CEN

WORKSHOP

AGREEMENT

CWA 16633

May 2013

ICS 91.010.30

English version

Ageing behaviour of Structural Components with regard to Integrated Lifetime Assessment and subsequent Asset Management of Constructed Facilities

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Ref. No.:CWA 16633:2013 E

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Foreword

This CEN Workshop Agreement has been drafted and approved by a Workshop of representatives of interested parties on 2012-04-13, the constitution of which was supported by CEN following the public call for participation made on 2010-10-10.

A list of the individuals and organizations which supported the technical consensus represented by the CEN Workshop Agreement is available to purchasers from the CEN-CENELEC Management Centre. These organizations were drawn from the following economic sectors (universities and consultancies):

— Aristotle University of Thessaloniki, Greece

— BAM (Federal Institute of Materials Research and Testing), Germany

— INRIA, France

— Risk Engineering LTD, Bulgaria

— University of Genoa – DICAT, Italy

— VCE Holding GMBH, Austria.

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The final review/endorsement round for this CWA was started on 2012-06-12 and was successfully closed on 2012-08-12.The final text of this CWA was submitted to CEN for publication on 2013-02-06.

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Comments or suggestions from the users of the CEN Workshop Agreement are welcome and should be addressed to the CEN-CENELEC Management Centre.

Introduction

Managing assets is about making decisions. From this it follows that lifecycle cost (LCC) 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 routines 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 regarding the limit states. The impacts of uncertainty in estimating the risk involved in establishing appropriate demand envelopes for various limit events are significant for LCC analysis in design and in maintenance management.

The present CWA was prepared by CEN Workshop 63 "Condition Determination for Integrated Lifetime Assessment of constructed facilities and Components" the secretariat of which is held by ASI. It was developed through close collaboration with experts from the IRIS project "Integrated European Industrial Risk Reduction System", supported by the European Union's Seventh Framework Programme. Work in this project was organized in eight work projects.

In the course of the IRIS project methodologies for lifecycle management of constructed infrastructure were developed. In order to meet the infrastructure owner's governing requirements regarding safety, operability and durability, the present CWA addresses the following major aspects:

1) The determination/estimation of the design life of new structures

2) The determination/estimation of the residual life of existing structures

3) Assessment criteria whether the real degradation process – determined by proper technologies - corresponds with the assumed and applied life cycle model, in order to take corrective measures in cases of accelerated ageing

4) Maintenance instructions to ensure the intended service life

In IRIS Work Package 3 and WP 7 and CEN Workshop 63 experts from universities, consultancies, public authorities and standardization bodies contributed to the work. The present CWA has received the support of representatives of these sectors.

1 Scope

1.1 Ageing model

The objective of the CWA is to elaborate a standard framework for the results of the IRIS Project, while it is recognized that there cannot be one extensive methodology fit for all specific industries.

There is a simple basic model with considerable uncertainties, which is improved step by step through introduction and evaluation of new knowledge gained about a structure. The ideal result is a precise assessment of the condition with reasonable margins of uncertainty. The model is able to show the successive impact during the long-term deterioration process as well as the effect of sudden changes in condition (retrofit actions of local failure). It is recognized that the individual results from visual inspection and assessment will influence the quality of the prediction. Nevertheless after a number of assessments these uncertainties will be reduced to reasonable levels.

It is acknowledged that the basic model shall be kept simple and transparent for the end-users. In return the background computation is expected to become more and more complex with every new knowledge and methodology developed.

Therefore the concept is to give a common understanding on structural ageing in general, which can be incorporated into different industrial applications and adapted regarding the industry-specific demands.

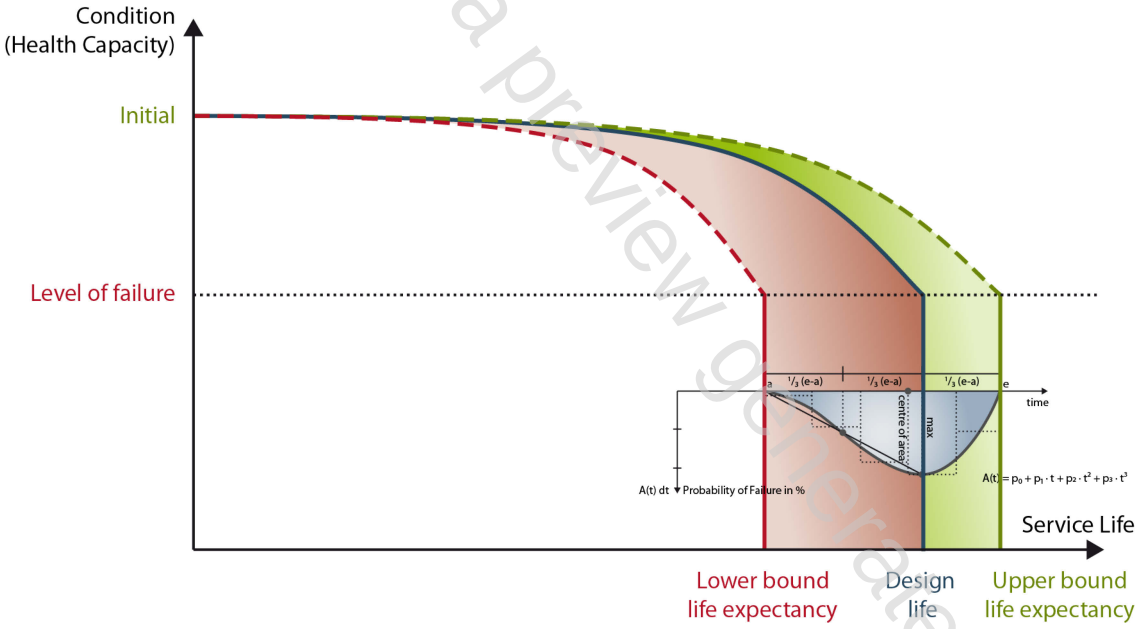

Figure 1 — General concept of structural ageing

In further consequence the focus of the CWA is on the area of bridge infrastructure, as there the most mature status within the IRIS Project has been reached.

The aspect of acceptance of structural failure and accidents is always depending on the involved individual society. The current document already reflects the current situation in Austria, Germany, the Netherlands and the USA.

1.2 Background – Asset management

In the following an overall assessment scheme for asset management on the network level is described very briefly. The scheme is divided in two main processes:

— Flowchart 1: Input data with regard to Life Cycle Analysis (LCA) and Life Cycle Cost Analysis (LCCA) (as shown in Figure 2)

— Flowchart 2: LCA and LCCA itself, addressing the determination of maintenance schedules (composed by individual treatments) and linked to budget category-related optimization (as shown in Figure 3).

In both flowcharts those parts, being explicitly covered by the current CWA are highlighted (yellow marking) and are discussed in full detail in the following chapters.

It is to be pointed out, that the shown assessment scheme utilises conventional ratings (from structural inspection), which are usually available for every structure or can easily be provided. Neither the assessment scheme itself or the underlying rating process are intended to be standardized – but the curve describing structural ageing (Lifeline). Thus the intention of this CWA is to improve the current practice of maintenance budget planning based on ratings. The given ratings are transformed into health indices and incorporated into comprehensive life cycle calculations. By this means the gap between rating and service life considerations is bridged.

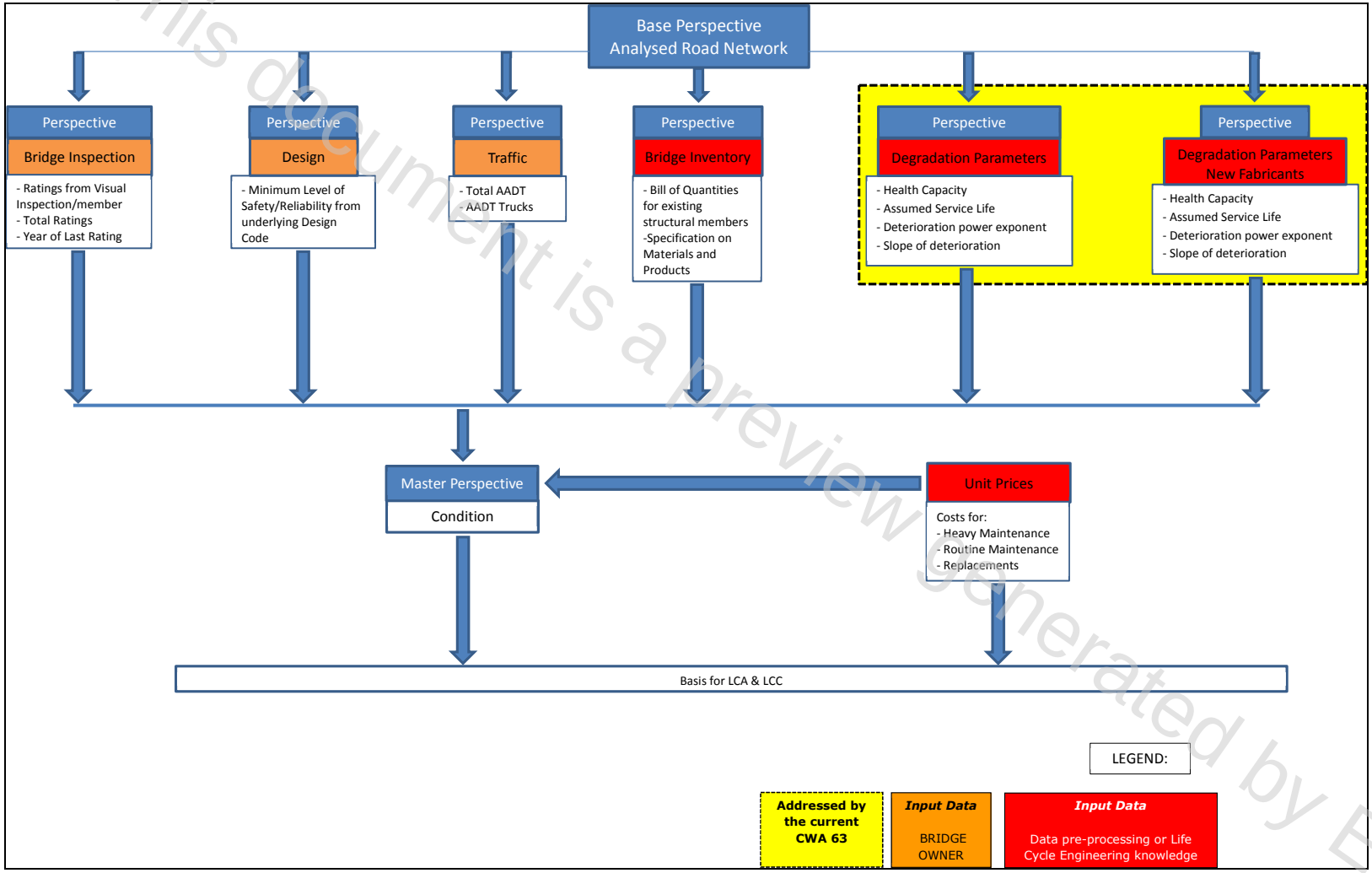

Figure 2 — Input data with regard to Life Cycle Analysis (LCA) and Life Cycle Cost Analysis (LCCA)

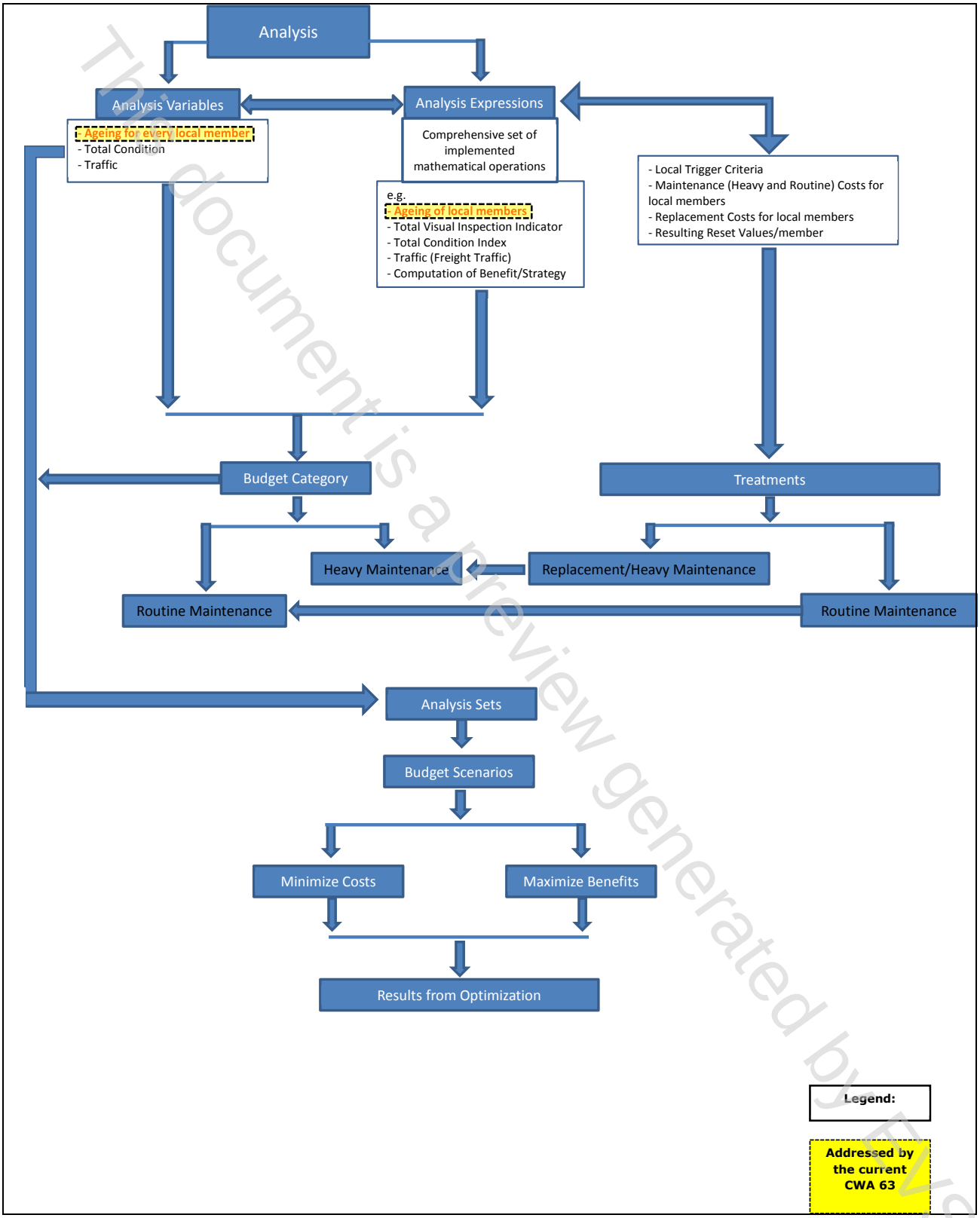

Figure 3 — Life Cycle Analysis (LCA) and Life Cycle Cost Analysis (LCCA)

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.

In terms of standards, there are no referenced documents being indispensable for the application of this document. Certain relevant literature and a list of standards giving an overview on the related activities have been added to the bibliography.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
ageing
degradation due to long-term influence of operational conditions related to use

2.2
assessment
set of activities performed to verify the reliability of an existing structure for future use

2.3
asset
whole building or structure or unit of construction works, or a system or component or part thereof

2.4
capacity
capability to perform

Note 1 to entry: Capacity describes the resistance of a member or component, or a cross-section of a member or component of a structure to actions without mechanical failure e.g. bending resistance, buckling resistance, tension resistance.

2.5
condition; health
characteristic of a structure, system or component which can be observed, measured or trended to infer or directly indicate the current and future ability of the structure, system or component to function within acceptance criteria

2.6
degradation
process whereby an action on an item causes a deterioration of one or more properties

Note 1 to entry: Properties affected may be, for example, physical, mechanical or electrical.

2.7
demand
requirement for functionality

2.8
design life
service life intended by the designer

Note 1 to entry: Design life is also referred to as intended service life or expected service life.