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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Industrial-process measurement, control and automation – Life-cycle-management for systems and components

Mesure, commande et automation dans les processus industriels – Gestion du cycle de vie pour systèmes et composants

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Industrial-process measurement, control and automation – Life-cycle-management for systems and components

Mesure, commande et automation dans les processus industriels – Gestion du cycle de vie pour systèmes et composants

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CONTENTS

FOREWORD 4
INTRODUCTION 6
1 Scope 7
2 Normative references 7
3 Terms, definitions and abbreviations 7
3.1 Terms and definitions 7
3.2 Abbreviated terms and acronyms 12
4 Generic models for Life-Cycle-Management 13
4.1 Product type and product instance 13
4.2 Life-Cycle-Model 14
4.3 Structure model 16
4.4 Compatibility model 19
5 Strategies for Life-Cycle-Management 23
5.1 General 23
5.2 Last-time buy 25
5.3 Substitution 26
5.4 Re-design 27
5.5 Migration 28
5.6 Comparison of the strategies 30
5.7 Application of Life-Cycle-Management strategies for service 31
5.7.1 Service regarding Life-Cycle-Management 31
5.7.2 Service levels 31
5.7.3 Standard service 31
5.7.4 Service through special agreement 31
6 Life-Cycle-Management 32
6.1 Proactive Life-Cycle-Management 32
6.2 Life-Cycle-Excellence 33
Annex A (informative) The current status of life-cycle aspects 35
Annex B (informative) Requirements, influencing factors, industry-specifics 38
B.1 General requirements 38
B.2 Consideration of industry-specific requirements 40
B.3 Requirements of the energy industry 48
B.3.1 General industry characteristics 48
B.3.2 Life-cycle related requirements 49
B.3.3 Industry-specific economic aspects 49
B.3.4 Anticipated industry trends 50
B.4 Industry-neutral aspects 50
B.4.1 Overview 50
B.4.2 Examples of external technical influences 51
B.4.3 Examples of the influence of standardization and legislation 51
B.4.4 Examples of socio-economic influences 51
B.5 Summary 52
Annex C (informative) Life-cycle considerations for selected examples 55
C.1 Component life-cycles 55
C.2 Microprocessors 55

C.3 Field device integration 56
C.4 Standards and regulations 57
Annex D (informative) Example for the application of the Life-Cycle-Management strategies 59
Annex E (informative) Plant user strategies 62
Annex F (informative) UML diagram semantics 64
Bibliography 66

Figure 1 – Relationship of product type and its product instance(s) 13
Figure 2 – Generic Life-Cycle-Model of a product type 14
Figure 3 – Evolution of products (type with version and revision) 15
Figure 4 – Maintenance of products (type with version and revision) 15
Figure 5 – Life time of a product instance 16
Figure 6 – UML diagram of a hierarchical system structure 17
Figure 7 – Hierarchical system structure (example) 17
Figure 8 – Example for Life-Cycle-Management of a system (type) by integrating components (types) 18
Figure 9 – Example of integrating components into a system 19
Figure 10 – Example of mapping of compatibility requirements to the level of compatibility 22
Figure 11 – Example of a compatibility assessment of a product 23
Figure 12 – Relationships between the partners in the value chain 23
Figure 13 – Ensuring delivery of a system through last-time buy of a component 25
Figure 14 – Ensuring delivery of a system through substitution of a component 26
Figure 15 – Re-design of a system due to end of production of a component 28
Figure 16 – Level model for migration steps 29
Figure 17 – Typical characteristics of the Life-Cycle-Management strategies 30
Figure 18 – Life-Cycle-Excellence 34
Figure A.1 – Typical structure of an instrumentation and control system with functional levels according to IEC 62264-1 35
Figure A.2 – Example of the effects of component failure 36
Figure A.3 – Life-cycles of plants and their components 37
Figure A.4 – The iceberg effect 37
Figure B.1 – Trade-off between procurement costs (initial investments) and costs for operating and maintenance 39
Figure B.2 – Typical ranges of variables which influence the life-cycle 53
Figure C.1 – Examples of component life-cycles 55
Figure D.1 – Compatibility assessment of replacement devices 59
Figure D.2 – Replacement of the defective device with a new device 61
Figure F.1 – Semantics of UML elements used in this document 64

Table B.1 – Overview of industry-specific requirements 42
Table B.2 – Overview of industry-specific requirements 45
Table E.1 – Fundamental characteristics of plant users 63

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INDUSTRIAL-PROCESS MEASUREMENT, CONTROL AND AUTOMATION – LIFE-CYCLE-MANAGEMENT FOR SYSTEMS AND COMPONENTS

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The text of this International Standard is based on the following documents:

FDIS	Report on voting
65/805/FDIS	65/820/RVD

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

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

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

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INTRODUCTION

In today's automation applications, an increasing divergence of the life-cycles of components, devices and systems in comparison to the life time of overall plants is evident. The increasing functionality of components, the advancing development of electronics and the innovation dynamics inherent to hardware and software are continuously shortening the life-cycle of individual automation components. Certain semiconductor components are only manufactured for a short period of time, for example, and subsequently abandoned.

By comparison, the time in use of automation systems is considerably longer. Moreover, there are considerable differences depending on the industry sector. The time in use of a production line in the automobile industry is usually identical with the period of time in which a new model is manufactured which is around 7 to 8 years today. By comparison, the operational life of a process plant in the chemical industry is typically some 15 years, while up to 50 years may be reached in the case of oil and energy, and power plants. The plant and product life-cycles have to be considered by the management for the overall plant functionality and economic considerations.

Increased utilization and integration of plant process data from automation systems towards enterprise and asset management systems has caused technology dependencies between hierarchy layers of automation systems. A more uniform way of dealing with Life-Cycle Management between these layers and all partners in the value chain is essential with respect to plant regularity, operability and security aspects.

Consequently, this necessitates different strategies to maintain the availability of the plant by. sophisticated maintenance strategies. As a result, considerable demands are made on the delivery capacity of automation products and spare parts, as well as the provision of services, such as maintenance and repairs. For example, when the planning of a new plant envisages the usage of a newer version of an engineering system, the producer has to ensure that this newer version can also be employed for older components and systems already in use in the existing plant and may have to develop upgrades accordingly. To an increasing extent, this calls for close cooperation between the partners along the value chain.

The presented situation illustrates that mastering these conflicting characteristics of Life-Cycle-Management will become increasingly significant in automation, not least in the ongoing discussions between plant users and manufacturers as well as manufacturers and suppliers. The interaction between global, legal and technical aspects – including demands for high functionality and efficiency, as well as the influence of IT technologies in automation – helps to demonstrate the scope of this topic.

This International Standard has been prepared in response to this situation. It is comprised of basic, complementary and consistent models and strategies for Life-Cycle-Management in automation. These generic models and strategies are then applied to various examples.

Consequently, this document represents a consistent general approach, which is applicable to automation in various industrial sectors. The economic significance of Life-Cycle-Management is a recurring theme of this document. The definitions of generic models, terms, processes and strategies form an indispensable foundation for a joint understanding between plant users and manufacturers and between manufacturers and suppliers regarding Life-Cycle-Management.

Proactive Life-Cycle-Management focuses on the selection of robust components, specifications, and technologies that consequently have long-term stability. The proactive approach includes the application of this set of generic reference models in the development of standards in order to be able to efficiently ensure sustainable interoperability and compatibility.

INDUSTRIAL-PROCESS MEASUREMENT, CONTROL AND AUTOMATION – LIFE-CYCLE-MANAGEMENT FOR SYSTEMS AND COMPONENTS

1 Scope

This International Standard establishes basic principles for Life-Cycle-Management of systems and components used for industrial-process measurement, control and automation. These principles are applicable to various industrial sectors. This standard provides definitions and reference models related to the life-cycle of a product type and the life time of a product instance, It defines a consistent set of generic reference models and terms. The key models defined are:

– Life-Cycle-Model;

– structure model;

– compatibility model.

This document also describes the application of these models for Life-Cycle-Management strategies. The content is used for technical aspects concerning the design, planning, development and maintenance of automation systems and components and the operation of the plant.

The definitions of generic models and terms regarding Life-Cycle-Management are indispensable for a common understanding and application by all partners in the value chain such as plant user, product and system producer, service provider, and component supplier.

The models and strategies described in this standard are also applicable for related management systems, i.e. MES and ERP.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviations

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
after-sales support phase
phase in the life-cycle of a product type which begins at the end of the selling phase and ends with product abandonment

3.1.2
backward compatibility
downward compatibility
fulfilment by a new component of all the specified requirements of the compatibility profile of its predecessor

Note 1 to entry: Antonyms are forward compatibility and upward compatibility, respectively.

3.1.3
capability profile
compatibility profile that represents characteristics of a product type

3.1.4
compatibility
ability of a component to fulfill the compatibility profile of another component

3.1.5
compatibility assessment
verification of an agreed compatibility level

3.1.6
compatibility profile
list of all compatibility requirements of a system, or a component of a system, depending upon the application

3.1.7
component
autonomous element of a system, which fulfills a defined sub-function

3.1.8
construction compatibility
fulfilment of the constructional aspects of a compatibility profile by a component

Note 1 to entry: Related requirements are physical dimensions, construction properties, connection method (including e.g. power supply) and the location with respect to environmental conditions.

3.1.9
data compatibility
fulfilment of the functional aspects related to data type and format of a compatibility profile by a component

3.1.10
delivery release
end of the manufacturing preparation process after which series production can begin

Note 1 to entry: The manufacturing preparation process is part of the development phase.

3.1.11
development phase
phase of the product life-cycle which begins with the decision to develop a product type and ends with delivery release of the product type

3.1.12
disposal
removal of a product instance following the time in use and disposal or recycling

Note 1 to entry: This is the final phase of the life-cycle of a product instance

3.1.13
end of sales
end of all active sales activities for a product

Note 1 to entry: This is also called discontinuation of a product.

3.1.14
end of service
end of all service activities for a product type

3.1.15
end of production
point of time when instances of a product type are no longer produced

3.1.16
full compatibility
fulfilment of all aspects of a compatibility profile by a component

Note 1 to entry: The aspects are function, construction, location and performance.

3.1.17
function compatibility
fulfilment of the functional aspects of a compatibility profile by a component

3.1.18
instance
concrete, clearly identifiable component of a certain type

Note 1 to entry: It becomes an individual entity of a type, for example a device, by defining specific property values.

Note 2 to entry: In an object-oriented view, an instance denotes an object of a class (of a type).

3.1.19
last-time buy
Life-Cycle-Management strategy in which instances of an abandoned product type are purchased before end of sales

3.1.20
level of compatibility
fulfillment of the requirements described in the compatibility profile

3.1.21
life time
length of time from the end of the creation of a product instance to the end of disposal

3.1.22
life-cycle
length of time from the start of the development phase of a product type to the product abandonment

3.1.23
Life-Cycle-Costs
sum of all instance costs for plant user incurred after purchase up to the end of the life time of a system

3.1.24
Life-Cycle-Excellence
holistic approach to managing changing conditions to ensure technical, application specific, economic and ecological robustness of the Life-Cycle-Management for products

3.1.25
Life-Cycle-Management
methods and activities for the planning, realization and maintenance of products for the life-cycle of types and the life time of instances

3.1.26
Life-Cycle-Management strategy
strategy for applying Life-Cycle-Management methods to ensure the availability of a system throughout the time in use

3.1.27
migration
replacement of components in an existing system by a component with extended or modified functionality or with a different technology while maintaining functionality

3.1.28
milestone
defined point in time with a specific meaning for example:

– 3.1.10 delivery release
– 3.1.13 end of sales
– 3.1.15 end of production
– 3.1.14 end of service sales
– 3.1.32 product abandonment

3.1.29
obsolete product
not available product from the original producer to the original specification

[SOURCE: IEC 62402:2019, 3.1.15, modified]

3.1.30
producer
company which develops a product type, maintains it during its life-cycle and manufactures instances of this type

3.1.31
product
commodity (goods or service) for operational business, with defined properties (of product type), which is created (product instance) in a value chain process with reproducible quality

Note 1 to entry: It is sold during a defined period and is technically and logistically supported until product abandonment. The value chain process can be a process for integrating components into a system (integration process). Products can be hardware, software, services or combinations thereof.

3.1.32
product abandonment
point of time when all service for a product type have stopped

3.1.33
product instance
Instantiated product types

Note 1 to entry: Instantiated expresses that the product has been produced, the service has been performed, the software has been registered, etc.

3.1.34
product type
definition of all characterizations for instantiated products

Note 1 to entry: Instantiated expresses that the product has been produced, the service has been performed, the software has been registered, etc.

3.1.35
re-design
Life-Cycle-Management strategy in which a new version of a product type is developed which typically fulfils or exceeds the specification, and therefore the compatibility profile, of a previous type

3.1.36
requirements profile
compatibility profile that represents characteristics of a role-based equipment, required to achieve its role

3.1.37
revision
defined status of a software or hardware, including all of its integrated components, which is explicitly identified by a revision number

3.1.38
robustness
capability of a system to continue to fulfill its function under changing conditions

3.1.39
sales phase
phase of life-cycle which begins at delivery release and end with end of production

3.1.40
sales release
point of time when active sales activities for a product type have started

3.1.41
service
total of all supporting activities for products (types and instances)

Note 1 to entry: Standard services end with product type abandonment. Supporting activities after product abandonment are subject to special service agreements.

3.1.42
signal compatibility
level of compatibility from the function view of the compatibility profile related to signal acquisition and processing

3.1.43
software compatibility
level of compatibility from the function view of the compatibility profile related to software

3.1.44
standard services
level of service without consideration of specific user requirements

3.1.45
substitution
Life-Cycle-Management strategy in which instances of a product type are replaced by instances of a compatible new type without repercussions for the system

3.1.46
system
defined and structured set of components which fulfill a function (system function) through interactions or interrelationships with each other

Note 1 to entry: Systems could have a hierarchical structure, i.e. they could consist of underlying systems (which are then considered components of the system).

Note 2 to entry: From a sales perspective, a system denotes a set of product types belonging to a specific portfolio line.

3.1.47
time in use
portion of the life time in which a product instance is actually in use for its intended purpose

3.1.48
update
new revision of a version designed for error correction and/or minor functional improvements

Note 1 to entry: For software, an update is called a patch which can include bug fix for general errors and hotfix for critical or urgent error corrections.

3.1.49
upgrade
product for upgrading a component to a newer version with improved or enhanced functionality

Note 1 to entry: The term upgrade can apply to hardware and software.

3.1.50
version
defined status of a product type, including all of its integrated components, which is explicitly identified by a version number

3.1.51
warranty period
time frame in which a replacement or repair of a faulty item is contractually assured

3.2 Abbreviated terms and acronyms

ASIC Application specific integrated circuit

CE Conformité Européenne

COTS Components Off The Shelf

NOTE 1 Also used for Commercial Off The Shelf.

EMC Electromagnetic compatibility

ERP Enterprise Resource Planning

EU European Union

FDA Food and Drug administration

FPGA Field programmable gate array

ID Identifier

IT Information technology

LCC Life-Cycle Costing

MES Manufacturing execution system

PLM Product Life-Cycle Management

RoHS Reduction of Hazardous Substances

TCO Total Cost of Ownership

UML Unified Modelling Language

NOTE 2 See Annex F.

USB Universal serial bus

4 Generic models for Life-Cycle-Management

4.1 Product type and product instance

Requirements from industries result in a very wide range of factors which affect the life-cycles of products to varying degrees. Consequently, the Life-Cycle-Model specified in this document takes this into account. The differentiation between product types and product instances is fundamental. Each product instance is an instantiation (produced product, registered software, performed service, etc.) of a product type. As shown in the UML diagram of Figure 1, a product type can be represented by a UML class and a product instance by a UML object. The semantics of the UML elements used in this document are explained in Annex F.

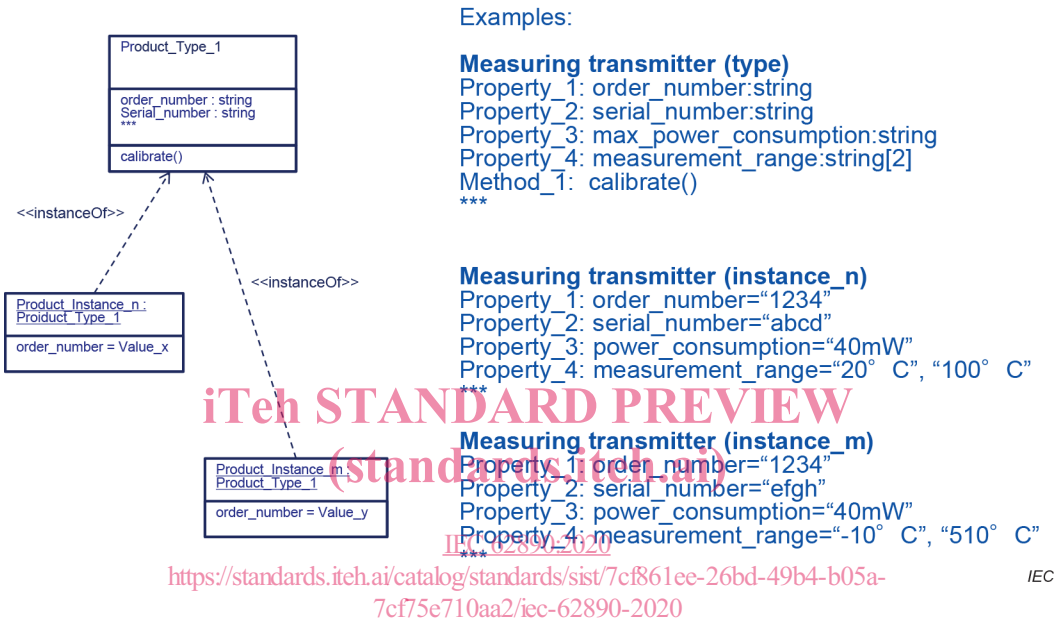

Figure 1 – Relationship of product type and its product instance(s)

A product type is characterized by an unambiguous product ID (for example the order number), a set of development documents, manufacturing and test descriptions, and technical documentation. For approval of a product type for specific applications, certificates can be demanded and issued. This definition of a product type is valid for hardware products, software products, and products that are hardware/software bundles. Typically, the right to use product types is regulated in reproduction licensing agreements. All activities that are performed regarding the development, maintenance, and service of a product type, regardless of how often it is manufactured, refer to the product type.

According to Figure 1, each produced unit of a product type represents a product instance of this type. The product instance is always an individual entity and shall be identified by an unambiguous identifier (such as a serial number). The right to use product instances of software products is regulated by license agreements.

NOTE 1 Some countries have specific guidelines. [9][1].

Activities for a product instance are: manufacturing, all services during the life time, etc. It is recommended to document activities related to the product instance throughout its life time for e.g. asset management (see Figure 2).

NOTE 2 In some cases, there exists recommendations or regulation for archiving of history beyond the end of the life time.

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1 Figures in square brackets refer to the bibliography.