Service Life Estimation using Reference Service Life Databases and Enhanced Factor Method

Bruno Daniotti ¹
Sonia Lupica Spagnolo ²

ABSTRACT

Service Life Prediction to plan optimized maintenance involves the necessity for designers to handle with tools which can allow the definition of Estimated Service Lives of single buildings’ components and moreover of buildings themselves: ICT tools to manage service life prediction need Reference Service Life Data Bases. The report deals with the development of tools for the application of enhanced Factor Method through grids to guide users in assigning the values to the factors, avoiding subjectivity. Application of Factorial Method needs the knowledge of Reference Service Lives of building components, starting point of the calculation. That’s the reason why, it is fundamental to provide a data collection of reference Service Lives which can help and drive the designer in obtaining the value of Estimated Service Life in each context of application. In collaboration with the C.S.T.B., Research Group on Durability of Building Components of Politecnico di Milano is collecting data coming from researches at Politecnico’s itself and from the Italian durability network. The work wants to provide an open database which can be constantly implemented through the auxilium of researchers, owners, designers, manufactures, insurance companies, property asset managers from all over Europe, leaking and driving the insertion thanks to grids of control purposely prepared. Service life management systems are, therefore, analysed from the point of view of the information due to allow designers to manage service life prediction and maintenance planning. Databases will supply the input datas to predict Service Life of each single building component and will be available on internet in order to be a valid tool for designers. The paper reports on methods and tools developed to produce data and information in an easy-to-use form, on the durability of building components about both the quality of the manufacturing processes and the service life of products.

KEYWORDS

Database, tools, prediction, design, management.

¹ Politecnico di Milano, BEST Department, Milan, Italy, 20133, piazza Leonardo Da Vinci, 32, Phone +39 02 23996002, bruno.daniotti@polimi.it
² Politecnico di Milano, BEST Department, Milan, Italy, 20133, piazza Leonardo Da Vinci, 32, Phone +39 0223996002, sonia.lupica@polimi.it
1 INTRODUCTION

The Reference service life data is the information that includes the reference service life and any qualitative or quantitative data describing the validity of the reference service life.

As reported on the standard proposal ISO 15686-8, which provides guidance on the provision, selection and formatting of reference service life data and on the application of this data for the purposes of calculating estimated service life using the Factor method, a RSL and the appurtenant reference in-use conditions, together with additional required or useful information concerning the RSL, form a set of RSL data. A set of RSL data should be formatted into a RSL data record.

This International Standard provides guidance on RSL issues and a means of determining the ESL through application of the Factor method. The guidance for reference service life is structured into discussions regarding:
- provision of RSL data utilizing existing general data (see 4.2);
- selection of RSL data or general data (see 4.3);
- formatting of general data into RSL data records (see 4.4).

Manufacturers of building and construction products are usually in possession of considerable knowledge concerning the service life and durability of their products. However, such information is only occasionally made public, typically in product declarations, other documents, company websites and/or databases. Use of this International Standard is expected to motivate manufacturers to compile their knowledge and provide service life data following the guidelines and requirements stated in the proposal itself [ISO-DIS 15686-8: 2007].

The evaluation of service life, according to international ISO and national UNI standards, can be made following some different methods proposed. Politecnico di Milano is developing these methods, looking in particular an implementation of the Performance Based Approach in the construction industry, specifically in the design and management stages.

Analysing service life management systems form the point of view of the information due to allow designers to manage service life prediction and maintenance planning, Politecnico di Milano is structuring a Reference Service Life Data Bases thanks also to the Italian research durability network; that’s the input needed by ICT tools to manage service life prediction in order to plan a sustainable building maintenance.

2 THE COLLABORATION WITH CSTB: THE FRENCH-ITALIAN DATABASE FOR RSL

In collaboration with the CSTB – Scientific and Technical Centre for the Building Industry, Durability of Building Components Group of Politecnico di Milano is going to collect data coming from all researches undertaken in the last 10 years in order to create a French-Italian database of reference Service Lives of building components. in order.

The aim is to make available to designers, real estate and manufactures all data collected, giving them the possibility to apply methods described in ISO 15686 standards, and in particular the Factor one, for calculating Estimated Service Life.

To minimize the subjectivity of Factor method, ad hoc grids will be created which will drive users in choosing the right values of each factor according to the context conditions in which building components are placed.

These grids, obviously, can’t avoid the subjectivity in calculating Service Life, but they move it in the moment of grid creation: that why grids should be built by building sector experienced people, such as manufacturers themselves.

T 41, Service Life Estimation using Reference Service Life Databases and Enhanced Factor Method, B. Daniotti and S. Lupica Spagnolo
2.1 The French database

Currently, CSTB has already predisposed a Reference Service Life database, which is available on the web (see www.duree-de-vie-batiment.fr) and which becomes a very important tool to:
- exchange and collect data deriving from different providers of data, such as manufacturers of building and construction products, researchers, national assessment bodies and technical approval organizations, database holders;
- elaboration of evaluating and driving grids to determine each the seven factors needed by the Factor method (see table below).

Table 1. Factors used applying the Factor method.

<table>
<thead>
<tr>
<th>AGENTS</th>
<th>REMARKABLE FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Quality of components</td>
</tr>
<tr>
<td>B</td>
<td>Design level</td>
</tr>
<tr>
<td>C</td>
<td>Work execution level</td>
</tr>
<tr>
<td>D</td>
<td>Indoor environment</td>
</tr>
<tr>
<td>E</td>
<td>Outdoor environment</td>
</tr>
<tr>
<td>F</td>
<td>In-use conditions</td>
</tr>
<tr>
<td>G</td>
<td>Maintenance level</td>
</tr>
</tbody>
</table>

An example of the layout provided by French database is given below and it shows how with a user-friendly grid it is possible to select the context conditions of designing for determining Estimated Service Life.

![Figure 1. Example of the grid for assigning factors.](image-url)
2.2 The Italian contribution

Thanks to the cooperation among six Italian research units, Service Life prediction tools will take the input data from a set of the national regionalized information sources, a Reference Service Life Database, contemplating also a performance evaluation for feedback of Service Life data from practice, with an agreed European international structure (in conformity with ISO 15686).

The six research units of as many Italian university centres involved are Politecnico di Milano, Politecnico di Torino, University of Naples, University of Palermo, University of Brescia and University of Catania.

Using Factor method Politecnico di Milano is structuring a service life data collection of opaque vertical and horizontal enclosures taking into consideration different climatic contests; it is a collection of Reference Service Life values for different technical solutions among opaque vertical and horizontal enclosures, such as:

T 41, Service Life Estimation using Reference Service Life Databases and Enhanced Factor Method, B. Daniotti and S. Lupica Spagnolo
- traditional walls (double boarding of hollow and semi-hollow bricks with heat insulation interposed);
- externally thermal insulated walls;
- ceilings;
- enclosures typical of the Mediterranean contest.

Initially, the problem to solve is to define the range of the study established, including identification or specification of essential data, depending on the aim and ambition of the SLP and on the level of existing knowledge of the component.

Two extreme ranges are as follows:

a) specific study: this is intended to focus on a rather specific application of the component tested in terms of service environment and usage with a specified set of performance requirements;

b) general study: this is intended to cover a broad application of the component tested in terms of service environment and usage with an unspecified or a loosely specified set of performance requirements. The aim is to establish performance-over-time functions for the performance characteristics chosen in the whole range of applications.

2.3 Ways of providing and selecting Reference Service Life data

The standard proposal ISO 15686-8 provides also a guidance to the providers of data on how to structure and format general data into RSL data, which have to be selected in order to be correctly applied for the evaluation of Estimated Service Life using Factor method.

![Figure 4. The process of providing RSL data.](image)

![Figure 5. The process of selecting RSL data.](image)
2.4 Enhanced Factor method

Durability of Building Components Group has also developed the Factor method defining some criteria in order to make as more objective and scientifically validated as possible values given to each single factor. In fact, the Factor method provided by ISO 15686 is a very simple method for evaluating service life: thanks to seven deterministic factors, this method tries to model aleatory phenomena, such as climatic agents. That’s the reason why the scientific community has showed the necessity to improve the method, through two ways to proceed.

As a consequence, DBCG suggests a probabilistic approach and uses the same equation proposed by ISO standard, but treating factors as aleatory variables. The proposal is based on the use of triangular distributions of ISO factors, adopting Montecarlo method for solving the equation. Aleatory variables’ use describes better the complexity of decay and provides both the Service Life and an estreem of data’s reliability: it is possible to obtain a evaluation of duration with precise probabilistic guarantees.

![Figure 5.](image)

**Figure 5.** Enhanced Factor method: probabilistic (triangular) input for factors.

![Figure 6.](image)

**Figure 6.** Software SLP Tool to apply Enhanced Factor method.

REFERENCES


