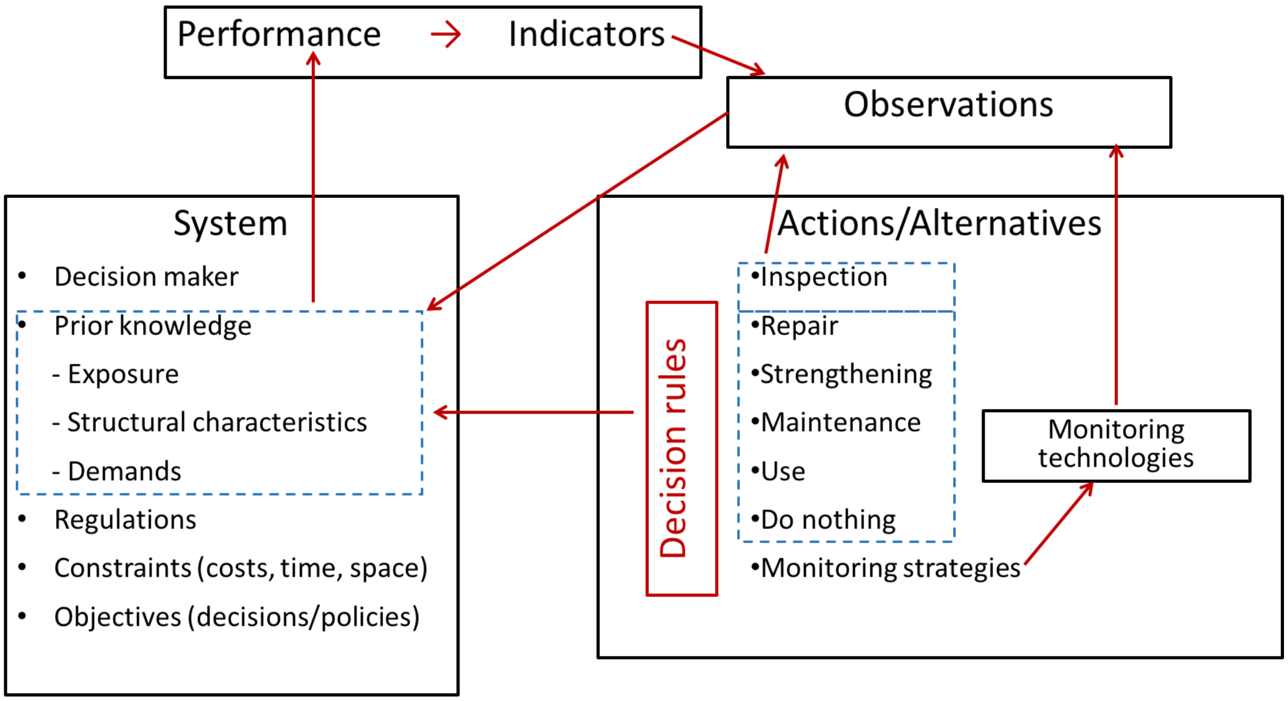

Figure 3: High level representation of the VoI analysis, highlighting the dependences in the process (outcome from break-out group 3).

Alternative versions were also derived and discussed, but the classifications shown in Figures 1 to 3 are the most distinct classifications. Previous schemes that were produced in WG1-WG3 [e.g. Straub and Chatzi 2016; Thöns and Miraglia 2016] served as inputs to the discussions.

2 Integrated VoI analysis flow chart

no single chartBased on the proposals for classification made in the individual working groups, an integrated chart was developed with all workshop participants jointly. The chart in Figure 4 is the result of this integration. We term this the *VoI analysis flow chart*.

It was agreed that no single chart (classification system) can capture all the dimensions and aspects of the VoI analysis. For example, the chart in Figure 2 will in many applications still be necessary to understand the decision model and the calculation of the VoI. But it is desirable to start out with a single, unifying framework, and the aim of the chart in Figure 4 is to provide such a common entry point to VoI analyses.

The categories highlighted in green should be updated according to the case-study/problem under analysis. These categories define: (i) the general context of the problem, (ii) the constraints, (iii) the objectives, (iv) the objective functions and (v) the performance criteria.

In order to help the reader in the utilization of the VoI analysis flow chart to a real case, two case studies are herein presented in following section. These two case studies are in progress, as part of WG4 of the COST Action, and therefore, they should be considered as an illustration only at this stage.

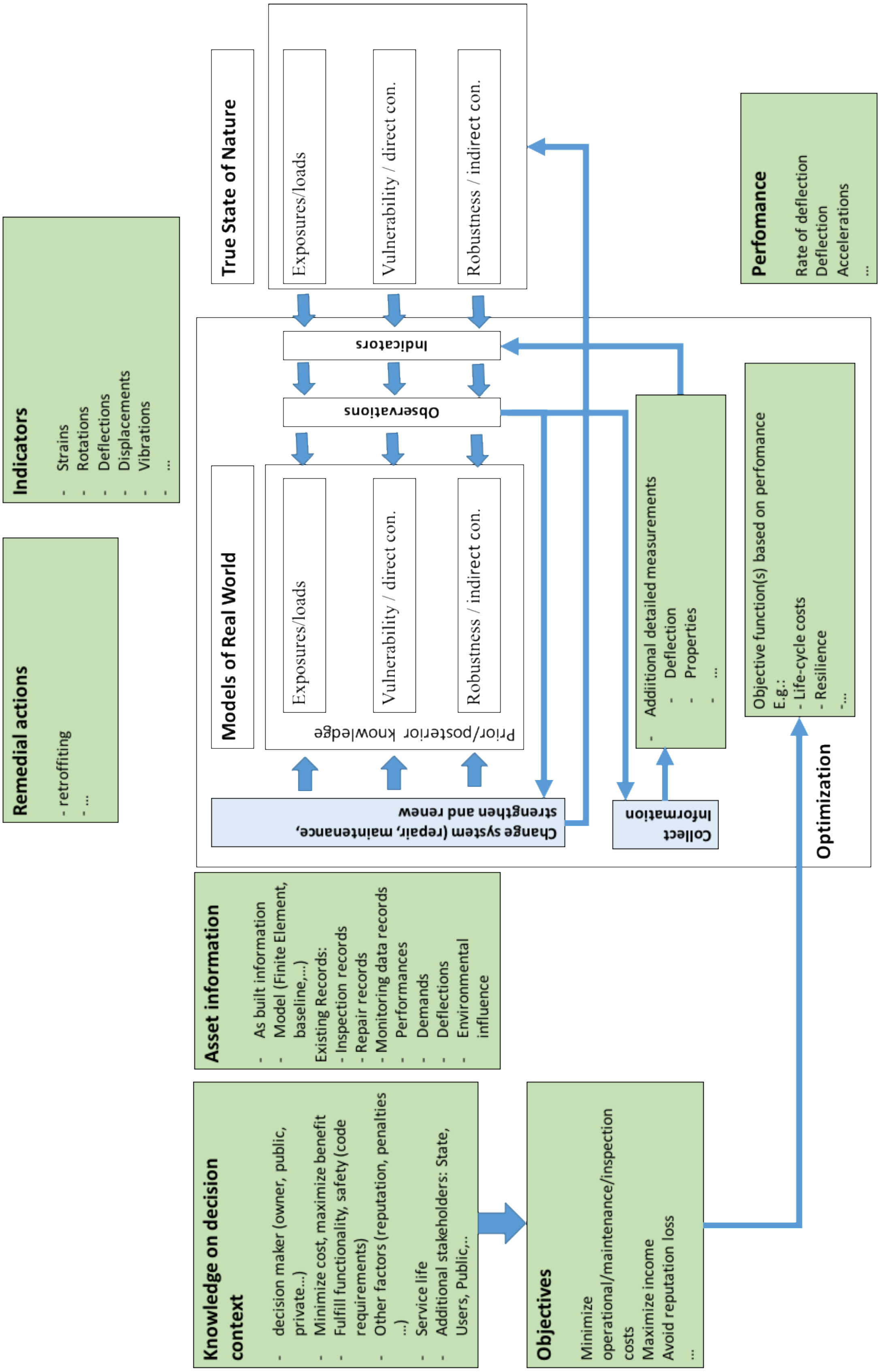

Figure 4: The VoI analysis flow chart: The entry point for a value of information analysis of an engineering system.

3 Application to case studies

3.1 Prestressed concrete bridge

The implementation of the VoI analysis flow chart (Figure 4) is firstly made for a pre-stressed concrete bridge that might be potentially subjected to excessive deflections. In more detail, this case study is related to the Lezíria Bridge, which was built between 2005 and 2007 and it forms part of the A10 highway, which lies at the outer boundary to the Lisbon metropolitan area (Figure 5). It benefits those who wish to travel from north to south (or vice versa) without needing to cross the Portuguese capital – Lisbon. Hence, the criticality of this asset is evident within the Portuguese highway network. More details about this bridge can be found elsewhere (Sousa et al. 2011; Sousa et al. 2014). Figure 6 presents the VoI analysis flow chart for this specific case with the aim of optimizing the inspection, monitoring and maintenance activities in order to control deflections.

Figure 5: Lezíria Bridge

3.2 Offshore wind park

Figure 7 presents the exemplary implementation of the planning of inspection, monitoring and maintenance activities for wind turbine support structures in an offshore wind park.

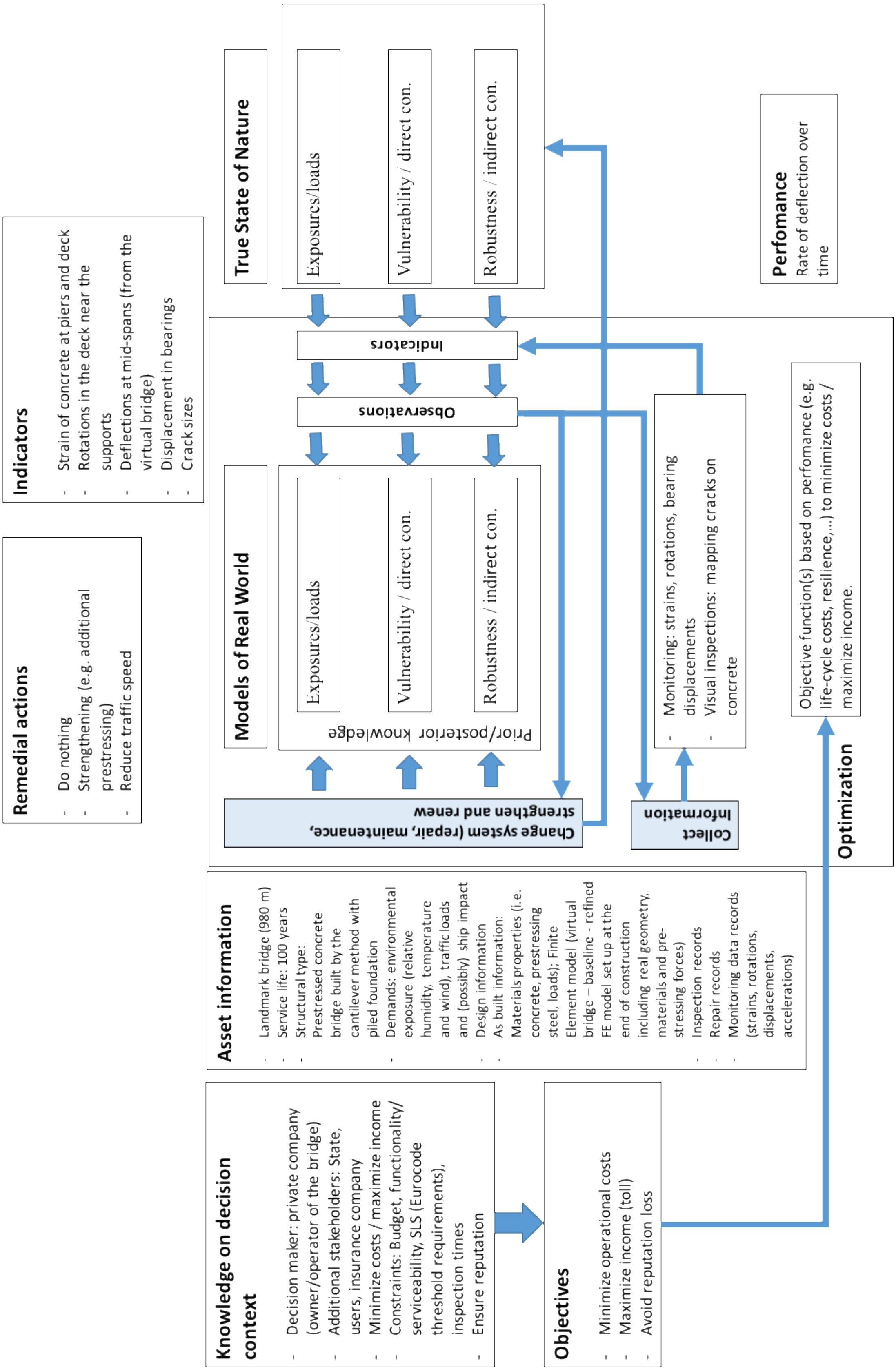

Figure 6: Application of the VoI analysis flow chart to a prestressed concrete bridge potentially susceptible to excessive deflections (Lezíria Bridge).

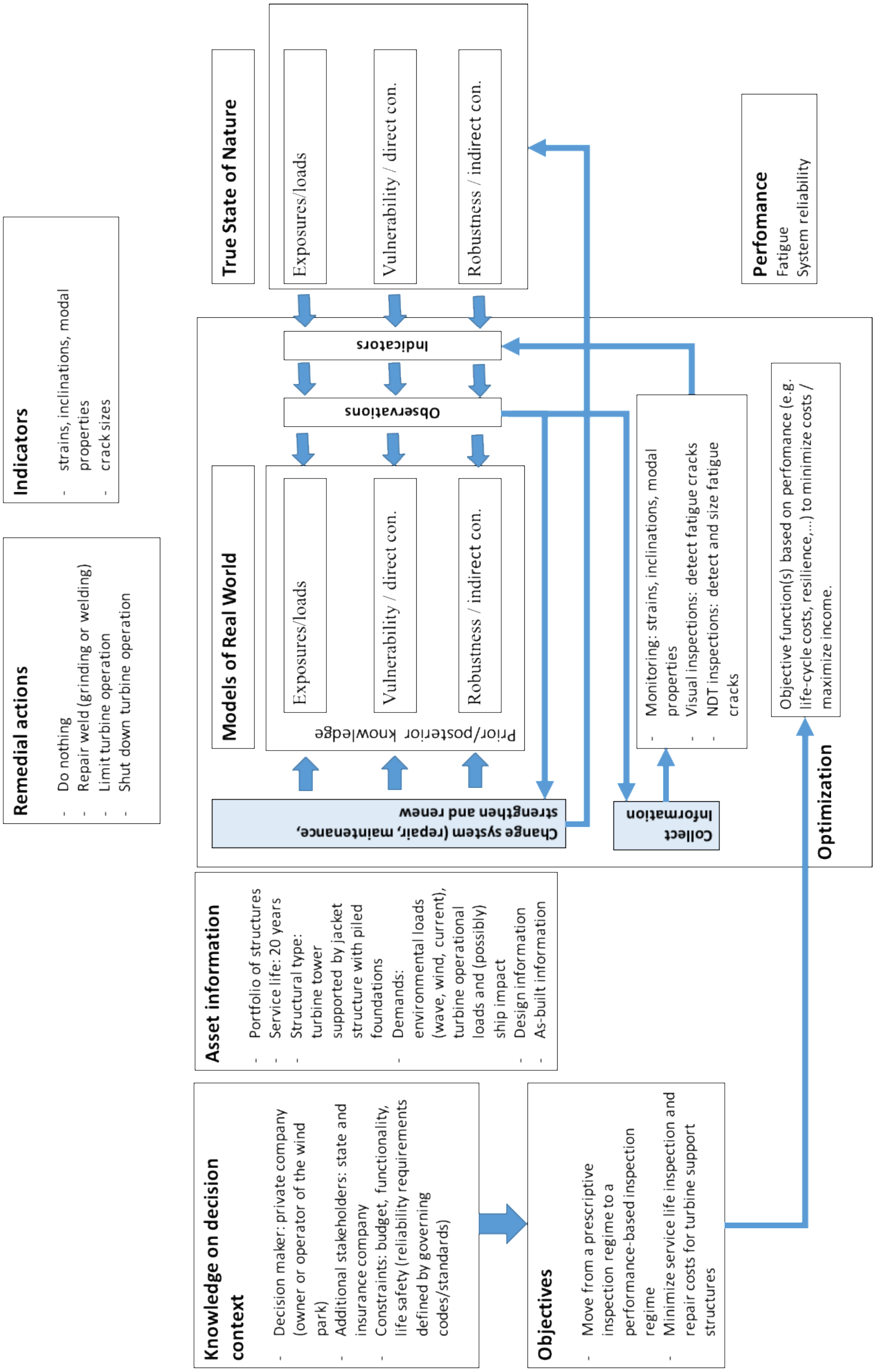

Figure 7: The VoI flow chart: asset integrity management of supports structures in an offshore wind park.

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