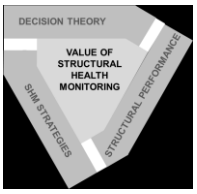

GLOSSARY OF TU1402

Acoustic emission: non destructive passive method of monitoring which makes use of the elastic energy released when a material undergoes a change at the atomic scale, such as plastic deformation or cracking. Piezoelectric sensors attached to the surface of the structure detect the surface waves caused by these events and produce a voltage output. Signals which reach any sensor with amplitude greater than a user defined threshold are recorded and subsequently stored on an AE acquisition system. (Mc Rory et al.)

Adverse state: State in which a performance criterion is not met.

Asset management: broadly defined, refers to any system that monitors and maintains things of value to an entity or group. It may apply to both tangible assets such as buildings and to intangible concepts such as intellectual property and goodwill. Asset management is a systematic process of operating, maintaining, upgrading, and disposing of assets cost-effectively. Alternative views of asset management in the engineering environment are: The practice of managing assets to achieve the greatest return (particularly useful for productive assets such as plant and equipment), and the process of monitoring and maintaining facilities systems, with the objective of providing the best possible service to users (appropriate for public infrastructure assets). (IRIS)

Availability: The probability that a component or system is functioning at a time t.

Bayesian decision theory: is based upon Utility theory (Von Neumann & Morgenstern) and is formulated in reference (Raiffa&Schlaifer 1961).It represents a probabilistic framework to quantify the utility and decision attributes (such as costs, benefits, consequences for human safety). It is differentiated between a prior, posterior, pre-posterior and a Value of information analysis.

Bayesian updating: takes basis in the Bayes theorem

Benefit: A benefit constitutes a decision attribute associated with a gain.

Capacity: ability of a member or a component, or a cross-section of a structure to action without mechanical failure e.g. bending resistance, buckling resistance, available ductility.. (*IRIS-CEN modified*).

Condition assessment: the process of reviewing information gathered about the current condition of structure or its components, its service environment and general circumstances, allowing a prognosis to be made of current and future performance, taking account of active deterioration processes and actual damage and, if appropriate, predictions of potential future deterioration processes and future damage.

Condition monitoring: damage identification in rotating and reciprocating machinery (Farrar&Worden, 2007).

Damage: physical disruption or changes to the material and/or geometric properties of these a systems, including changes to the boundary conditions and system connectivity, which adversely affect the system's performance (Farrar&Worden, 2007).

Damage assessment: Process of ascertaining the severity of the damage to a structure.

Damage detection: Process of ascertaining whether the damage to structure exists or not. (IBS_Glisic)

Damage feature: quantifiable property or pattern sensitive to damage. It can be either directly monitored (e.g., strain) or extracted from monitoring data (e.g., modal characteristics from accelerometer measurements) (IBS-Glisic).

Damage feature extraction: Extracting a quantifiable property or pattern sensitive to damage from monitoring data (e.g., modal characteristics from accelerometer measurements) (based on definition of damage feature in IBS-Glisic).

Damage identification: In addition to damage detection, localization and assessment, damage identification includes ascertaining the cause of the damage and its consequences.

Damage localization: Process of ascertaining where the damage to structure is located.

Damage prognosis: prediction of remaining useful life of a damaged system (Farrar & Lieven, 2007).

Data cleansing: The process of identifying and correcting corrupted or erroneous measurements from a data set. Typical examples of refers to identifying incomplete records (missing data), incorrect values (outliers), or inaccurate values due to temporary malfunctioning of the monitoring system or its components (sensors, communication lines, etc.). The corrupted data is mostly removed, and sometime modified or replaced using some pre-defined algorithms. (IRIS)

Data-driven approach: data interpretation approach performed utilizing computer algorithms to calculate or recognize damage features from measurement datasets. They do not need building a physical model of the structure.

Decision analysis and theory: See Bayesian decision analysis.

Decision options/alternatives: Decision options or alternatives represent decision scenarios for which the utility and/or decision attributes are quantified. In the context of the quantifying the value of Structural Health Monitoring (SHM) decision alternatives may constitute different SHM strategies encompassing e.g. technology, locations and algorithms.

Decision tree: A decision support tool that uses a tree-like graph or model of decisions and their possible consequences, including probabilities and costs or utilities.

Degradation: Worsening of condition with time (see also Deterioration).

Demand: request (resistance, ductility,…) coming from all the actions applied to the structure.

Deterioration: Process that adversely affects the structural performance, including the reliability over time. Deterioration of structural performance can be caused by various reasons, such as: naturally occurring chemical, physical and biological actions; repeated actions such as those causing fatigue; normal or severe environmental influences; wear due to use; improper operation and maintenance of the structure. (SAMCO)

Direct risk: The risk associated with consequences directly related to the structure, engineering system or its immediate users, such as physical damages in a structure, or injuries and fatalities caused by structural failures (see also JCSS 2008).

Failure: state in which the performance requirements are not satisfied. NOTE: (1) Failure is associated with the specific performance goal and the associated performance requirements (2) Failure is not synonymous with collapse.

Fault detection: Fault detection, isolation, and recovery (FDIR) is a subfield of control engineering which concerns itself with monitoring a system, identifying when a fault has occurred, and pinpointing the type of fault and its location. Two approaches can be distinguished: A direct pattern recognition of sensor readings that indicate a fault and an analysis of the discrepancy between the sensor readings and expected values, derived from some model. In the latter case, it is typical that a fault is said to be detected if the discrepancy or residual goes above a certain threshold. It is then the task of fault isolation to categorize the type of fault and its location in the machinery. Fault detection and isolation (FDI) techniques can be broadly classified into two categories. These include Model-based FDI and Signal processing based FDI (Wikipedia).

Information: In the context of a Value of Information analysis, information represent any model parameter gained by means of an experiment but also by analytical, numerical or empirical methods related to the decision scenarios. Information (Sample): Knowledge that describes a realization of the value or state of a random property. Information (Perfect): Knowledge that describes the true value/state of a deterministic property.

Indirect risk: The risk associated with consequences that follow from a failure event, but are not direct consequences. These are consequences associated with loss of system functionalities. (JCSS 2008). These include business interruptions due to failures in transportation or energy networks.

Inspection: On-site, non-destructive examination to establish the present conditions of the structure.

A visible inspection performed on regular base is called the routine inspection and a more detailed inspection usually performed as a follow-up to a routine inspection to identify any deficiencies discovered is called the in-depth inspection. (SAMCO)

Life-cycle (action): Long-term action that extends over entire lifespan of the structure, from the construction until the decommissioning or dismantling. (IRIS modified)

Likelihood: A general concept that expresses qualitatively (e.g. high, medium, and low) or quantitatively (e.g. frequency or probability) the chance that an event may occur in a specific time period (IRIS).

Maintenance: Technical intervention during the service life of a structure aimed to preserve its required performance. (IRIS modified)

Model-driven approach: data interpretation approach performed comparing the responses of a structure with those of a predicted model (analytical model or finite element model) based on physical and mechanical characteristics of a structure.

Monitoring system: The set of all the means destined to carry out measurements or observations and to register them is called a monitoring system. Monitoring system has two subsystems: measurement and observation subsystem and data management subsystem. The measurement and observation subsystem consists of sensors, observation tools, and the data acquisition system – data acquisition hardware (including reading units, accessories, and channel switch) and data acquisition software. The data management subsystem consists of data management hardware and data management software. Various monitoring systems can be used for structural health monitoring, operational monitoring, and security monitoring, but they all have, in general, the above mentioned subsystems. Nowadays, there is a large number of monitoring systems, based on different functioning principles, and which system will be used in a specific application depends on specifications of the monitoring system such as resolution, measurement error, maximal measurement rate, data management software, etc. (IBS-Glisic)

Non-destructive testing: off-line local method after damage detection

Performance: behavior a structure must exhibit under various acting forces, to achieve human safety, construction functions, and user comfort.

Performance criteria: Quantitative limits, defining the border between desired and adverse behaviour (i.e. failure criteria). *NOTE: In context of Limit State Approach, performance criteria are the threshold values that describe for each limit state the conditions to be fulfilled.*

Performance indicator: a metric measured or computed to provide evidence of a system's performance.

Performance modeling: Process of simulating various system loads against varying system configurations by using a mathematical model.

Performance requirement: A condition used to describe a required service quality with regard to specific performance goal, established by means of performance indicator(s) and associated performance criteria with constrains, related to service life and reliability.

Posterior decision analysis: A decision analysis with additional information. For more detailed information see reference (Raiffa&Schlaifer 1961)

Pre-posterior decision analysis: A decision analysis with unknown information. For more detailed information see reference (Raiffa&Schlaifer 1961).

Prior decision analysis: A decision analysis with known information. For more detailed information see reference (Raiffa&Schlaifer 1961)

Probabilistic deterioration model: A predictive model of deterioration, which considers prediction uncertainty by modeling parameters and/or deterioration states as random variables or random processes.

Probabilistic risk analysis: A formal approach to computing the risk of a system, based on probability theory.

Probabilistic risk assessment: A probabilistic risk analysis followed by an appraisal of the risk.

Reliability: The probability that a component or system has not failed (until time t).

Repair: Technical intervention on a damaged or degraded structure aimed to restore its required performance. (IRIS modified)

Resilience: is the ability of a structure to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions. (UNISDR modified)

Risk analysis: A formal approach to computing the risk of a system**.**

Risk: The possibility of a loss. In a probabilistic setting, it is defined as the expected value of adverse consequences. In its simplest form, this reduces to the probability of a failure event multiplied with the consequence of the failure event.

Risk-based inspections : A systematic approach to plan and perform inspections, in which inspections are prioritized according to their effect on the system risk. The RBI approach aims at optimizing the sum of cost (of inspection and maintenance) and risk (due to non-treated damages).

Robustness: ratio between the direct risks and the total risks, (total risks is equal to the sum of direct and indirect risks), for a specified time frame and considering all relevant exposure events and all relevant damage states for the constituents of the system. (JCSS 2008)

Safety: The condition of a structure being protected against failure, damage, design errors, accidents, or harms, in both causing and exposure.

Serviceability limit state: Condition in which a structure or component becomes unfit for service and is judged to be no longer useful for its intended function under normal usage.

Standardization: process of implementing and developing technical standards (Wikipedia)

Strain gauges: device used to measure strains. Jargon synonym for “electrical resistance strain gauge”. (IRIS modified)

Strengthening: Technical intervention on a structure aimed to improve its performance. (IRIS modified)

Structural Health Monitoring: (SHM) the process of identifying the presence and quantifying the extent of damage in a system based on information extracted from the measured system response (Farrar & Lieven, 2007).

Structural integrity: The ability of structural components to act together as a competent single entity.

System identification: process of building mathematical models of dynamic systems and of estimating physical parameters from observed data.

Threshold: boundary defined to compare different states

Vulnerability: ratio between the risks due to direct consequences and the total value of the considered asset or portfolio of assets considering all relevant exposures and a specified time frame.(JCSS, 2008)

Ultimate limit state: Condition in which a structure or component becomes unfit for service and is judged to have reached its ultimate capacity.

Ultrasonic technology: non destructive inspection method based on the Lamb waves, ultrasonic elastic waves that propagate along the surface of plates and can be generated and acquired using piezoelectric transducers. The ultrasonic interact with obstacles/flaws/borders in the structure and reflect back to the transducer. The comparison between the initial and reflected signal gives information about the obstacles/flaws/borders

Uncertainty: An uncertainty constitutes any imprecision of a model parameter. Uncertainties can be classified by their origin in the following types, namely (1) model uncertainty, (2) statistical uncertainty, (3) measurement uncertainty or error, (4) human and organization error. Uncertainties can be categorized in epistemic uncertainties due to a lack of knowledge and in aleatoric uncertainties due to randomness. Epistemic uncertainties maybe reduced by means of knowledge gain. Aleatory uncertainties constitute the inherent randomness of e.g. a process which cannot by be reduced.

Usage monitoring: the process of acquiring operational loading data from a structure or system, which preferably includes a measure of environmental conditions (e.g. temperature and moisture) and operational variables (Farrar&Lieven, 2007).

Utility: A numerical (most often monetary) measure that corresponds with a certain procedure/decision that has been followed.

Value of Information: A pre-posterior decision analysis quantifying a utility or decision attribute increase as the difference between a prior or posterior decision analysis and a pre-posterior analysis. For more detailed information: (Raiffa&Schlaifer, 1961)

X-ray technology: non destructive inspection method based on the use of X-rays to detect variations of density in the material which is a function of the amount of radiation that passes through.

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