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Automation systems and integration — Integration of advanced process control and optimization capabilities for manufacturing systems —

Part 2: Activity models and information exchange

Systèmes d'automatisation et intégration — Intégration de contrôles de processus avancés et capacités d'optimisation des systèmes de fabrication —

Partie 2: Modèles d'activité et échange d'informations

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 184, *Automation systems and integration*, Subcommittee SC 5, *Interoperability, integration and architectures of enterprise systems and automation applications*.

A list of all parts in the ISO 15746 series can be found on the ISO website.

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Introduction

As a crucial part of manufacturing systems with increased complexity, the automation and control applications enabled by the advanced process control and optimization (APC-O) methodology and solutions perform the operations directed by production planning and scheduling. This work will initially deal with the specific use of APC-O to enable integration of manufacturing operations management (MOM) with the automation and control of manufacturing processes and equipment.

Automation solutions composed of software and hardware components are provided by different suppliers to accomplish APC-O functions. Due to the diversity of development environments and the variety of demand focus, the automation solutions from various suppliers are isolated and relatively independent. These differences make the integration of automation solutions difficult. Consequently, the customers could purchase different automation solution components with redundant and duplicated functions, resulting in a waste of resources and limited interoperability. The proposed standard offers a reference interoperability framework for advanced process control and optimization. It is intended to maximize the integration and interoperability of automation solutions.

This document provides a consistent framework for integration and interoperability between APC-O systems, parts of an APC-O system, Level 2 automated process control systems, and Level 3 manufacturing operations management systems. It builds on the functional models defined by ISO 15746-1 by defining activity models for APC-O systems and the information exchange requirements needed to support those activity models. The modelled activities operate within Level 2 and Level 3 with interaction between each level.

It is not the intent of this document to suggest that there is only one way of implementing APC-O or to force users to abandon their current way of implementing APC-O.

The target users of this standard include: users and providers of advanced process control and optimization solutions, such as, project solution suppliers, automation systems integrators, production departments of companies, process engineers, independent software testing organizations, implementation and consulting service organizations of advanced process control and optimization software, and relevant government and academic organizations.

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Automation systems and integration — Integration of advanced process control and optimization capabilities for manufacturing systems —

Part 2: Activity models and information exchange

1 Scope

This document defines:

— activity models to describe the dynamic aspects of the APC-O modules;

— information exchange requirements of the dynamic aspects of the APC-O modules;

— workflows and lifecycles of APC-O elements;

— service definitions to support the following information exchanges between:

  — Level 3 and APC-O components;

  — Level 2 and APC-O components;

  — APC-O components within one or more APC-O systems.

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 15746-1, *Automation systems and integration — Integration of advanced process control and optimization capabilities for manufacturing systems — Part 1: Framework and functional model*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15746-1 and the following apply.

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

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

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

3.1
alarm
notification regarding an abnormal condition of special significance to an *APC-O component* (3.2)

EXAMPLE A temperature controlled by an APC module exceeds a high limit or an input to a Soft Sensor module is outside the valid range.

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3.2
APC-O component
procedural object in an APC-O system that is an instantiation of an APC-O functional module

Note 1 to entry: An APC-O component can execute various functions involving reasoning and communication with other APC-O components, interaction with simulation and optimization, diagnostic and forecasting, and control.

3.3
APC-O package
group of commercial software products supplied by a single vendor to deliver one or more APC-O functional modules

3.4
APC-O platform
computer-based system capable of managing and executing an APC-O system comprised of one or more *APC-O components* (3.2)

3.5
bias
adjustment made to a calculated value to force it to match actual measurements

Note 1 to entry: A bias is normally applied to account for unmeasured disturbances.

3.6
controlled variable
variable that a controller maintains either at a target or within minimum and maximum limits

Note 1 to entry: It accomplishes this by adjusting the *manipulated variables* (3.11).

3.7
disturbance variable
variable that a controller considers as influencing the *controlled variables* (3.6) but is not adjustable by the controller

3.8
event
detectable change or occurrence that changes the state of an *APC-O component* (3.2) or requires action by an APC-O component

EXAMPLE The mode of a PID loop associated with a *manipulated variable* (3.11) in an APC module changes to REMOTE or a process managed by an APC-O system changes state from “Producing” to “Shutdown”.

3.9
final control element
physical equipment that is actually moved to accomplish control of a process

EXAMPLE Valves, dampers, and variable speed drives.

3.10
hard limit
limit that a controller is not allowed to exceed under any circumstances

3.11
manipulated variable
variable that a controller adjusts

Note 1 to entry: These are typically setpoints of PID loops but could also be direct manipulation of a *final control element* (3.9).

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3.12
performance baseline
evaluation and assessment of a set of key performance indicators for a process prior to implementing an APC-O system

Note 1 to entry: The intent is to evaluate performance of the APC-O system against the performance baseline.

3.13
rate of change limit
limit placed on the amount a value is allowed to change over a defined period of time

3.14
recipe
set of ingredients, product specifications, and process settings that define how to produce a product

3.15
soft limit
limit a controller should attempt to respect but may exceed if necessary

3.16
tracking
action of making the value of one parameter the same as the value of another parameter

EXAMPLE A PID controller may track the setpoint to the process value when it is in MANUAL mode.

3.17
trajectory
set of values, typically an array, representing expected behaviour over a defined time horizon

Note 1 to entry: In APC applications, the trajectory of a *manipulated variable* (3.11) is the set of moves planned by the controller and the trajectory of a *controlled variable* (3.6) is the expected changes based on those planned moves and recent history of process changes.

3.18
watchdog
function to determine if a component of the control system or an external system is functioning properly

Note 1 to entry: Typically, a watchdog function will perform some set of instructions if it determines the watched component is not functioning properly.

3.19
workflow
sequence of activities with explicit starting and ending points to describe a task

Note 1 to entry: Workflows may also have branches, decision points, and *events* (3.8). A workflow is a type of activity model.

4 Abbreviated terms

APC	advanced process control
APC-O	advanced process control and optimization
CV	controlled variable
DV	disturbance variable
KPI	key performance indicator
MPC	model predictive control

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