CEN Workshop Business Plan

"Condition Determination for Integrated Lifetime Assessment of constructed facilities and Components"

1. Background of the CEN Workshop

1.1 Market Environment

An improved discipline is needed concerning lifecycle cost approaches to infrastructure design. All our industrial infrastructures are ageing. However, some reach their theoretical end of life without showing signs of weakness as such. Considering lifecycle cost approaches the costs of upgrading and replacement can be reduced considerably.

For example, bridges are essential for transport and therefore to the economy. Reference is made to the situation in the United States, where within the network of the *Federal Highway Agency* (*FHWA*) there are 590 000 bridges, of which 160 000 are rated deficient when the traditional methodology for assessing their structures is applied. It is estimated that replacement costs of seven billion US$ annually over 20 years are required to achieve a perfect upgrade of these bridges. In order to avoid such costly situations, the lessons learned relevant to design should be considered in modern bridge design processes. Another drastic example is a bridge built in Austria in 1978, following the minimization principle of construction costs, at a cost of 8.5 million €. Within 25 years, a total of 19.5 million € had to be invested in retrofitting measures. Methodologies which enable a proper extension of lifetime based on new knowledge and supported by data from monitoring are desperately required to keep Europe competitive in the global context. Statistics show that on average 75% of our industrial infrastructure is operational for 40 years, which in many cases represents the theoretical end of life. The demand for a life extension based on the experience that these structures are still performing well and obviously bear excess capacities, justifying longer use, is strong. This is not only a economic question but also touches on the use of resources, the necessary energy input for replacement and general environmental questions. Risk-based tools embedded in probabilistic frameworks are the appropriate means to achieve this goal.

Risk based decision making in infrastructure management has seen growing importance recently. Structural Health Monitoring can provide a sound basis for hazard assessment and for the determination of vulnerabilities. Only an integral approach will lead to useful results for the infrastructure owners. This implies that explicit consideration is given to the interaction between all relevant agents, i.e. technical systems, natural environment, humans, stakeholders and organizations when assessing the risk associated with the system considered. In the context of sustainable societal development an intergenerational aspect of risk and decision making must be considered. The demand is to provide information on decision support for risk and safety management based on SHM at strategic, normative and operational level. A holistic perspective on the approach and principles needs to be provided with examples from various industries and sectors; (i.e. bridge management and building assessment).

According to the US National Institute for Standards and Technology (NIST), “life-cycle cost analysis (LCCA) is a method for assessing the total cost of facility ownership.” It takes into account all costs of acquiring, owning, and disposing of a building or building system. LCCA is especially useful when project alternatives which fulfil the same performance requirements but differ with respect to initial and operating costs, have to be compared in order to select the one that maximizes net savings (www.wbdg.org)."

(see additional information as annex A)

1.2 Legal Environment

European legal conditions are very fragmented. The regulations applied show a wide range of variation. Many nations in Europe have made political decisions on the lifetime of critical infrastructure such as nuclear power plants. On the other hand international regulatory bodies like IAEA (International Atomic Energy Agency) are issuing binding international guidelines for the operation of these facilities.

All these regulations exhibit one main disadvantage. To be generally applicably they have to be conservative, and are unable to take plant-specific conditions into account. Standardization of new methodologies which will help to overcome this fragmentation is desired.

1.3 Existing Standards and Standard related Activities and Documents

1.3.1 Overview

Previous activities and work of other groups worldwide have already produced a basic set of standards. The most sophisticated procedure is established in Germany, where based on existing DIN-standards, specific rules for application in different industries are being developed by VDI (Verein Deutscher Ingenieure). A dense network of certification agencies (managed by TÜV) takes care of sound and safe procedures. Nevertheless the current practice does not take account of the typical end of life situation with assessment of lifetime extension.

The relevant standards include the following (this list is not considered to be exhaustive):

1.3.2 European Standards (EN)

EN 31010 (2008) Risk management - Risk assessment techniques (IEC 56/1268/CDV)

EN 15331 (2009) Criteria for design, management and control of maintenance services for buildings

EUROCODES: EN 1990 to 1999: Design of buildings, bridges and other engineering structures

EN 206-1 (2000) Concrete – Specification, performance and conformity

1.3.3 International Standards (ISO)

ISO 13824 (2009) Bases for design of structures -- General principles on risk assessment of systems involving structures

ISO 14044 (2006) Environmental management - Life cycle assessment - Requirements and guidelines

ISO 31000 (2009) Risk management - Principles and guidelines

ISO 16587 (2004) Mechanical vibration and shock - Performance parameters for condition monitoring of structures

ISO 13822 (2009) Bases for design of structures - Assessment of existing structures (Revision of ISO 13822:2001)

ISO14963 (2003) Mechanical vibration and shock - Guidelines for dynamic tests and investigations on bridges and viaducts

ISO 18649 (2004) Mechanical vibration - Evaluation of measurement results from dynamic tests and investigations on bridges

ISO 15686 (2008) Buildings and constructed assets - Service-life planning

ISO 13823 (2008) General principles on the design of structures for durability

1.4 Motivation for the Creation of this Workshop

From a regulatory point of view, requirements within Europe for condition determination and lifetime assessment of existing industrial installations are still administered at the level of the individual member states of the European Union. It follows that these requirements may be very different from one country to the other, even for very similar installations. Furthermore the philosophy of regulation in different countries is quite different.

Form an industrial point of view, practices differ from one industry to another, both for specific reasons and because there is little contact between different industries for reasons of competition. This has led to a very individual level of expertise at individual plants, and also major differences between industrial sectors.

Existing, nationally fragmented, regulations which do not cover the current demand threaten the competitiveness of European industry. Furthermore it would be desirable to ensure an equal level of safety in the entire European Union, and ultimately possibly one global level. This generates the following motivation for the creation of this CEN Workshop:

- Existing regulations were elaborated when plants were young, and end of life was not an issue;
- Fragmented regulations all over Europe have led to disadvantages in competition based on overhead costs imposed;
- New knowledge generated by the scientific community has not so far been taken up, given that regulatory processes are slow;
- The lack of standards does not allow to apply the new methodologies systematically in the European industry for reliability reasons;
- A voluntary standardization approach, using in the first instance the informal consensus process of a CEN Workshop, will help to improve the understanding of these issues Europe-wide and begin to bridge the gap.

It is recognized that there cannot be one concept fit for all. Therefore the concept of this CEN Workshop is based on a horizontal specification of the methodology with subsequent parts representing the specific industries with their specific demands.

2. Workshop Proposals and Workshop Participants

2.1 Relation to the IRIS Project

The IRIS project (FP7-213968) was proposed to the Commission in 2007, and started in October 2008.

The IRIS project is led by industry, as a means to consolidate and generate knowledge and technologies to enable the integration of new safety concepts related to technical, human, organizational and cultural issues. Over 1 million workers are employed in participating companies.

The project underpins relevant EU policies, and integrates all aspects of industrial safety with however a priority on saving human lives and prior cost reductions..

The concept of IRIS is to focus on diverse industrial sectors and their main safety problems as well as to transform its specific requirements into integrated and knowledge-based safety technologies, standards and services. The project includes significant demonstration elements, training activities and facilitation of technology transfer, including on an international level.

The structure of IRIS is presented in Figure 1.

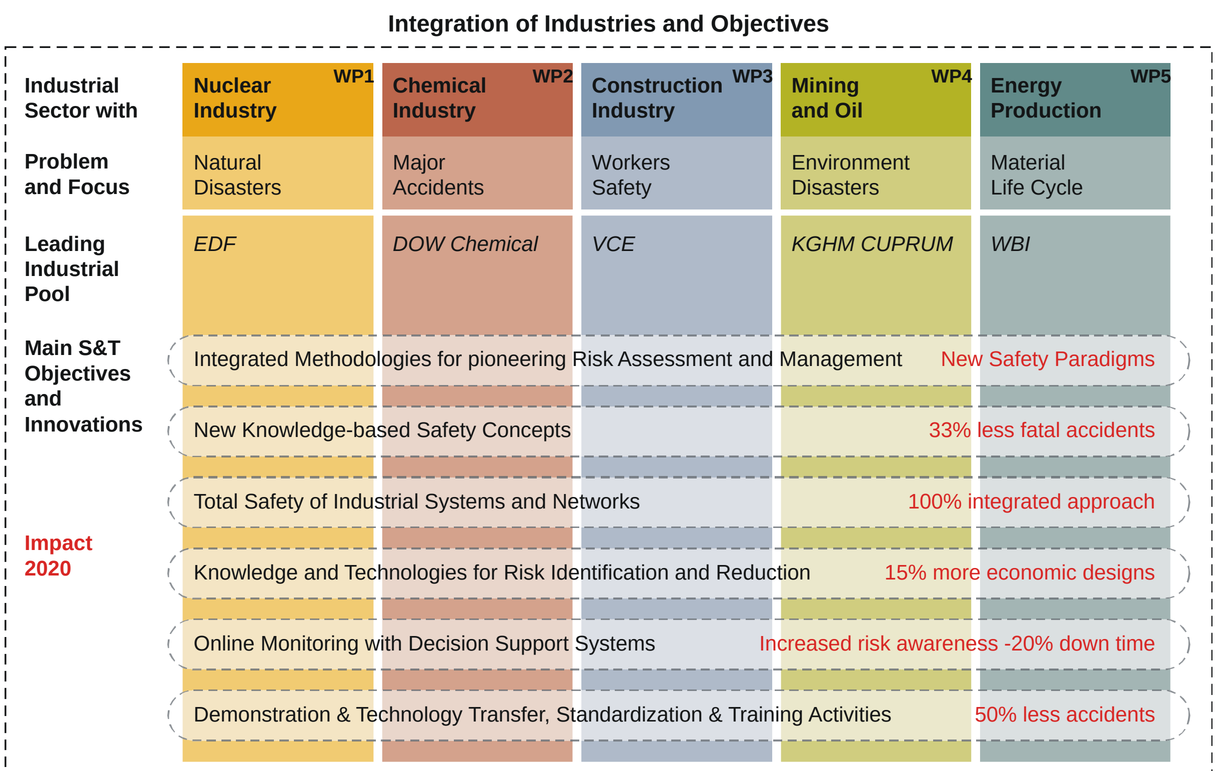

Figure 1: IRIS - Integration of industries and objectives

(see additional information on the project IRIS as annex B)

2.2 Original Proposers of the CEN Workshop

The original proposers of this CEN Workshop are the members of the IRIS Consortium as listed in the table below.

Beneficiary Number	Beneficiary name	Beneficiary short name	Country
1(CO)	Universität Linz – Institut für Anwendungsorientierte Wissensverarbeitung	JKU	Austria
2	Electricite de France	EDF	France
3	DOW Deutschland Anlagengesellschaft mbH	DOW	Germany
4	EGNATIA ODOS SA.	EOAE	Greece
5	KGHM Cuprum sp.z o.o. CBR	KGHM	Poland
6	RWE Power AG	RWE	Germany
7	Woelfel Beratende Ingenieure GmbH und Co KG	WBI	Germany
8	Universität Stuttgart	USTUTT	Germany
9	Commissariat à L'Energie Atomique	CEA	France
10	Commission of the European Communities – Directorate General Joint Research Centre	JRC	Belgium
11	Institut National de Recherche en Informatique et en Automatique	INRIA	France
12	Politecnico di Torino, Dipartimento di Ingegneria Strutturale e Geotecnica	POLITO	Italy
14	Technische Universität Braunschweig, Institut für Geodäsie und Photogrammetrie	TUB	Germany
15	Aristotelio Panepistimio Thessalonikis	AUTH	Greece
16	MEGA International GmbH	MEGA Risk	Germany
17	Galleria di Base del Brennero – Brenner Basistunnel BBT SE	BBT SE	Italy
18	Kozloduy NPP PLC	KNPP	Bulgaria
19	ICEMENERG – Institute for Energy Research and Development	ICEMENERG	Romania
20	Risk Engineering Ltd	RISKENG	Bulgaria
21	Ceske Vysoke Uceni Technicke V Praze	CTU	Czech Republic

Beneficiary Number	**Beneficiary name**	**Beneficiary short name**	**Country**
22	Disaster Management Directorate of Tolna County	DTCDM	Hungary
23	ERF Produktion Würzburg GmbH	ERF GmbH	Germany
24	Büro für Angewandte Geowissenschaftliche Fernerkundung	BAGF	Germany
25	Bundesanstalt fuer Materialforschung und -pruefung	BAM	Germany
27	Aplica Advanced Solutions, GmbH	Aplica	Austria
28	VR VIS Zentrum für Virtual Reality und Visualisierung Forschungs-GmbH	VRVis	Austria
29	Università degli Studi di Genova	UNIGE	Italy
30	University of Manchester	UNIMAN	United Kingdom
31	Universidad Politécnica de Cartagena	U Cartagena	Spain
32	Lulea Tekniska Universitet	U Lulea	Sweden
33	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.v.	Fraunhofer	Germany
34	CKTI-Vibroseism Co. Ltd	CVS	Russian Federation
35	Bhabha Atomic Research Centre	BARC India	India
36	Chinese Academy of Sciences, Institute of Mechanics	CAS	China
37	University of Sheffield	USFD	United Kingdom
38	VCE Holding GmbH	VCE	Austria

3. Workshop Objectives

The objective of this CEN Workshop is to produce a CEN Workshop Agreement entitled "Condition Determination for Integrated Lifetime Assessment of Constructed facilities and components,", which will:

- elaborate a standard framework for the results of the IRIS Project. Results will become directly available for relevant industries to apply;
- , document specific requirements for individual sector-related applications using this framework..

The focus will be given to those areas that have reached a very mature status within the IRIS Project, which are:

- bridges;
- industrial piping systems inthe chemical industry;
- wind turbines land and offshore;
- high temperature piping systems in the power industry;
- further sectors to be integrated on demand.

4. Workshop Programme

4.1 General

The purpose of the CEN Workshop is to facilitate the transfer of IRIS procedures into a CEN Workshop Agreement. This will allow all parties interested in the activity to discuss and contribute to the development of the CWA.

The kick-off meeting of the CEN Workshop will be open (free of charge) to any interested party willing to participate. Registration and information will be disseminated through the CEN website and via the CEN Members.

After approval of the CEN Workshop Business Plan at the kick-off meeting further interested parties willing to collaborate will need to register at the CEN Workshop secretariat. Participation will be subject to acceptance of the Workshop objectives and the commitment to provide the financing as set out below.

The CWA will be approved by the registered members, to satisfy the objectives stipulated by the Workshop Business Plan. A draft of the CWA will be made available by CEN for public comment for a duration of 60 days, and the Workshop will take due account of any comments received. This will be facilitated by means of the interactive website.

4.2 Deliverables

The Workshop will deliver one CWA in at least two parts.

4.3 Workshop Schedule

The tentative Workshop schedule is provided in subsequent table.

Activity or item	Date	Responsibility
Kick-off meeting	10.12.2010	CEN-CENELEC Management Centre
Deadline for registration of new participants	31.03.2011	Secretariat
Produce and distribute the draft version of the CWA to registered participants	31.12.2011	Chairman, Secretariat
Circulation of the draft CWA for public comment process	29.2.2012	Secretariat, CCMC
Comments Resolution Meeting and approval of the CWA	15.5.2012	Chairman, Workshop participants, Secretariat
Preparation of final CWA draft, including accepted changes; sending the final WS draft to CEN	15.9.2012	Chairman, Secretariat
Editing the CWA for publishing	15.10.2012	CCMC
Publication of the CWA	1.11.2012	CCMC

5. Workshop Structure

5.1 Workshop Chairman

The Chairman is nominated by the Workshop proposers and approved by the Kick-Off meeting, Responsibilities include:

- chairing the CEN Workshop Plenary meetings;
- representing the CEN Workshop in outside meetings in cooperation with CEN-CENELEC Management Centre and with the Workshop Secretariat;
- monitoring the progress of the CWA,
- ensuring the liaison with CEN/TC 250 “Structural Eurocodes”.

5.2 Workshop Secretariat

ASI, the Austrian Standards Institute, has offered to hold the Workshop Secretariat and has been approved during the Kick-Off meeting, providing the formal link to the CEN system. ASI will be assisted in the whole operating issues of the Workshop by the IRIS operating team. The following activities will be carried out by the Workshop Secretariat:

- organizing WS plenary meetings;
- producing WS and project meeting reports and action lists;
- administrative contact point for WS projects (if any, for now there are no projects planned);
- managing WS membership lists;
- managing WS document registers;
- follow-up of action lists;
- if the Workshop works mainly by electronic means, assist Chairperson in monitoring and follow-up of electronic discussions.
- administer the liaison with CEN/TC 250 "Structural Eurocodes"

6. Resource Requirements

6.1 Costs of the Workshop Secretariat

The cost of the Workshop Secretariat will be met by a participation fee of 850 € per registered participant, to be billed by the Secretariat.

6.2 Additional funding by the EC Project IRIS

It is acknowledged that the fee for the Secretariat (refer to 6.1) is a fixed lump sum. Any additional funding not be covered by registration fees, will be carried by the IRIS Project.

7. Liaison

Close liaison shall be ensured between CEN WS 63 and CEN/TC 250 "Structural Eurocodes"

8. Related activities

8.1 National standardization activities in Europe

Standardization of condition assessment procedures have started in the construction industry after the collapse of the Reichsbrücke in Vienna in 1976. After that parallel activities were implemented quickly in various European countries. It is to be noticed that there are fragmented approaches even within small nations of the European Union and unified national standards don't exist in most of the countries. Activities are often broken down to owner's levels. In Austria the relevant guideline (one of the most sophisticated in Europe) is documented in RVS 13.03.11 which is currently undergoing a fundamental revision. This guideline is now also introducing monitoring activities for the improvement of the assessment quality. The Austrian members of the CWS are also members of the committee implementing this national guideline. The material worked out for this exercise will be provided for this workshop.

In Germany DIN 1076 contains similar approaches and in Switzerland a complete set of Codes for existing structures have been implemented since January 2011. They all recognize the necessity of harmonization in Europe. Further contacts are planned to comparable activities in Italy, France, Netherlands, Great Britain and Denmark.

8.2 International standardization activities

In the United States an ASCE manual is currently elaborated under the chairmanship of Prof. Emin Aktan from Drexel University in Philadelphia. This international exercise includes experts from Europe, some of them being partners in the IRIS Project and willing to contribute to this CEN Workshop. Discussion on harmonization of international standards has been carried out over the past 5 years with impressive progress to be reported.

Collaboration with Japan has started and it has been promised that an English version of the Japanese code will be provided. There is currently a strong discussion underway in Japan on new approaches to be established in this field.

In Europe CEN/TC 250 started 2007 an initiative for developing rules for existing structures complementing the rules of EN Eurocodes. The relevant draft project proposal is dated May 2010.

8.3 Collaboration with international research partners

An international demonstration project has been agreed on between the IRIS Project of the European Commission, the Long Term Bridge Performance Project (LTBP) of the Federal Highway Agency (FHWA) in the United States and a group of researchers from Japan, including representatives of industry under the leadership of the University of Tokyo (Prof. Yozo Fujino).

All these teams had the opportunity to participate in the demonstration project S101 of IRIS and are now undergoing another demonstration at a bridge on Highway 202 in New Jersey, U.S.A..

The exercise is intended to compare the various approaches to the same problem and to finally harmonize the approaches. This exercise will be completed before a final draft of the CWA will be submitted.

9. Contact Points

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Annex A: Additional information on the Background of the CWA

According to Christensen (2005), LCCA is more than a means to assess total cost of ownership or to distinguish between alternatives; it is the most relevant objective throughout the entire design and operation process. The often listed design goals of maximizing reliability, manufacturability (construct ability), durability, maintainability, etc. are clearly all desirable. However, when these objectives compete with one another there is no clearly defined recourse. In contrast, basing designs on life-cycle cost removes the need for arbitrary rankings of attributes, and provides a basis for identifying trade-offs related to the bottom line. Christensen (2005) attributes this approach to procurement guidelines of both US and Canadian armed forces and notes that in 1960, US Department of Defence officials reported that 75% or more of the total cost for a weapons system is due to operations and support costs. While the exact portion of the total cost of transportation infrastructure due to maintenance and renewal costs is unclear, it is clearly substantial and thus should play a role in the design and management decision-making.

It follows that lifecycle cost and in some cases lifecycle benefit/cost analysis is a critical concept for making investment decisions, and therefore should be incorporated in the engineering and management of infrastructure systems. However, several important questions remain before one may conduct a meaningful LCC analysis. These relate to the determination of the lifecycle of a new, maintained, rehabilitated or retrofitted structure and its expected performance along the lifecycle as affected by the limit states. The impacts of uncertainty in estimating the risk involved in establishing appropriate demand envelopes for various limit events are significant for LCCA in design and in maintenance management.

An important benefit of LCCA in the case of integrated asset management is the guidance it provides regarding the integration of the different definitions and indicators of performance for different asset groups such as bridges and pavements. By adopting the lifecycle benefit/cost and in some cases lifecycle cost of any project for any asset group, whether this is a stretch of pavement, or a bridge, or signalisation and lighting of an intersection as a normalized measure for comparison, we may formulate the relative worth of any investment and this may serve as the key common denominator for integrated management of all asset groups. We should note that in this context LCCA is not serving as a decision tool by itself but is facilitating integrated asset management.

Annex B: Additional information on the IRIS project

The project partners has been selected on the principles of complementarities, non competition and commitment to the subject of industrial safety. The respective top management is committed to take a big step towards considerably improved safety performance in the European industry. The main objectives and expected impact by 2020 are given below.

- Integrated Methodologies for pioneering risk assessment and management

A major enhancement in risk management is the integration of multiple risk assessment methods. The objective is continuous risk assessment based on a combination of probabilistic (state-of-the-art) and measurement-based risk analysis.

Expected Results: An integrated online monitoring system that combines the new paradigm integrating operation with risk management.

Impact: 20% less down time in production.

- New knowledge-based safety concepts

A general achievement of IRIS is to enable progressive continuous improvement through refinement of risk identification, assessment and control processes due to building on knowledge already gained.

Expected Results: Realization of a new knowledge based safety concept.

Impact: Reducing the number of accidents by 50%.

- Total safety of industrial systems and networks

Such systems are based on integrated technical solutions through new models for industrial systems which consider interdependencies during design and operation. They lead to accident free networked production also in the increasing complexity of value-chain based production activities.

Expected Results: Accident free networked production reducing the number of fatal accidents in Europe by 1/3 with potential on more reduction in future.

Impact: Reducing the number of fatalities by 33% which equals 1600 deaths.

- Knowledge and technologies for risk identification and reduction

Innovative risk identification and reduction has to consider the reassessment of exposure and vulnerability of environment, society, industry to the impact of natural, technological and man-made hazards. The implementation needs to provide the detection and early warning of risk potentials before they become critical and whilst avoiding actions are executed.

Expected Results: Risk identification and mitigation tools fit for everyday practice.

Impact: 50% less accidents.

- Online monitoring with decision support systems

The realisation of the mentioned objectives requires hardware and software for continuous risk assessment by online monitoring of the interactions in the industrial systems during their life cycle. S&T achievements are the development of decision support systems (knowledge-based system, self learning and artificial intelligence) for the evaluation of colleted data as well as sensors, data management and a required cyber infrastructure.

Expected Results: Embedded online risk monitoring systems for all industries.

Impact: -20% down times; no loss of basic power supply.

- Pattern recognition in signal processing

Detection of hidden attributes characterising evolving damages in materials and systems is the challenge. A general approach to detect unfinished forms of patterns will be developed as a basis for decision making and early warning. This includes treatment of contaminated data and algorithms.

Expected Results: Basic tools for damage detection as basis for early warning.

Impact: Reduced maintenance costs at equal safety level (-15%).

- Demonstration & technology transfer, standardization & training activities

Expected Results: Wide spread technology demonstration, technology transfer, underpinning standardization and training activities are critical for broad application and guaranteed by the consortium represented by industry, main international and European stakeholders, specialized SMEs, research institutions and universities.

Standardisation is achieved through this CEN Workshop.