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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Dependability management – Part 3-3: Application guide – Life cycle costing

Gestion de la sûreté de fonctionnement – Partie 3-3: Guide d'application – Évaluation du coût du cycle de vie

IEC 60300-3-3:2017-01(en-fr)

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FOREWORD

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International Standard IEC 60300-3-3 has been prepared by the IEC technical committee 56: Dependability.

This third edition cancels and replaces the second edition published in 2004. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) addition of a complete analysis process;
b) greater reference to international accounting practices;
c) increased discussion of financial concepts.

The text of this standard is based on the following documents:

FDIS	Report on voting
56/1713/FDIS	56/1720/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60300 series, published under the general title *Dependability management*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

Life cycle costing is the process of performing an economic analysis to assess the cost of an item over a portion, or all, of its life cycle in order to make decisions that will minimize the total cost of ownership while still meeting stakeholder requirements. Generally, an organization may only be able to, or need to, evaluate cost for a portion of the total life of an item. Across the life of any item, decisions involving a trade-off between current and future costs will be necessary. This trade-off process will be enhanced by defining the short and long term implications of feasible expenditure decisions.

The principal use of this document is to compare one alternative system solution to another where future cost of ownership comprising maintenance, operations, enhancement and disposal actions is significant and require a balance between the cost of acquisition and the residual unrealized risk of ownership. Such a balance is achieved by technical and monetary assessments that take into account varying outcomes of availability, reliability, maintainability and supportability. Life cycle costing can also provide essential data to develop budgetary estimates.

This document is also intended to assist those who may be required to specify, commission and manage such activities when undertaken by others.

The highest value from life cycle costing is achieved early in the life of an item when many configuration options are possible and influence on future costs the greatest. Studies have shown that life cycle costs are mostly committed and the opportunity for affordable change is progressively reduced as item detailed design is approached.

Life cycle costing comprises only expense elements, which may be tangible or intangible; revenue or value outcomes are not included. Costs comprise all expected future expenditure including financial allowance for residual risk. Value outcomes, such as revenue, are analysed in the subsequent financial or economic trade-off analysis that use the results of the life cycle cost analysis.

Analysis outcomes are often presented as a single figure representing all future expenditures at a single point in time. The analysis may also be presented as a future cost profile without inclusion of the time value of money. However, as future costs are uncertain in both approaches, the analysis may also be presented as a probability distribution to highlight any potential sensitivity of the outcome to that uncertainty.

When assessing the impacts of potential options, analysts may need to cost intangible outcomes such as safety exposure, loss of public amenity or damage to corporate image. The use of multi-attribute rank ordering or semi-quantitative matrixes are not applicable for assessing these impacts as life cycle costing has a quantitative outcome of cost, namely: life cycle cost (LCC). Many quantitative techniques, such as “willingness to pay” or “choice modelling” have been developed and are often applied to assure all direct consequences are included in the analysis.

The approach defined in this document recognizes that life cycle costing has been applied for many decades across many industries, some of which have developed their own set of terms and language. An organization may adapt the terms used in this document to their context of use to ensure that the intent of this document is achieved.

DEPENDABILITY MANAGEMENT –

Part 3-3: Application guide – Life cycle costing

1 Scope

This part of IEC 60300 establishes a general introduction to the concept of life cycle costing and covers all applications. Although costs incurred over the life cycle consist of many contributing elements, this document particularly highlights the costs associated with the dependability of an item. This forms part of an overall dependability management programme as described in IEC 60300-1 [1][1].

Guidance is provided on life cycle costing for use by managers, engineers, finance staff, and contractors; it is also intended to assist those who may be required to specify and commission such activities when undertaken by others.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
acquisition cost
initial cost of developing and realizing an item so it can be utilized and placed into service

3.1.2
amortization
paying off of debt with a fixed repayment schedule in regular instalments over a period of time

Note 1 to entry: Amortization is also defined as the spreading out of capital expenses for intangible assets over a specific period of time (usually over the asset's useful life) for accounting and tax purposes.

3.1.3
base date
fixed point in time set as the common cost reference

3.1.4
cost breakdown structure
framework of cost elements so that they can be distinctly defined and estimated

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1 Numbers in square brackets refer to the Bibliography.

3.1.5
cost driver
cost element that has a major influence on the life cycle cost

3.1.6
cost element
component of life cycle cost for which cost data are, or can be, collected

3.1.7
depreciation
method of allocating the cost of a tangible asset over its useful life

3.1.8
discount rate
factor or rate reflecting the time value of money that is used to convert cash flows occurring at different times to a base date

3.1.9
intangible item
identifiable non-monetary item without physical substance

Note 1 to entry: The item is separable, that is, is capable of being separated or divided from the entity and sold, transferred, licensed, rented or exchanged, either individually or together with a related contract, asset or liability.

Note 2 to entry: The item arises from contractual or other legal rights, regardless of whether those rights are transferable or separable from the entity or from other rights and obligations.

Note 3 to entry: An intangible item is recognised if, and only if:

- it is probable that the expected future economic benefits that are attributable to the asset will flow to the entity,
- the cost of the asset can be measured reliably.

[SOURCE: IAS 38]

3.1.10
item
subject being considered

Note 1 to entry: The item may be an individual part, component, device, functional unit, equipment, subsystem, or system.

Note 2 to entry: The item may consist of hardware, software, people or any combination thereof.

Note 3 to entry: The item is often comprised of elements that may each be individually considered. See sub item (192-01-02) and indenture level (192-01-05) in IEC 60050-192:2015.

[SOURCE: IEC 60050-192:2015, 192-01-01, modified — Notes 4 and 5 deleted]

3.1.11
liability cost
cost associated with actual or alleged non-compliance with statutory or contractual obligations

3.1.12
life cycle
series of identifiable stages through which an item goes, from its conception to disposal

EXAMPLE A typical system lifecycle consists of: concept and definition; design and development; construction, installation and commissioning; operation and maintenance; mid-life upgrading, or life extension; and decommissioning and disposal.

Note 1 to entry: The stages identified will vary with the application.

[SOURCE: IEC 60050-192:2015, 192-01-09]

3.1.13
life cycle cost
whole life cost
LCC
<of an item> total cost incurred during the life cycle

Note 1 to entry: See also life cycle costing (3.1.14).

[SOURCE: IEC 60050-192:2015, 192-01-10]

3.1.14
life cycle costing
process of economic analysis to assess the cost of an item over its life cycle or a portion thereof

[SOURCE: IEC 60050-192:2015, 192-11-11]

3.1.15
mean operating time to failure
MTTF
expectation of the operating time to failure

Note 1 to entry: In the case of non-repairable items with an exponential distribution of times to failure (i.e. a constant failure rate) the MTTF is numerically equal to the reciprocal of the failure rate. This is also true for repairable items if after restoration they can be considered to be "as-good-as-new".

Note 2 to entry: See also operating time to failure (IEC 60050-192:2015, 192-05-01).

[SOURCE: IEC 60050-192:2015, 192-05-11]

3.1.16
mean operating time between failures
MTBF
MOTBF
expectation of the duration of the operating time between failures

Note 1 to entry: Mean operating time between failures should only be applied to repairable items. For non-repairable items, see mean operating time to failure (3.1.15).

[SOURCE: IEC 60050-192:2015, 192-05-13]

3.1.17
ownership cost
total cost of utilizing an item including all operating, maintenance and unrealized risk costs until the end of its life cycle

3.1.18
time value of money
measurement of the difference between future and the present-day value of monies

3.1.19
useful life
<of an item> time interval, from first use until user requirements are no longer met, due to economics of operation and maintenance, or obsolescence

Note 1 to entry: In this context, “first use” excludes testing activities prior to hand-over of the item to the end-user.

[SOURCE: IEC 60050-192:2015, 192-02-27]

3.2 Abbreviated terms

Abbreviated term	Definition
CBS	cost breakdown structure
CU	currency unit
DCF	discounted cash flow
GAAP	generally accepted accounting procedures
IASB	International Accounting Standards Board
IFRS	international financial reporting standards
IRR	internal rate of return
kCU	1 000 currency units (CU)
LCC	life cycle cost
LORA	level of repair analysis
MTBF	mean operational time between failures
MTTF	mean time to failure
NPV	net present value
VAT	value added tax

4 Concepts of life cycle costing

4.1 Objectives of life cycle costing

The objective of life cycle costing is to assist decision-makers in selecting the most appropriate alternative options at any time throughout the life cycle of an item. The life cycle cost analysis only adds value when it informs decision-making. Whether a supplier is aiming to penetrate a new competitive market or a purchaser is looking to buy a new item, life cycle costing can provide important data and guidance information enabling decision-makers to evaluate available options. These activities should form part of a dependability management programme as described in IEC 60300-1 [1].

In the context of the life cycle, options can be evaluated in terms of their relative cost, timescale, performance, dependability or other considerations. Options can also be evaluated in terms of design concepts, such as the benefits of economy-of-scale savings resulting from commonality in design and structure, or whether to invest in an improvement programme. Where there are few or no options, the analysis can also provide essential data to develop budgetary estimates for the utilization stage, or decisions to bid (or not) for new work.

When defining the objectives of an analysis, it is important to decide if a comprehensive analysis or a more limited one should be performed. The purpose of life cycle costing may relate to evaluation of alternatives, financial planning or, as is often the case, situations where both are required.

When life cycle cost analysis is used in financial planning, the full range of costs may have to be considered. This is usually a detailed analysis where there will be less uncertainty and greater accuracy in the results, but extensive and accurate input data will be required.

If the intent of the analysis is to evaluate alternatives, only cost elements that relate to the comparison need be included. This is usually a comparative analysis where less input data will be needed, but will provide less accuracy and only a relative ranking of options.

The life cycle cost analysis can be beneficially performed by a supplier, manufacturer, sales organization, commissioning authority or installer. It can also be performed by the purchaser, user, operator, paymaster, maintainer, or decommissioning authority. It is important to be

aware of the perception of the analysis task by the relevant authority (or authorities), and to be clear about the purpose and objectives of the analysis. Given the different interested parties that may benefit from the analyses, for the sake of simplicity, in this document the parties involved can be divided into the categories of suppliers and purchasers.

4.2 Application of life cycle costing

The methods described in this document may be applied throughout the life cycle of an item for making decisions regarding trade-offs between performance, cost and schedule, for applications such as:

- project planning;
- budgeting and funding;
- acquisition processes;
- feasibility studies;
- concept development;
- selection of alternative design solutions;
- assessment of remaining life;
- comparison between new system acquisition and renovation of a current system.

An understanding of the life cycle of an item and the activities that are performed during each stage is fundamental to the application of life cycle costing. It is also essential that there is a clear understanding of the relationship of these activities to performance, safety, dependability and other characteristics that contribute to life cycle costs. Annex A describes the major life cycle stages and aspects of life cycle costing appropriate to each.

It is common practice to identify the costs associated with specific life cycle stages in order to ensure that any trade-off studies are relevant to that stage or stages. The number of stages considered and the detail in which they are analysed is application specific both in terms of the item under study and the context in which it is being analysed. The identification of suitable stages and levels of analysis detail should therefore form part of the analysis plan and may result in multiple analyses.

Decisions will often include the trade-off between short and long-term expenditure, such as:

- item reliability and the ongoing cost for preventive and corrective maintenance;
- item maintainability, supportability and future cost for preventive and corrective maintenance;
- item performance and cost of future operation, for example: passive building insulation and future cost for active temperature control.

The boundary of each life cycle stage should be clearly defined in order to ensure consistency of approach and that meaningful results can be obtained to achieve the objectives set for that stage.

Life cycle costs can be divided into those that are associated with acquiring the item and subsequently those required to exercise ownership. An important consideration when planning to perform life cycle cost analysis is that costs are largely committed or determined during acquisition even if the actual costs only occur later during the ownership stage. This is illustrated in Annex A.

Examples of life cycle costing include:

- broad assessment of alternative operational concepts of a system subject to full scale engineering development;
- assessment of alternative technologies during design;

- assessment of alternative commercial items to procure in a system by trade-off studies between reliability, maintainability, supportability and cost;
- costing of alternative maintenance concepts and associated strategies applied to achieve business objectives;
- assessment of potential internal trade-offs in provision of integrated support (personnel, spares, training, facilities, etc.) necessary to achieve cost effective availability;
- assessment of the medium and long term implications of changes to short term expenditure.

4.3 Factors influencing LCC

The greatest effect on LCC can be achieved during the initial stages of the life cycle, particularly the concept and development stages. Design practices should therefore recognize that, as the design becomes established, improving the LCC is increasingly difficult and costly.

The characteristics of an item are established during the concept and development stage when the fundamental need for that item is scoped. This need is made more specific in a set of requirements, which are further converted into a detailed specification. Decisions made as to how the requirement is to be met, including constraints, determine to a great extent the eventual LCC.

Factors that influence the LCC of an item are closely linked to the requirements that are to be satisfied. Examples of these include, but are not limited to requirements for:

- dependability;
- safety;
- regulations;
- physical operating environment;
- environmental impact;
- financial performance;
- expected duration of use;
- obsolescence management.

4.4 Factors related to dependability

Dependability plays a major role in the LCC of an item; the attributes of dependability which affect LCC vary with the stage of the life cycle. Options can be evaluated in terms of availability, reliability, maintainability, supportability or other dependability-related considerations.

The first aspect of dependability that is considered is usually the required reliability of the system and the reliability of its components. If the required reliability is not feasible, redundancy may have to be part of the design in which case the acquisition cost will usually increase. Improved reliability can result in a major benefit in LCC by reducing operating and maintenance costs although this usually entails a higher acquisition cost.

Improved maintainability has a similar impact on LCC through lower operating and maintenance costs and improved availability through reduced downtime. Adequate supportability by means of available, efficient and cost-effective maintenance support and logistics usually improves the LCC of an item.

Dependability considerations should be an integral part of the design process and LCC evaluations. These considerations should be critically reviewed when preparing item specifications and be regularly evaluated throughout the design stages in order to optimize system design and the LCC.