

INTERNATIONAL STANDARD



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



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2020 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

INTERNATIONAL STANDARD



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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 25.040.40

ISBN 978-2-8322-8683-8

Warning! Make sure that you obtained this publication from an authorized distributor.

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

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

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62890 has been prepared by IEC technical committee 65: Industrial-process measurement, control and automation.

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

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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.