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Petroleum, petrochemical and natural gas industries — Life cycle costing

Industries du pétrole et du gaz naturel — Estimation des coûts globaux de production et de traitement

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 12, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement)

This first edition cancels and replaces ISO 15663-1:2000, ISO 15663-2:2001 and ISO 15663-3:2001, which have been technically revised. The main changes compared to the previous editions are as follows:

— Clause 3: several new terms, definitions, symbols and abbreviations;

— Clause 4: a new clause has been introduced;

— Clause 5 and Clause 6: new clauses describing life cycle costing management and methodology which have been restructured from previous edition;

— Annex A: contains restructured text from ISO 15663-3:2001;

— Annex C: new annex describing life cycle costing techniques which also includes text from ISO 15663-2:2001;

— Annex B, Annex D, Annex E and Annex F are new annexes, but contain also some elements from the previous editions.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Cost management within the petroleum, petrochemical and natural gas industries is important and will benefit from adoption of a common and consistent approach to life cycle costing.

Life cycle costing is the systematic consideration of costs and revenues associated with alternative options required to fulfil the objectives of the business. It is an iterative process of planning, estimating and monitoring costs and revenue differences throughout an asset's life. It is used to support the decision-making process by evaluating alternative options and performing trade-off studies. While the largest benefits are typically achieved in the early life cycle phases, it is equally applicable to all life cycle phases and at many levels of detail.

The petroleum, petrochemical and natural gas industries have historically assessed the financial viability of project options based on minimum capital expenditure and achieving project schedule, whilst operating expenditures and lost revenue have received less focus in the decision-making process. This has ignored potentially large cost factors and has in some cases resulted in selecting non-optimal solutions.

Recognizing this situation, life cycle costing is increasingly being applied by a variety of organizations within the industry. All participants in the process — operators, contractors and vendors — can have a substantial impact on the life cycle cost, and it is not until all are involved that the benefits sought from the use of life cycle costing will be realized.

Petroleum, petrochemical and natural gas industries — Life cycle costing

1 Scope

This document specifies requirements for and gives guidance on the application of life cycle costing to create value for the development activities and operations associated with drilling, exploitation, processing and transport of petroleum, petrochemical and natural gas resources. This document covers facilities and associated activities within different business categories (upstream, midstream, downstream and petrochemical).

The life cycle costing process as described in this document is applicable when making decisions between competing options that are differentiated by cost and/or economic value. This document is not concerned with decision-making related to the economic performance of individual options or options differentiated by factors other than cost or economic value.

Guidance is provided on the management methodology and application of life cycle costing in support of decision-making across life cycle phases. The extent of planning and management depends on the magnitude of the costs involved, the potential value that can be created and the life cycle phase. It also provides the means of identifying cost drivers and provides a cost-control framework for these cost drivers, allowing effective cost control and optimization over the entire life of an asset.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14224:2016, *Petroleum, petrochemical and natural gas industries — Collection and exchange of reliability and maintenance data for equipment*

ISO 19008:2016, *Standard cost coding system for oil and gas production and processing facilities*

ISO 20815:2018, *Petroleum, petrochemical and natural gas industries — Production assurance and reliability management*

3 Terms, definitions and abbreviated terms

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:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1 Terms and definitions

3.1.1
abatement cost
cost generated for the removal or reduction of an undesirable item

Note 1 to entry: An item can be several types of avoided emissions, e.g. emissions to air and water, but most commonly used for CO_2 emission reductions. See further information in Clause C.7.

Note 2 to entry: Abatement cost can be both CAPEX and OPEX cost elements.

3.1.2
asset
item, thing or entity that has potential or actual value to an organization

Note 1 to entry: Physical assets usually refer to equipment, inventory and properties owned by the organization. Physical assets are the opposite of intangible assets, which are non-physical assets such as leases, brands, digital assets, licenses, intellectual property rights, reputation or agreements.

Note 2 to entry: A grouping of assets referred to as an asset system (see ISO 55000:2014, 3.2.5) could also be considered as an asset.

[SOURCE: ISO 55000:2014, 3.2.1, modified — Note 1 to entry has been deleted.]

3.1.3
best available techniques
BAT
latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicates the practical suitability of a particular measure for limiting discharges, emissions and waste

[SOURCE: OSPAR Convention:1992, Appendix 1]

3.1.4
break-even price
U_{PV}
price which applied flat to the production sold gives N_{PV}=0

Note 1 to entry: The production can be related to material such as oil, equipment or services. See further information in C.6.3.8.

3.1.5
break-even volume
volume where a stream of revenues and cost balance results in N_{PV}=0

Note 1 to entry: The volume can be related to material such as oil, equipment or services that generates income. See further information in C.6.3.7.

3.1.6
capital efficiency index
CEI
I_E
NPV of project after tax divided by NPV of cash flow after tax up to a defined end point

Note 1 to entry: The capital efficiency index illustrates value creation relative to capital exposure. See further information in C.6.3.9.

Note 2 to entry: The net present value of cumulative cash flow after tax applies until the point where this becomes positive [see Formula (C.8)].

3.1.7
capital expenditure
CAPEX
investment used to purchase, install and commission an asset

Note 1 to entry: See further information regarding estimation of CAPEX in Clause C.2.

3.1.8
code of resource
COR
hierarchical structure of SCCS that classifies all project resources according to the type of contract/ resource that is involved in the activity and has an associated set of rates

Note 1 to entry: Specific code of resource structure exist, i.e. SCCS is described in ISO 19008:2016. COR codes can be found at https://standards.iso.org/iso/19008.

[SOURCE: ISO 19008:2016, 2.1]

3.1.9
committed costs
fixed costs that cannot be eliminated or even cut back without having a major effect on profits or on the organization's objectives

3.1.10
constraint
limit imposed externally or internally by the project that rules out the selection of an option if the limit is exceeded

3.1.11
cost breakdown structure
structure related to the methods that an organization employs to record and report costs

Note 1 to entry: Specific cost breakdown structure exists, i.e. SCCS is described in ISO 19008:2016. See https://standards.iso.org/iso/19008.

3.1.12
cost data
cost information associated with a defined cost element

Note 1 to entry: Cost data can be qualitative or quantitative cost information.

3.1.13
cost driver
major cost element which, if changed, will have a major impact on the life cycle cost of an option

3.1.14
cost element
subset at any level of the total cost for a cost breakdown structure

Note 1 to entry: The cost of an object/item, resource, activity or a combination of those.

Note 2 to entry: Specific cost element exists when ISO 19008:2016 is applied, i.e. the term 'cost item' as defined in 3.1.16.

3.1.15
cost issue
cost element which, if changed, will not have a major impact on the life cycle cost of an option

3.1.16
cost item
particular part/level that is coded/classified using the SCCS

[SOURCE: ISO 19008:2016, 2.2]

3.1.17
discount rate
d
rate of return used in determining the net present value of future cash flow

Note 1 to entry: The discount rate is normally given on an annual basis, but can also be given based on another time period, e.g. a monthly or quarterly basis.

Note 2 to entry: See further information in C.6.2.

3.1.18
economic evaluation measure
quantitative measure used to quantify economic characteristics

Note 1 to entry: Economic evaluation measures may apply for the economic comparison where only subsets of costs are needed (e.g. subset of CAPEX, OPEX and revenue factors).

Note 2 to entry: See further information in C.6.3.

3.1.19
fixed cost
cost that does not vary with production volume or with the level of activity

Note 1 to entry: Fixed cost is not necessarily constant along the full life of an activity or a producing asset.

Note 2 to entry: Both CAPEX and OPEX can have fixed cost items.

3.1.20
initial investment
first investment for a project

Note 1 to entry: Initial investment is a part of the overall CAPEX or the overall CAPEX for the project itself and will depend on the type of project. The timing of initial investment can vary and is important to describe in the LCC calculations in a given project.

3.1.21
internal rate of return
IRR
d_R
rate of return of future net cash flow that gives $N_{PV}=0$

Note 1 to entry: See further information in C.6.3.4.

3.1.22
item
subject being considered

Note 1 to entry: The item can be an individual part, component, subunit, equipment, system, plant or installation.

[SOURCE: IEC 60050-192:2015, 192-01-01, modified – Note 1 to entry has been adjusted.]

3.1.23
life cycle
series of identifiable stages through which an item goes, from its conception to disposal

Note 1 to entry: The identified stages are defined as *life cycle phases* (3.1.28).

[SOURCE: IEC 60050-192:2015, 192-01-09, modified — Note 1 to entry has been added.]

3.1.24
life cycle cost
LCC
L_{CC}
total cost incurred during the life cycle

Note 1 to entry: LCC is the discounted sum of CAPEX, OPEX and LOSTREV, see C.6.3.3.

Note 2 to entry: Total cost of ownership is sometimes used in preference to LCC when explaining the application of life cycle costing (i.e. the methodology) but it is not used in this document. See further information in 4.2.

[SOURCE: IEC 60050-192:2015, 192-01-10, modified — Notes 1 and 2 to entry have been added.]

3.1.25
life cycle cost analysis
LCC analysis
systematic evaluations and calculations carried out to assess competing options using economic evaluation measures of as part of life cycle costing

Note 1 to entry: The economic evaluation measures are described in C.6.3.

3.1.26
life cycle cost model
LCC model
mathematical relationship between cost elements and life cycle cost differences

Note 1 to entry: The LCC model will contain different economic evaluation measures as described in C.6.3.

3.1.27
life cycle costing
process of evaluating the difference between the life cycle cost of two or more alternative options

Note 1 to entry: Life cycle costing can involve quantitative and/or qualitative assessment.

3.1.28
life cycle phase
discrete stage in the life cycle with a specified purpose

Note 1 to entry: The different life cycle phases are further described in 4.5.

3.1.29
lost revenue
LOSTREV
income loss that occurs when generated income are less than expected due to external or internal factors

Note 1 to entry: When the generated income is related to production, ISO 20815:2018, 3.1.25 defines lost revenue as: Total cost of lost or deferred production due to down time. Production and time loss categories are defined in ISO 20815:2018, Clause G.3.

Note 2 to entry: See further information regarding estimation of lost revenue in Clause C.4.

3.1.30
net present value
NPV
N_{PV}
present value that is calculated by discounting the future net cash flow with the required rate of return as the discount rate

Note 1 to entry: In this document, the term net present value is used, even though industry sometimes uses also the term present value reflecting the same discounted value. See further information in C.6.3.2.

3.1.31
operating expenditure
OPEX
expenses used for operation and maintenance, including associated costs such as logistics and spares

Note 1 to entry: See further information regarding estimation of OPEX in Clause C.3.

3.1.32
payback period
Y_{PB}
period after which the initial investment has been paid back by the accumulated net revenue counted from first income

Note 1 to entry: The payback period is also sometimes called pay-out time. See further information in C.6.3.6.

Note 2 to entry: When payback period is calculated, it is important to state whether it is based on summation of nominal values or based on discounted values where the latter can lead to somewhat longer payback period.

3.1.33
physical breakdown structure
PBS
hierarchical structure of SCCS that defines the types of physical asset components of field installations being delivered by the activity

Note 1 to entry: Specific physical breakdown structure exists, i.e. SCCS is described in ISO 19008:2016. PBS codes can be found at https://standards.iso.org/iso/19008.

[SOURCE: ISO 19008:2016, 2.6, modified — Note 1 to entry has been added.]

3.1.34
production availability
ratio of production to planned production, or any other reference level, over a specified period of time

Note 1 to entry: This measure is used in conjunction with analysis of delimited systems without compensating elements such as substitution from other producers and downstream buffer storage. Battery limits need to be defined in each case.

Note 2 to entry: See further information in ISO 20815:2018.

[SOURCE: ISO 20815:2018, 3.1.46, modified — Notes 1, 3, 4 and 5 to entry have been deleted, new Note 2 to entry has been added.]

3.1.35
profitability index
PI
I_P
ratio of NPV of the project divided by the discounted CAPEX

Note 1 to entry: See further information in C.6.3.5.

3.1.36
required rate of return
discount rate requirement by the decision-maker for minimum profit for the investment project

3.1.37
revenue
income generated from normal business activities

3.1.38
revenue gain
generated income that is higher than expected due to external or internal factors

3.1.39
risk
combination of the probability of an event and the consequences of the event

Note 1 to entry: This definition is based on ISO/IEC Guide 51:2014, 3.9 that defines risk as combination of the probability of occurrence of harm and the severity of that harm, where the probability of occurrence includes the exposure to a hazardous situation, the occurrence of a hazardous event and the possibility to avoid or limit the harm. "Harm" has been replaced by "event" in the definition to cope with production assurance purpose. It is also similar to the definition of the "level of risk" given in ISO Guide 73:2009, 3.6.1.8 (i.e. "combination of consequences and their likelihood").

[SOURCE: ISO 20815:2018, 3.1.54, modified — Note 2 to entry has been deleted.]

3.1.40
standard activity breakdown structure
SAB
hierarchical structure of SCCS that defines the type of activity that is being performed

Note 1 to entry: Specific standard activity breakdown structure exists, i.e. SCCS is described in ISO 19008:2016. SAB codes can be found at https://standards.iso.org/iso/19008.

[SOURCE: ISO 19008:2016, 2.8, modified — Note 1 to entry has been added.]

3.1.41
standard cost coding system
SCCS
standard system for classification and coding cost estimates, monitoring and final quantities and cost data

Note 1 to entry: The SCCS code comprises three individual hierarchical coding structures named PBS, SAB and COR, each based upon a different aspect/facet of the scope of work.

Note 2 to entry: In this document, SCCS means use of ISO 19008:2016.

[SOURCE: ISO 19008:2016, 2.7, modified — Note 2 to entry has been added.]

3.1.42
sustainability
state of the global system, including environmental, social and economic aspects, in which the needs of the present are met without compromising the ability of future generations to meet their own needs

[SOURCE: ISO Guide 82:2019, 3.1, modified — Notes to entry have been deleted.]

3.1.43
uncertainty
<of a quantity> inability to determine accurately what is or will be the true value of a quantity

Note 1 to entry: Uncertainty can have different meanings. It can be used as a measure of variability within a population, which is a type of uncertainty often referred to as stochastic (or aleatory) uncertainty. Uncertainty can also have a subjective meaning (epistemic uncertainties).

Note 2 to entry: Uncertainty of input data is particularly important for life cycle costing. See further information in 6.4.4 and D.5.

Note 3 to entry: Uncertainty is the state, even partial, of deficiency of information related to, understanding or knowledge of, an event, its consequences, or likelihood.

[SOURCE: ISO 14224:2016, 3.95, modified — Note 1 to entry has been adjusted, and Notes 2 and 3 to entry have been added.]

3.1.44
variability
variations in performance measures for different time periods under defined framework conditions

[SOURCE: ISO 20815:2018, 3.1.62, modified — Note 1 to entry has been deleted.]

3.1.45
weighted average cost of capital
WACC
average after-tax cost of a company's various capital sources, including stocks and interest-bearing debt

Note 1 to entry: WACC is the average rate a company expects to pay to finance its assets. See further information in C.6.3.2.

3.2 Abbreviated terms

DRILLEX	drilling expenditures
EPC	engineering procurement and construction
EPCI	engineering procurement construction and installation
EPIC	engineering procurement installation and commissioning
FEED	front-end engineering design
FID	final investment decision
FPSO	floating production storage and offloading
HSE	health safety and environment
LCCMP	life cycle costing management plan
LNG	liquefied natural gas
MU	monetary units

4 Application

4.1 Users of this document

This document is intended for users responsible or involved in life cycle costing and associated activities such as:

— Installation/plant/facility: Operating facility, e.g. HSE, engineering, construction, installation, operation and maintenance personnel.

— Operator/owner/company: Project management and control, technology development, technology qualification, concept and system design, HSE, integrity management, maintenance management, production assurance, etc.

— Contractor: Main contractor for engineering, procurement, construction, drilling, installation, operation, maintenance services, etc.

— Vendor/manufacturer/supplier: Technology development, technology qualification, system design to ensure product quality and improvements, etc.

— Authority/regulatory body: Regulatory requirements that can refer to this document to enhance HSE, production availability, system availability, operability, maintenance and resource utilization.

— Consultant: Consultancy services for supporting system design, production assurance and reliability management, technical safety, etc.

— Industry: Any other user involved in life cycle costing activities in the industry.

4.2 Framework conditions

The objective associated with life cycle costing is to provide decision support for selecting between alternative options (e.g. technical and operational items), which are aligned with overall corporate business objectives. Figure 1 illustrates that this is different from company economics and project economics.

The following applies as part of defining the framework:

— when establishing a consistent cost breakdown structure for the competing options, ISO 19008:2016, related to cost coding, shall be evaluated for use (see 6.3.1 and Annex C);

— when establishing qualified data input and calculation of operating expenditures, revenue and lost revenue, ISO 14224:2016 and ISO 20815:2018, related to reliability data, production assurance and reliability management, shall be used (see Annex C);

— consideration should be given to quality management, for which ISO 9000:2015, ISO 9001:2015 or ISO 29001:2020 can be used;

— consideration can be given to social responsibility, for which ISO 26000:2010 can be used.

The LCC model is the quantitative model used when comparing competing options. This LCC model may be different from economic models used by operator for other purposes. In such specific cases, explanation of essential differences should be given.

In the majority of cases, a spreadsheet model represents the most cost efficient and flexible solution for an LCC model for comparison of options (see 6.4.2). The LCC model developed should be simple enough to be transparent to the user, but accurate enough to represent the difference between options.

Life cycle cost is defined as the total cost incurred during the life cycle. As indicated in Figure 1, life cycle cost is derived numerically. This numerical output is sometimes referred to as the total cost of ownership rather than LCC, to provide distinction between life cycle costing as an activity and LCC as an output. While LCC and total cost of ownership can be considered numerically equivalent, LCC is used in this document. Total cost of ownership is not used to prevent possible confusion of with so-called “ownership cost”, which can exclude cost elements and cost drivers that are included in LCC. Similarly, ownership cost may include costs relating to project economics (e.g. depreciation) that do not form part of LCC.

IEC 60300-3-3:2017 provides a general introduction to the concept of life cycle costing and covers all industry applications.