

TECHNICAL REPORT

ISA-TR108.1-2015

Intelligent Device Management
Part 1: Concepts and Terminology

Approved 16 June 2015



Documents
Document Sharing Hub

ISA-TR108.1-2015, Intelligent Device Management Part 1: Concepts and Terminology

ISBN: 978-1-941546-52-9

Copyright © 2015 by ISA. All rights reserved. Not for resale. Printed in the United States of America. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means (electronic mechanical, photocopying, recording, or otherwise), without the prior written permission of the Publisher.

ISA
67 Alexander Drive
P.O. Box 12277
Research Triangle Park, North Carolina 27709



Documents
Document Sharing Hub

Preface

This preface, as well as all footnotes and annexes, is included for information purposes and is not part of ISA-TR108.1-2015.

This document has been prepared as part of the service of ISA toward a goal of uniformity in the field of instrumentation. To be of real value, this document should not be static but should be subject to periodic review. Toward this end, the Society welcomes all comments and criticisms and asks that they be addressed to the Secretary, Standards and Practices Board; ISA; 67 Alexander Drive; P. O. Box 12277; Research Triangle Park, NC 27709; Telephone (919) 549-8411; Fax (919) 549-8288; E-mail: standards@isa.org.

The ISA Standards and Practices Department is aware of the growing need for attention to the metric system of units in general, and the International System of Units (SI) in particular, in the preparation of instrumentation standards. The Department is further aware of the benefits to USA users of ISA standards of incorporating suitable references to the SI (and the metric system) in their business and professional dealings with other countries. Toward this end, this Department will endeavor to introduce SI-acceptable metric units in all new and revised standards, recommended practices, and technical reports to the greatest extent possible. IEEE/ASTM SI 10, *American National Standard for Metric Practice*, and future revisions, will be the reference guide for definitions, symbols, abbreviations, and conversion factors.

It is the policy of ISA to encourage and welcome the participation of all concerned individuals and interests in the development of ISA standards, recommended practices, and technical reports. Participation in the ISA standards-making process by an individual in no way constitutes endorsement by the employer of that individual, of ISA, or of any of the standards, recommended practices, and technical reports that ISA develops.

CAUTION — ISA DOES NOT TAKE ANY POSITION WITH RESPECT TO THE EXISTENCE OR VALIDITY OF ANY PATENT RIGHTS ASSERTED IN CONNECTION WITH THIS DOCUMENT, AND ISA DISCLAIMS LIABILITY FOR THE INFRINGEMENT OF ANY PATENT RESULTING FROM THE USE OF THIS DOCUMENT. USERS ARE ADVISED THAT DETERMINATION OF THE VALIDITY OF ANY PATENT RIGHTS, AND THE RISK OF INFRINGEMENT OF SUCH RIGHTS, IS ENTIRELY THEIR OWN RESPONSIBILITY.

PURSUANT TO ISA'S PATENT POLICY, ONE OR MORE PATENT HOLDERS OR PATENT APPLICANTS MAY HAVE DISCLOSED PATENTS THAT COULD BE INFRINGED BY USE OF THIS DOCUMENT AND EXECUTED A LETTER OF ASSURANCE COMMITTING TO THE GRANTING OF A LICENSE ON A WORLDWIDE, NON-DISCRIMINATORY BASIS, WITH A FAIR AND REASONABLE ROYALTY RATE AND FAIR AND REASONABLE TERMS AND CONDITIONS. FOR MORE INFORMATION ON SUCH DISCLOSURES AND LETTERS OF ASSURANCE, CONTACT ISA OR VISIT WWW.ISA.ORG/STANDARDSPATENTS.

OTHER PATENTS OR PATENT CLAIMS MAY EXIST FOR WHICH A DISCLOSURE OR LETTER OF ASSURANCE HAS NOT BEEN RECEIVED. ISA IS NOT RESPONSIBLE FOR IDENTIFYING PATENTS OR PATENT APPLICATIONS FOR WHICH A LICENSE MAY BE REQUIRED, FOR CONDUCTING INQUIRIES INTO THE LEGAL VALIDITY OR SCOPE OF PATENTS, OR DETERMINING WHETHER ANY LICENSING TERMS OR CONDITIONS PROVIDED IN CONNECTION WITH SUBMISSION OF A LETTER OF ASSURANCE, IF ANY, OR IN ANY LICENSING AGREEMENTS ARE REASONABLE OR NON-DISCRIMINATORY.

ISA REQUESTS THAT ANYONE REVIEWING THIS DOCUMENT WHO IS AWARE OF ANY PATENTS THAT MAY IMPACT IMPLEMENTATION OF THE DOCUMENT NOTIFY THE ISA STANDARDS AND PRACTICES DEPARTMENT OF THE PATENT AND ITS OWNER. ADDITIONALLY, THE USE OF THIS DOCUMENT MAY INVOLVE HAZARDOUS MATERIALS, OPERATIONS OR EQUIPMENT. THE DOCUMENT CANNOT ANTICIPATE ALL POSSIBLE

APPLICATIONS OR ADDRESS ALL POSSIBLE SAFETY ISSUES ASSOCIATED WITH USE IN HAZARDOUS CONDITIONS. THE USER OF THIS DOCUMENT MUST EXERCISE SOUND PROFESSIONAL JUDGMENT CONCERNING ITS USE AND APPLICABILITY UNDER THE USER'S PARTICULAR CIRCUMSTANCES. THE USER MUST ALSO CONSIDER THE APPLICABILITY OF ANY GOVERNMENTAL REGULATORY LIMITATIONS AND ESTABLISHED SAFETY AND HEALTH PRACTICES BEFORE IMPLEMENTING THIS DOCUMENT.

The following people served as members of ISA Committee ISA108.

NAME

COMPANY

Voting members

K. Demachi, Co-Chair	Yokogawa Electric Corp.
H. E. Storey, Co-Chair	Herman Storey Consulting, LLC
I. Verhappen, Managing Director	Orbis Engineering Field Services Ltd.
R. H. Caro	CMC Associates
N. Garrett	Beamex Group
R. P. Gul	Shell Global Solutions
S. N. Hokeness	Emerson Process Management
K. P. Lindner	Endress+Hauser Process Solutions AG
C. Micallef	CJM Consulting Inc.
B. A. Neal	Consultant
R. O'Brien	ARC Advisory Group
K. Onodera	Yokogawa Electric Corp.
T. Petty	Fieldbus Foundation
G. H. Phan	Chevron
J. D. Rezabek	Ashland
H. Sasajima	Azbil Corporation
N. M. Shah	ABB GmbH

Alternate

Jonas Berge	Emerson Process Management
-------------	----------------------------

Information members

A. D. Acharya	GE Energy
E. Adams	BP Products North America
G. A. Aguilar	Celanese
A. S. Ajmeri	Yokogawa Electric Corp.
R. Arias	California Polytechnic at Pomona
P. C. Aryamane	Bechtel
U. Atsuki	Fuji Electric
H. S. Balhareth	Saudi Aramco
K. L. Beatty	Flowserve Corp.
R. S. Bhojani	BP
W. H. Bosler	Texas Consultants Inc.
D. Brand	Endress + Hauser Process Solutions AG
P. E. Brett	Honeywell Inc.
S. Bump	Schneider Electric
A. Cala	Schneider Electric
M. Carlson	FDT Group North America
D. L. Carnahan	Rockwell Automation Advanced Tech
J. Chainani	BP
S. Dasani	Suncor Energy Inc.
G. Dehler	Shell Global Solutions Canada
B. M. Dumortier	Schneider Electric

G. Ellwood
E. Espy
T. Fiske
S. R. Foos
G. Gardner
G. F. Gaykovich
C. George
I. H. Gibson
G. A. Gomez
D. M. Gray
G. S. Haines
S. Iftikhar
C. M. Johnson
A. Kaelble
J. A. Kaulfersch
T. Kawai
J. C. Kirsch
U. Klingler
S. K. Kolavi
S. Kondo
C. Kraivichien
A. Laubenstein
M. Louise
C. Manoj
W. Maru
E. Mathiason
T. Matsumoto
R. L. Matthis
H. K. McKinley
A. Medina
B. R. Mehta
N. Menet
J. C. Menoher
N. Meyer
J. Milburn
A. R. Mills
C. W. Moreno
D. Motta
R. Muller
R. Nair
N. Nandakumar
E. Naranjo
P. Ng
N. Ogura
R. Osborn
J. Pierce
S. Prabhakaran
D. F. Rae
G. A. Rathwell
R. W. Roberts
E. Roche
P. Rutherford
S. Saeed
N. P. Sands
R. S. Carrijo
C. S. Filho

North West Red Water Partnership
Beamex Inc.
Yokogawa Electric Corp.
Rockwell Automation
Fluke Corporation
Institute for Information Transmission Problems
BusCorp Inc.
Consultant
Universidad Nacional de Cordoba
Mettler-Toledo Thornton Inc.
Sherwin-Williams
Honeywell Process Solutions
DuPont
Solutia Inc.
Pepperl+Fuchs Inc.
Azbil North America Research and Development Inc.
Spartan Controls Syncrude
Marathon Petroleum
Honeywell
Fuji Electric Co Ltd.
Rayong Engineering & Plant Service Co Ltd.
ABB Automation GmbH
Aramco
Schneider Electric
OGH/OGM
Emerson Process Measurement
Yokogawa Electric Corp.
AUMA Actuators Inc.
Motiva Enterprises LLC
Emerson Project Management
Reliance Industries Limited
Emerson Process Management
Owl Computing Technologies
Emerson Process Management
Brown and Caldwell
University of Sheffield
Ultramax Corporation
Shell Canada Ltd.
Rosemount Inc.
Siemens AG
KBR
Emerson Process Management
Honeywell
Hitachi Ltd.
Emerson Process Management
Koch Fertilizer
Saudi International Petrochemical
Chevron Energy Tech Co.
Enterprise Consultants
Suncor Energy Inc.
SIS-Tech
BP Exploration
BP
DuPont
Smar Equipamentos Industriais Ltda
Accenture



R. E. Sherman
 J. R. Stapleton
 S. Sundarakumar
 H. W. Thomas
 M. Thompson
 A. Tighe
 H. Tsugane
 R. V. Oevelen
 C. Verney
 S. H. Walker
 I. Weber
 J. M. Weiss
 A. Whitfield
 C. D. Wuertz
 J. Yingst
 C. Robinson

Consulting Technologists Ideagroup
 Schneider Electric
 Nynas AB Sweden
 Exida.com LLC
 Koch industries
 FF End User Council Australia
 Azbil Corporation
 Dow Benelux BV
 Senior Consultant
 Dow Chemical Company La Division
 Siemens AG DF FA
 Applied Control Solutions LLC
 Chevron Energy Technology Pty Ltd.
 AMEC Oil & Gas Americas
 Honeywell Process Solutions
 ISA Staff

This standard was approved for publication by the ISA Standards and Practices Board on 16 June 2015.

NAME

N. Sands, Vice President
 D. Bartusiak
 P. Brett
 D. Dunn
 J. Federlein
 B. Fitzpatrick
 J. Gilsinn
 J-P Hauet
 J. Jamison
 K. P. Lindner
 V. Maggioli
 T. McAviney
 V. Mezzano
 C. Monchinski
 H. Sasajima
 T. Schnaare
 J. Tatera
 K. Unger
 I. Verhappen
 W. Weidman
 J. Weiss
 M. Wilkins
 D. Zetterberg

COMPANY

DuPont
 ExxonMobil Chemical Co.
 Honeywell Inc.
 Consultant
 Federlein & Assoc. Inc
 Wood Group Mustang Inc
 Kenexis Consulting
 KB Intelligence, ISA France
 Encana Corp
 Endress + Hauser Process Solutions AG
 Feltronics Corp.
 Consultant
 Fluor Corporation
 Automated Control Concepts Inc
 Azbil Corp.
 Rosemount Inc
 Tatera & Associates Inc.
 Stone Technologies
 Orbis Engineering
 WCW Consulting
 Applied Control Solutions LLC
 Yokogawa IA Global Marketing (USMK)
 Chevron Energy Technology Co.



CONTENTS

1	Scope and purpose of ISA-TR108.1 Part 1	12
1.1	Scope of this document	12
1.2	Purpose of this document	12
2	Normative references	12
3	Terms, definitions, and abbreviated terms	12
3.1	Terms and definitions	12
3.2	Abbreviations and acronyms	19
4	Background and motivation of intelligent device management	20
4.1	Current situation and traditional work process	20
4.2	Challenges and opportunities	20
4.3	Benefits of intelligent device management (IDM)	21
5	IDM Structure	21
5.1	Introduction	21
5.2	Relationship to asset management	22
5.3	Organizational structure	23
5.4	IDM programs	25
5.5	Work processes	28
5.6	Procedures	30
5.7	Tasks	31
5.8	Relationship and characteristics of IDM activities	33
6	IDM lifecycles	34
6.1	Overview	34
6.2	IDM corporate lifecycle	35
6.3	IDM product lifecycle	38
6.4	Facility lifecycle	39
7	Maintenance processes	46
7.1	Overview	46
7.2	Factors for selection of maintenance strategy	48
7.3	Types of maintenance strategy	50
7.4	Other aspects of maintenance	53
8	Diagnostic notification management and utilization	54
8.1	Diagnostic notification management	54
8.2	Notification from intelligent device	54
8.3	Notification delivery mechanisms	56
8.4	Action responding to notification	57
9	Configuration management	60
9.1	Overview	60
9.2	Templates for device configuration	60
9.3	Toolkits	61
9.4	Configuration process	61
9.5	Maintaining device configuration data	62
	Annex A (informative) Standard diagrams used in ISA-108	63

Copyright International Society of Automation

A.1 Overview.....	63
A.2 Class diagram	63
A.3 Activity diagram (swimlanes)	65
Annex B (informative) Functional areas of IDM	69
B.1 Overview.....	69
B.2 Functional areas of IDM	69
B.3 Worker roles and the IDM functional architecture	73
Annex C (informative) Complementary standards efforts	75
Bibliography	79
Figure 1 — IDM and intelligent device in the context of asset management	23
Figure 2 — Organizational management structure	23
Figure 3 — IDM activity	24
Figure 4 — IDM program	26
Figure 5 — Intelligent device management documents	27
Figure 6 — IDM work process	29
Figure 8 — task.....	32
Figure 9 — Timing relationship between IDM Lifecycles	35
Figure 10 — Corporate lifecycle phases for IDM.....	36
Figure 11 — Facility lifecycle phases	40
Figure 12 — Risk Assessment Matrix (RAM) chart.....	42
Figure 13 — Criticality Usage in a Facility	43
Figure 14 — Process of turnaround.....	45
Figure 15 — Overview of Maintenance Processes	47
Figure 16 — State diagram for IDM	48
Figure 17 — Relationships betw	
Figure 1 — IDM and intelligent device in the context of asset management	23
Figure 2 — Organizational management structure	23
Figure 3 — IDM activity	24
Figure 4 — IDM program	26
Figure 5 — Intelligent device management documents	27
Figure 6 — IDM work process	29
Figure 7 — Procedure	31
Figure 8 — task.....	32
Figure 9 — Timing relationship between IDM Lifecycles	35
Figure 10 — Corporate lifecycle phases for IDM.....	36
Figure 11 — Facility lifecycle phases	40
Figure 12 — Risk Assessment Matrix (RAM) chart.....	42
Figure 13 — Criticality Usage in a Facility	43

Figure 14 — Process of turnaround.....	45
Figure 15 — Overview of Maintenance Processes	47
Figure 16 — State diagram for IDM	48
Figure 17 — Relationships between real time or time critical activities, semi real time activities, and planned activities	58
Figure A.1 — Position of activity diagram and class diagram in UML.....	63
Figure A.2 — Example of class diagram	65
Figure A.3 — Example of activity diagram	67
Figure A.4 — Example of swimlanes chart	68
Figure B.1 — Functional areas of IDM.....	69
Figure C.1 — Plant asset management within the lifecycle [SOURCE: NE129]	75
Figure C.2 — Flow of information in Plant Asset Management [SOURCE: NE129]	76
Figure C.3 — Explanation of Flow of Information in NE129	77
een real time or time critical activities, semi real time activities, and planned activities	58
Figure A.1 — Position of activity diagram and class diagram in UML.....	63
Figure A.2 — Example of class diagram	65
Figure A.3 — Example of activity diagram	67
Figure A.4 — Example of swimlanes chart	68
Figure C.1 — Plant asset management within the lifecycle [SOURCE: NE129]	75
Figure C.2 — Flow of information in Plant Asset Management [SOURCE: NE129]	76
Figure C.3 — Explanation of Flow of Information in NE129	77
Table 1 — Contents of IDM documents	28
Table 2 — Relationships and characteristics of IDM activities	33
Table 3 — Product Lifecycle Management.....	39
Table 4 — Failure consequence for non-SIS devices.....	53
Table 5 — Notification types	54
Table 6 — IDM benefits in real time automated responses.....	58
Table 7 — IDM benefits in real time operator responses	59
Table 8 — IDM benefits in semi real time responses	59
Table 9 — IDM benefits in longer term planned responses	60
Table A.1 — Notation of UML class diagram	64
Table A.2 — Model elements of activity diagram	66
Table B.1 — Functional Areas of IDM	70

ISA-TR108.1: Intelligent Device Management Part 1: Concepts and Terminology

0 Introduction

0.1 Scope of series of ISA-108 documents

The purpose of the ISA-108 document series is to provide an environment to use intelligent devices effectively based on risk management and optimization of other KPIs such as cost and production performance through common concepts and terminology and by specifying management activities and work processes. The series of ISA-108 documents describes the management structure and work process structure of intelligent device management (IDM).

IDM represents IDM programs, work processes and procedures for managing intelligent devices through the facility lifecycle and does not imply a particular asset management tool or set of those tools. Hardware and software tools are necessary to support work processes and procedures, but specification of the tools is not a part of ISA-108. IDM is a collection of the coordinated activities of an organization to optimize the value from intelligent devices.

While the work processes and implementation practices specified in the series of ISA-108 documents might be used for non-automation equipment with some diagnostic capability, the series of ISA-108 documents does not cover these equipment types.

Major functional areas of the intelligent device management are described in Annex B.

Some complementary standards efforts are described in Annex C.

0.2 Organization of series of ISA-108 documents

ISA-108 documents are divided into three main groups as follows:

- Part 1: Concepts and Terminology (Informative)
- Part 2: Work Process Specifications (Normative)
- Part 3: Implementation Guides (Informative)

Part 1 describes intelligent device management concepts and terminology necessary for in-depth understanding and effective communication. It gives an overview of the basic concepts of how intelligent devices can be managed and an overview of how this device management plays a larger role in the overall objectives of a facility throughout its lifecycle. The ultimate goal of Part 1 is to provide basic knowledge to understand the concepts of intelligent device management necessary to implement IDM.

Part 2 and Part 3 will consist of several sets of documents. Part 2.x documents will provide normative requirements for an IDM topic, and corresponding Part 3.x documents will provide guidelines for achieving the requirements of the corresponding 2.x documents.

1 Scope and purpose of ISA-TR108.1 Part 1

1.1 Scope of this document

Part 1 describes concepts and terminology necessary to understand and communicate effectively about intelligent device management. It gives an overview of the basic concepts of how intelligent devices can be managed and an overview of how this device management plays a larger role in the overall objectives of a facility throughout its lifecycle. This document explains the relationship between IDM and other existing asset management standards.

1.2 Purpose of this document

The ultimate goal of this document is to provide basic knowledge to understand the concept of intelligent device management so that they can implement such a system in their facility. This document gives the reader a basic understanding of what intelligent device management is and what it can do.

This document provides organization for the many diverse activities that are employed in IDM in addition to providing common language to describe those activities. The concepts include what kinds of activities are needed and some roles associated with these activities. The need for and methods for management coordination of multiple roles by multiple stakeholders is discussed. Future ISA108 documents will provide more detail on how these activities are managed and performed.

2 Normative references

Because this part of ISA-108.1 is a technical report it does not have contain normative references.

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

3.1.1

activity

collection of technical and/or administrative action(s) related in a form of IDM program (3.1.33), work process (3.1.58), procedure (3.1.44) or task (3.1.52)

3.1.2

alarm

notification (3.1.39) to the operator (3.1.42) an equipment malfunction, process deviation, or abnormal condition requiring a unique, timely, and documented (predetermined) response from the operator

[SOURCE: IEC 62682, modified — "An audible and/or visible means of indicating" was replaced with "notification", "unique, timely, and documented (predetermined)" was added, and "from the operator" was added.]

3.1.3

alarm management

processes (3.1.58) and practices for determining, documenting, designing, operating, monitoring, and maintaining alarm systems (3.1.4)

[SOURCE: IEC 62682]

3.1.4

alarm system

operator (3.1.42) support system for generating and handling alarms (3.1.2) for managing abnormal situations

[SOURCE: IEC 62682]

3.1.5

alert

notification (3.1.39) to operators (3.1.42), maintenance personnel, or engineering personnel of an abnormal condition that can require action with a time tolerance much longer than for alarms (3.1.2)

3.1.6

asset management

coordinated work processes (3.1.58) of an organization to ensure the intended capability of assets is available

[SOURCE: ISO 55001, modified — “activities” was replaced with “work processes”, “to realize value from assets” was replaced with “to ensure the intended capability of assets is available”.]

3.1.7

automated diagnostics

diagnostics (3.1.17) accomplished without human intervention

[SOURCE: IEC 60050-191, 07-15, modified – “maintenance” was replaced with “diagnostics”]

3.1.8

calibration

procedure (3.1.44) of checking or adjusting (by comparison with a reference standard) the accuracy of a measuring instrument

[SOURCE: ISO 15378, modified – “process” was replaced with “procedure”]

3.1.9

commissioning

procedure (3.1.44) prior, or related, to the handing over of a product ready for putting into service, including final acceptance testing, the handing over of all documentation relevant to the use of the product and, if necessary, instructing personnel

[SOURCE: IEC 82079-1, modified — “procedures” was replaced with “procedure”]

3.1.10

computerized maintenance management system

CMMS

computer system for measuring, managing, and analyzing the maintenance process (3.1.58) at a facility (3.1.20)

Note 1 to entry: CMMS function can include Maintenance Repair Operations (MRO) task planning and scheduling, inventory control and management, and labor and material cost accounting.

3.1.11

configuration

device configuration

procedure (3.1.44) that loads parameters into an intelligent device (3.1.31) to define its function

3.1.12

corporate lifecycle

lifecycle of an intelligent device management implemented by an enterprise (3.1.19)

3.1.13

corrective action

action to eliminate the cause of a non-fulfilment of a requirement and to prevent recurrence

[SOURCE: ISO 55000, Modified – “nonconformity” was replaced with “non-fulfilment of a requirement”]

3.1.14

covert fault

fault (3.1.25) in relation to hardware and software, undetected by the diagnostic tests, proof tests, operator (3.1.42) intervention (for example physical inspection and manual tests), or through normal operation

EXAMPLE: These adjectives are used in undetected fault and undetected failure.

[SOURCE: IEC 61508-4, ed. 2.0 (2010-04)]

3.1.15

criticality failure criticality

degree of risk (3.1.47) represented by specified set of levels

3.1.16

device

independent physical entity capable of performing one or more specified functions in a particular context and delimited by its interfaces

[SOURCE: IEC 61499-1]

3.1.17

diagnostics

automated function which detects faults (3.1.25), malfunctions, deviations, and/or variations of hardware or software

Note 1 to entry: Diagnostics can be initiated manually for off-line diagnostics.

Note 2 to entry: Although ISA-108 addresses only device diagnostics (not process diagnostics), some automated process diagnostics (e.g. local check of pressure drop across a filter and generation of an alarm) detect device faults (plugged filter).

Note 3 to entry: “diagnostic” is used for an adjective as a generic word.

3.1.18

diagnostic coverage

fraction of failures detected by automatic on-line diagnostics (3.1.41)

[SOURCE: IEC 62061, modified – “dangerous” and “tests” was deleted]

3.1.19

enterprise

group of organizations sharing a set of goals and objectives to offer products or services or both

[SOURCE: ISO 14258]

3.1.20

facility

physical entity (for example, a plant, factory, mill, site, etc.) that is built, constructed, installed or established to perform some particular function or to serve or facilitate some particular end

[SOURCE: IEC/TR 62066, ed. 1.0 (2002-06), modified examples]

3.1.21

facility lifecycle

lifecycle of a facility (3.1.20)

3.1.22

facility implementation project

set of activities (3.1.1) to implement a facility, which are conducted before the facility (3.1.20) starts its service

3.1.23

(device) failure

termination of the ability of a device (3.1.16) to perform a required function

Note 1 to entry: After failure the item has a fault.

Note 2 to entry: "Failure" is an event, as distinguished from "fault", which is a state.

Note 3 to entry: This concept as defined does not apply to items consisting of software only.

Note 4 to entry: Since ISA-108 addresses the availability of the device, the term "failure" is NOT used in the general sense.

[SOURCE: IEC 60050-191:1990, modified — "an item" was replaced with "a device", Note 4 to entry was added]

3.1.24

failure mode

predicted or observed results of a failure cause on a stated item in relation to the operating conditions at the time of the failure (3.1.23)

[SOURCE: IEC 62278]

3.1.25

fault

state of a device characterized by inability to perform its function when required

Note 1 to entry: Since ISA 108 addresses the availability of the device, the term "fault" is NOT used in the general sense.

[SOURCE: IEC 60050-191-04-01:1990, modified — "an item" was replaced with "a device" and "a required function, excluding the inability during preventive maintenance or other planned actions, or due to lack of external resources" was replaced with "its function when required", Note 1 to entry was added"]

3.1.26

functional safety assessment

investigation, based on evidence, to judge the functional safety achieved by one or more Safety Instrumented System and/or other protection layers

Note 1 to entry: "pre-startup safety review" is a synonym of "functional safety assessment".

Note 2 to entry: The evidence includes analysis and assumptions.

[SOURCE: IEC 61511-1, Note 1 to entry and Note 2 to entry was added]

3.1.27

host system

hardware and software implementation that manages the communication and application configuration of intelligent devices (3.1.31)

3.1.28

incipient fault

imperfection in the state or condition of a device (3.1.16) so that a degraded performance or critical failure (3.1.23) might eventually be the expected result if corrective action(s) is (are) not taken

[SOURCE: ISO 14224, modified — "an item" was replaced with "a device", "or critical failure might (or might not)" was replaced with "performance or critical failure (3.1.24) might" and "actions are" was replaced with "action(s) is (are)"]

3.1.29 inspection

action comprising careful scrutiny of a device (3.1.16) and its immediate environment in order to arrive at a reliable conclusion as to the condition of a device

[SOURCE: IEC 60050-426:2008, modified — "an item" was replaced with "a device" and "carried out either without dismantling, or with the addition of partial dismantling as required, supplemented by means such as measurement," was replaced with "and its immediate environment"]

3.1.30 installation

several combined items of apparatus or systems put together at a given place to fulfil a specific objective but not intended to be placed on the market as a single functional unit

[SOURCE: IEC 62103]

3.1.31 intelligent device

device (3.1.16) having digital communication and supplementary functions such as diagnostics (3.1.17) in addition to its basic purpose

EXAMPLES:

- 1) process connected devices, which is in the level 1 of IEC 62264 functional hierarchy, such as smart Instruments, valves and actuators, analyzers, custody transfer meters, electrical breakers, and transformers;
- 2) control devices, which are in the level 2 of IEC 62264 functional hierarchy, such as PLCs, data acquisition subsystems. Dedicated HMI devices;
- 3) other associated devices such as RTUs, managed industrial network routers, converters and gateways

3.1.32 intelligent device management IDM

coordinated activities (3.1.1) of an organization to realize value from intelligent devices (3.1.31)

Note 1 to entry: IDM is used to achieve setup (provisioning, engineering, configuration and calibration), optimization, diagnostics, maintenance and disposal of intelligent devices over the facility lifecycle based on an asset management system

[SOURCE: definition of "asset management" by ISO 55001, modified – assets is replaced with intelligent devices. Notes to entry were added.]

3.1.33 intelligent device management program IDM program

set of interrelated or interacting work processes (3.1.58) for achieving a particular objective defined by intelligent device management (3.1.32)

3.1.34 lifecycle

finite set of generic phases and steps a system can go through over its entire life history

[SOURCE: ISO 15704, modified — "may" was replaced with "can"]

**3.1.35
maintenance**

activity (3.1.1) consists of all technical and administrative actions, including supervisory actions, intended to retain an item in, or restore it to, a state in which it can perform a required function

[SOURCE: ISO 14224, modified — “combination” was replaced with “activity consists”]

**3.1.36
management of change**

process (3.1.58) of controlling and documenting any change in a system to maintain the proper operation of the equipment under control

Note 1 to entry: “change management” is a synonym of “management of change”

[SOURCE: IEC 62443-2-1, modified —term was replaced with “management of change”]

**3.1.37
management program**

activity that manages a group of related projects and/or work processes in a way that provides benefits and control not available by managing each activity individually and independently

**3.1.38
normal operation**

operation of apparatus conforming electrically and mechanically with its design specification and used within the limits specified by the apparatus manufacturer

[SOURCE: IEC 60050-426, modified — “apparatus” was added]

**3.1.39
notification**

audible and/or visible means of indicating something

**3.1.40
off-line diagnostics**

diagnostics (3.1.17) which is performed while device (3.1.16) is out-of-service

**3.1.41
on-line diagnostics**

diagnostics (3.1.17) which is performed while device (3.1.16) is in-service

**3.1.42
operator**

person who monitors and makes changes to the process

[SOURCE: IEC 62682]

**3.1.43
overt fault**

fault (3.1.25) in relation to hardware and software, detected by the diagnostic tests, proof tests, operator intervention (for example physical inspection and manual tests), or through normal operation

EXAMPLE These adjectives are used in detected fault and detected failure.

NOTE A dangerous failure detected by a diagnostic test is a revealed failure and can be considered a safe failure only if effective measures, automatic or manual, are taken.

[SOURCE: IEC 61508-4, ed. 2.0 (2010-04)]

3.1.44**procedure**

sequence of tasks (3.1.52) with a defined beginning and end that is intended to accomplish a specific objective

3.1.45**product lifecycle**

period of time over which a device (3.1.16) with a specific model code is developed, brought to market and eventually removed from the market

3.1.46**prompt**

notification (3.1.39) that requires the operator (3.1.42) to take an action that is part of normal operation (3.1.38).

3.1.47**risk**

combination of the probability of occurrence of harm and the severity of that harm

[SOURCE: ISO/IEC Guide 51: 1999]

3.1.48**risk assessment**

overall process comprising a risk analysis (3.1.49) and a risk evaluation

[SOURCE: ISO/IEC Guide 51]

3.1.49**risk analysis**

systematic use of available information to identify hazards and to estimate the risk (3.1.47)

[SOURCE: ISO/IEC Guide 51]

3.1.50**risk management**

process (3.1.58) of identifying and applying countermeasures commensurate with the value of the assets protected, based on a risk analysis (3.1.49)

[SOURCE: IEC 62443-1-1]

3.1.51**status notification**

notification (3.1.39) that helps provide the operator (3.1.42) situational awareness, is part of normal operation (3.1.38) and does not require operator action

3.1.52**task**

single piece of work that needs to be done and does not have interacting elements requiring management

[SOURCE: IEC 62304, modified — “a” was deleted, “and does not have interacting elements requiring management” was added]

3.1.53**template**

set of predefined parameters which characterize a make and model of a device (3.1.16) for a particular type of application prepared by the device vendor

3.1.54 testing

technical operation that consists of the determination of one or more characteristics of intelligent device (3.1.31) according to a specified procedure (3.1.44)

3.1.55 typical configuration

set of predefined parameters which characterize a make and model of a device for a particular type of application for a particular facility prepared by the personnel performing the host system configuration

3.1.56 toolkit

set of the typical configuration data and management tools and work processes (3.1.58) for integrating intelligent devices with host systems

3.1.57 turnaround

scheduled event wherein a facility (3.1.20) is taken off-line for maintenance (3.1.35)

EXAMPLE: planned shutdown

3.1.58 work process process

set of interrelated or interacting procedure(s) (3.1.44) which transforms inputs into outputs

[SOURCE: ISO 9000, ISO 55000, modified — “activities” was replaced with “procedures”]

3.2 Abbreviations and acronyms

CMMS	computerized maintenance management system
DCS	Distributed Control System
DD	Device Description
EPC	Engineering Procurement Construction
FAT	Factory Acceptance Test
HMI	Human Machine Interface
IDM	Intelligent Device Management
IAM	Institute of Asset Management
KPI	Key Performance Indicator
LCM	LifeCycle Management
MOC	Management of Change
RAM	Risk Assessment Matrix
RTU	Remote Terminal Unit
SAT	Site Acceptance Test
SIS	Safety Instrumented System
SIT	Site Integration Test
SME	Subject Matter Expert
PAM	Plant Asset Management
PLC	Program Logic Controller

PV	Process Value
P&ID	Piping and Instrumentation Diagram
RFQ	Request for Quotation
R&D	Research and Development
USB	Universal Serial Bus
UML	Unified Modeling Language
WDT	Watch Dog Timer

4 Background and motivation of intelligent device management

4.1 Current situation and traditional work process

Intelligent devices provide additional information aside from that of the basic or primary functions by exchanging information in a network environment. Intelligent field devices have the potential to transform traditional reactive maintenance towards the proactive maintenance schedule so that devices with impending problems can be identified before failure.

In many cases, the promise of intelligent devices in the facility remains unrealized. This is not so much a technology issue as a management understanding of the value, an implementation, personnel, and work process issue. Most devices used in facilities contain configuration data that need to be managed and diagnostics that can enable advanced maintenance techniques, but facilities have not integrated these capabilities into their systems and work processes. These lacks of integration result in less than optimum management of risk and less than optimum benefits from device intelligence.

Current work processes and current maintenance strategies are built around time-honored traditions including “run to failure”, periodic inspection, and testing software programs. These work processes were developed for devices that do not have built-in diagnostics. Pressure vessels and piping can be expected to fail very slowly over decades if operated within their design limits. Inspection and testing software programs are good work processes for such devices.

Instruments can also be pressure-retaining devices, but their primary purpose is for measurement, control and safeguarding. The measurement and control functions generally use precise components that can degrade very quickly and/or suddenly compared to typical pressure retaining devices. Furthermore, microprocessors embedded in these devices can do diagnostic work to identify when components are malfunctioning or degrading. In many cases, testing is unnecessary for these devices and inspection can be simplified. Tools and processes that utilize the built-in diagnostics could become alternate means of testing and inspection.

4.2 Challenges and opportunities

The primary challenge of Intelligent Device Management is presented by perceived complexity. Many users of intelligent devices are very familiar with the use or application of intelligent devices for their primary function but are not familiar with all of the auxiliary functions or diagnostics in the intelligent devices, and are not familiar with the digital communication technology that enables auxiliary functions. The digital communication and auxiliary functions are not necessarily difficult to deal with, but lack of familiarity can result in lack of use or misuse of these capabilities.

If local support is not available within a facility, the intelligent devices present an opportunity for remote support. The information for troubleshooting a problem can be remotely accessed without the cost and time for travel to the facility. However, if not implemented correctly remote support presents another layer of complexity and increases the potential for cybersecurity issues.

IDM's opportunities and challenges are both large because of the number and variety of intelligent devices, their global distribution, and a traditional lack of standardized work processes and

available skills at site for dealing effectively with this complexity. If intelligent devices are used correctly they can provide a significant improvement over traditional non-intelligent devices in functionality, accuracy, reliability, and total cost of ownership. Without correct use, intelligent devices could represent unmanaged risk and increased cost of ownership.

To meet the challenge and realize the opportunities, vendors, engineering firms, end users, and service providers all need to understand intelligent device management and the role they need to play in proper implementation and use of the tools and support systems for intelligent devices.

There are many standards efforts that are being undertaken in the process industries that revolve around plant assets and even devices, but none of these efforts addresses Intelligent Device Management for maintenance and operations (See Annex C).

4.3 Benefits of intelligent device management (IDM)

The argument for using intelligent device management has a strong economic value proposition. IDM is not just technology for technology's sake. IDM can produce efficiencies and savings in all phases of a facility lifecycle, but the largest incentives are in the operations and maintenance phase. Detecting and resolving problems before they proceed to failure and process impact reduce unplanned shutdowns. Depending on the application, one saving provided by capability of intelligent devices can pay for an entire automation investment.

The potential to cut maintenance costs is also significant. Many maintenance activities like periodic testing or maintenance of devices result in “no problem found.” These activities traditionally force personnel to enter hazardous areas, climb to areas with poor access, and spend time on unnecessary tests. Diagnostics can confirm proper operation without the expense and risk and lead to a quicker resolution of operational issues. IDM can significantly reduce these activities by shifting work from reactive (run to failure) to predictive maintenance (measurements that detect the onset of system degradation); therefore leaving personnel free to optimize existing processes in order to improve safety and efficiency of the plant process.

If IDM is implemented appropriately, technicians do not have to go to the intelligent device to get relevant information. Instead, information is provided directly to software tools that use the information such as DCSs (Distributed Control Systems), asset management systems, and other applications.

5 IDM Structure

5.1 Introduction

IDM requires a complex set of interactive and interdependent activities. To accomplish IDM goals, the management of these activities requires formal structure and the structure needs to be clearly documented. This document will present structures in conceptual form.

This clause will provide an introduction to the structures that can be used to manage activities necessary for IDM. Furthermore some of the relationships or dependencies for these activities are explained. The details of the work processes and the roles of personnel performing these activities are covered in Part 2 of ISA108. This document only introduces concepts and terminology.

Intelligent device management (IDM) is a management system for intelligent devices. The objective of IDM is to establish and maintain coordinated activities of the organization to realize the maximum value available from each intelligent device.

This document introduces some management structure and technical structure concepts that can be adapted by an asset owner company to manage intelligent devices with support by related organizations such as automation suppliers, EPCs, constructors, and maintenance contractors.

Although IDM is best supported in a structured environment that is established during the design and before operation of a facility, many facilities exist without this structure. The resulting facilities cannot be well suited to IDM without some hardware and software modification, new work processes, and retraining of personnel. Once corporate structures are in place, old facilities can be made to perform better with lower risk, and new facilities can be designed, constructed, and operated in a more efficient fashion. In other words, IDM structures and processes improve both new and existing facilities.

The features of the intelligent devices that bring new value to the facility operation include the following:

- digital processing capability which allows diagnostics of functionalities of the intelligent device itself and related equipment,

EXAMPLE 1: A valve positioner can be recognized as an intelligent device, and the valve body can be recognized as its related equipment. The valve positioner can detect malfunction of the valve body such as valve hysteresis.

EXAMPLE 2: A pressure transmitter can be recognized as an intelligent device, and its impulse line can be recognized as its related equipment. The pressure transmitter can detect clogging of the impulse lines.

- digital communication capability which provides access to the basic device function plus additional information that is useful to manage the device.

These capabilities of the intelligent devices support (but are not limited to) the following benefits:

- more stable and safer operation of the facility,
- higher quality of the product,
- saving material and energy to produce the product,
- prolonging the life of equipment including the device itself and related equipment,
- reducing the operation cost to maintain the devices,
- reducing the effort and cost to check the functionalities of the devices,
- to prevent loss of production by reducing unscheduled shutdowns.

5.2 Relationship to asset management

IDM contains asset management concepts that are outlined in ISO 55000 and specified by ISO 55001. Therefore, IDM will meet the basic requirements specified by ISO 55001.

As ISO 55000 mentions, the nature and purpose of an organization and its operating environment all have a strong influence on the type of assets that the organization needs to achieve its objectives. An organization's and its stakeholders' intents are translated into design criteria for an asset management system.

Figure 1 shows the relationship between intelligent device management and intelligent devices in the context of asset management in UML class diagram. The overview and convention of UML class diagram is described in Annex A.

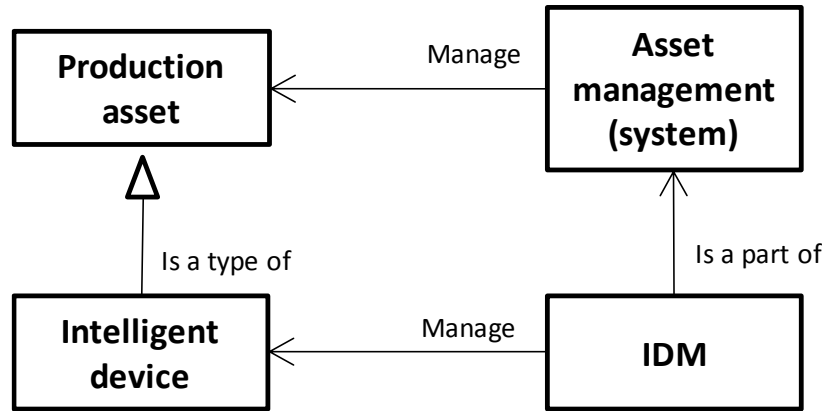


Figure 1 — IDM and intelligent device in the context of asset management

5.3 Organizational structure

5.3.1 Overview

Multiple levels of organizations are involved in IDM activities. This document introduces and describes many of the technical activities and how they fit into an organizational structure and IDM program.

NOTE — Further parts of the series of ISA-108 documents will describe in detail several of the technical activities.

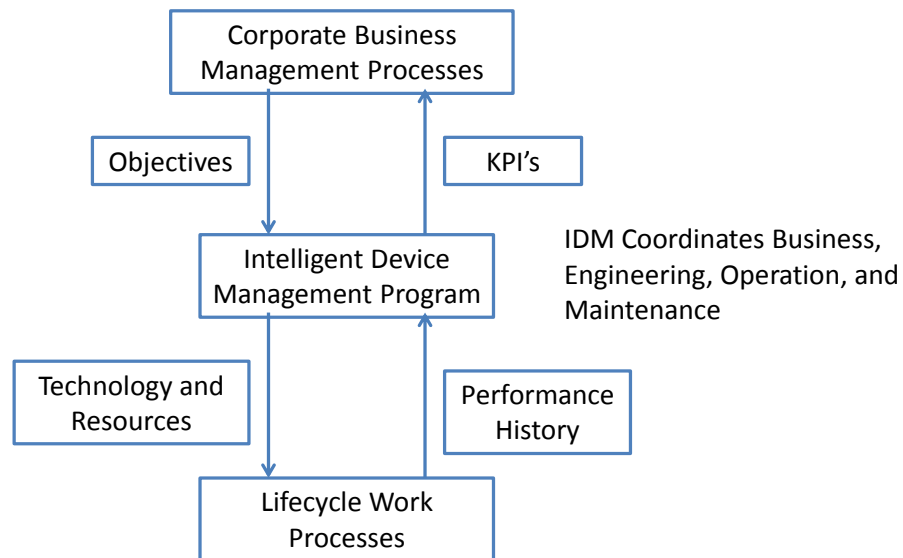


Figure 2 — Organizational management structure

Implementation methods for business management are non-technical and best left to operating companies who have many different methods of implementation. Many business processes can have a stake in the success of IDM, but most are created for larger purposes and are not structured to directly manage IDM. A technical and business focus for IDM and a mid-level management structure that can focus on IDM can provide valuable coordination between the lifecycle activities and higher level management activities. This structure is depicted in Figure 2 above.

Management structure for IDM can be very different depending on company size and management style. Small single facility companies will have a different optimum structure from a large multinational and multi facility company. Other differences can come from a top down or bottom up management culture. Management structure is not central to the success of IDM. This document covers some management functions that are important regardless of structure.

5.3.2 Structure of IDM activities

Intelligent Device Management activities can be divided up into IDM Programs that contain multiple Work Processes, which contain or utilize Procedures and Tasks. Intelligent Device Management consists of multiple layers of activity of increasing complexity with management involvement at the top and fairly simple technical activities at the bottom. This structure is illustrated in Figure 3 below.

Structure of IDM Activities

Definitions

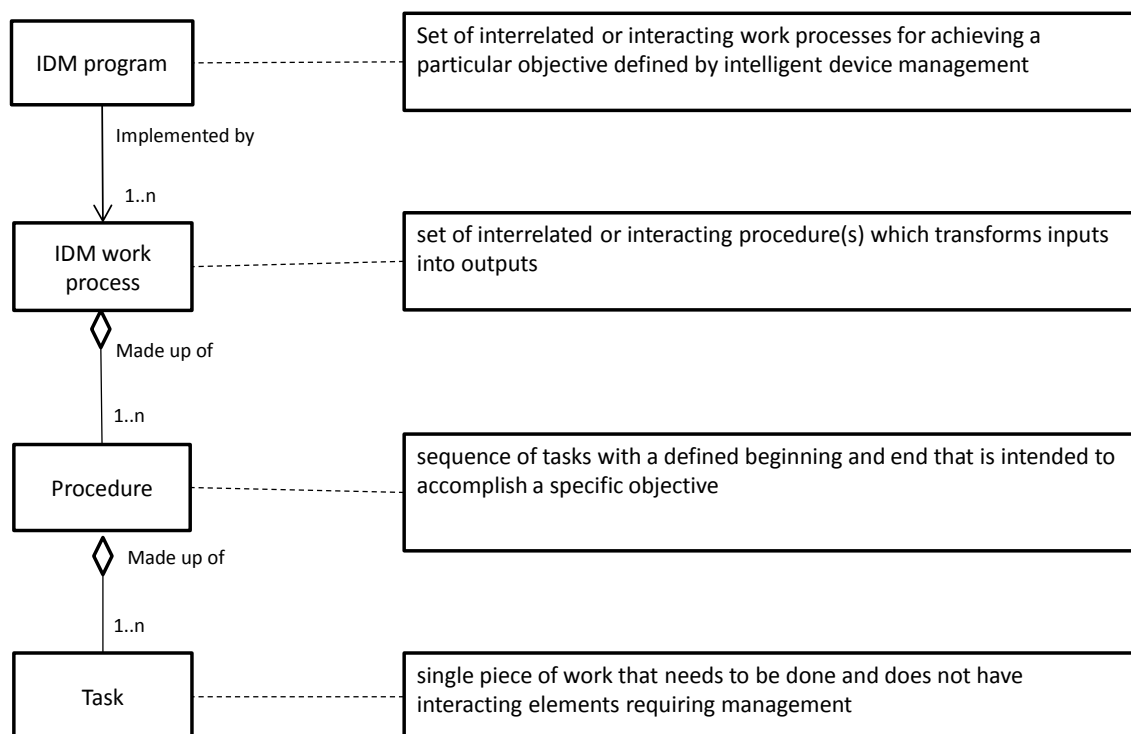


Figure 3 — IDM activity

5.4 IDM programs

5.4.1 Overview

The IDM program specifies activities to realize the objective. This subclause provides methodology to specify the IDM program, which is used in Part 2 of ISA-108, “Work Process Specifications”. The ISA-108 series provides a common template of the IDM work process documents. A work process document is specified for each enterprise based on its IDM policy and IDM objective(s) taking into account its individual organizational context.

IDM programs are the most complex and need balancing multiple and sometimes conflicting goals, have the most direct involvement of managers, and require support from technical personnel. An IDM program assures budget, technical tools, and skills are supplied, and assures accountability based on quantitative metrics. IDM programs coordinate multiple lifecycles and multiple work processes.

The work processes under an IDM program are very interdependent and depend on external resources. These relationships are described in the IDM program.

A role that is often utilized for achieving success in a IDM program is a technical, maintenance, and/or business lead (sometimes called a champion) that can lead technical efforts and bridge the gap between technical and management functions. The champion role is a very useful organizational feature for IDM and key for successful implementation of this initiative.

5.4.2 Structure of IDM program

The IDM program consists of an IDM role assignment, work process specifications, procedure specification, and task specifications.

The IDM role assignment includes organizational roles, responsibilities and authorities specified in ISO 55001 (5.3), however the main purpose of this document is to assign persons to the tasks specified by the IDM procedure. The IDM role assignment is developed by leadership in a hierarchical way.

A work process specification specifies an IDM work process.

A procedure specification specifies a procedure, which is a part of an IDM work process.

A task specification specifies a task, which is a part of a procedure. A same task can be utilized by different procedures.

NOTE —Since specifications of work process, procedures and tasks are specific to the particular models of equipment and their installation, series of ISA-108 documents does not intend to specify those particular procedures but it intends to specify generic methodology to specify procedures for intelligent device management.

Figure 4 shows the structure of an IDM work process document.