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Industrial automation systems and integration — Process specification language —

Part 43: Definitional extension: Activity ordering and duration extensions

Systèmes d'automatisation industrielle et intégration — Langage de spécification de procédé —

Partie 43: Extension de définition: Extensions de la durée et de classement d'activité

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards (DIS) adopted by technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

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ISO 18629-43 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration,* Subcommittee SC 4, *Industrial data.*

A complete list of parts of ISO 18629 is available from the Internet:

http://www.tc184-sc4.org/titles

Introduction

ISO 18629 is an International Standard for the computer-interpretable exchange of information related to manufacturing processes. Taken together, all the parts contained in the ISO 18629 Standard provide a generic language for describing a manufacturing process throughout the entire production process within the same industrial company or across several industrial sectors or companies, independently from any particular representation model. The nature of this language makes it suitable for sharing process specifications and properties related to manufacturing during all the stages of a production process.

This part of ISO 18629 provides a description of the definitional extensions of the language related to activity extensions defined within ISO 18629.

All parts of ISO 18629 are independent of any specific process representation model used in a given application. Collectively, they provide a structural framework for improving the interoperability of these applications.

Industrial automation systems and integration — Process specification language —

Part 43:
Definitional extension: Activity ordering and duration extensions

1. Scope

This part of ISO 18629 provides a specification of non-primitive concepts of the language, using a set of definitions written in the language of ISO 18629. These definitions provide an axiomatization of the semantics for terminology in this part of ISO 18629.

The following is within the scope of this part of ISO 18629:

— definitions of concepts using terminology specified in ISO 18629-13.

The following is outside the scope of this part of ISO 18629:

— definitions of state and time-related concepts using only terminology specified in ISO 18629-11 and ISO 18629-12.

2. Normative References

The following referenced documents are indispensable for the application 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/IEC 8824-1, *Information technology — Abstract Syntax Notation One (ASN.1) — Part 1: Specification of basic notation*

ISO 15531-1, *Industrial automation systems and integration — Industrial manufacturing management data — Part 1: General overview*

ISO 15531-42, *Industrial automation systems and integration — Industrial manufacturing management data — Part 42: Time Model*

ISO 18629-1: 2004, *Industrial automation systems and integration — Process specification language — Part 1: Overview and basic principles*

ISO 18629-11 2005, *Industrial automation systems and integration – Process specification language – Part 11: PSL core*

ISO 18629-12, *Industrial automation systems and integration — Process specification language — Part 12: Outer core*

ISO 18629-13, *Industrial automation systems and integration — Process specification language — Part 13: Duration and ordering theories*

3. Terms, definitions, and abbreviations

3.1 Terms and definitions

For the purpose of this document, the following terms and definitions apply:

3.1.1
automorphism
one-to-one mapping of elements on a set that preserves the relations and functions in some model

[ISO 18629-13]

3.1.2
axiom
well-formed formula in a formal language that provides constraints on the interpretation of symbols in the lexicon of a language

[ISO 18629-1]

3.1.3
defined lexicon
set of symbols in the non-logical lexicon which denote defined concepts

NOTE Defined lexicon is divided into constant, function and relation symbols.

EXAMPLE terms with conservative definitions.

[ISO 18629-1]

3.1.4
definitional extension
extension of PSL-Core that introduces new linguistic items which can be completely defined in terms of the PSL-Core

NOTE: Definitional extensions add no new expressive power to PSL-Core but are used to specify the semantics and terminology in the domain application.

[ISO 18629-1]

3.1.5
duration
interval of time
length of a period of time, measured using a given unit of time

[ISO 15531-42]

3.1.6
endomorphism
mapping from a set onto a subset that preserves the relations and functions in some model

[ISO 18629-13]

3.1.7
extension
augmentation of PSL-Core containing additional axioms

NOTE 1 The PSL-Core is a relatively simple set of axioms that is adequate for expressing a wide range of basic processes. However, more complex processes require expressive resources that exceed those of the PSL-Core. Rather than clutter the PSL-Core itself with every conceivable concept that might prove useful in describing one process or another, a variety of separate, modular extensions need to be developed and added to the PSL-Core as necessary. In this way a user can tailor the language precisely to suit his or her expressive needs.

NOTE 2 All extensions are core theories or definitional extensions.

[ISO 18629-1]

3.1.8
grammar
specification of how logical symbols and lexical terms can be combined to make well-formed formulae

[ISO 18629-1]

3.1.9
homomorphism
mapping between sets preserves some relations on the elements of the set

[ISO 18629-13]

3.1.10
language
combination of a lexicon and a grammar

[ISO 18629-1]

3.1.11
lexicon
set of symbols and terms

NOTE The lexicon consists of logical symbols (such as Boolean connectives and quantifiers) and non-logical symbols. For ISO 18629, the non logical part of the lexicon consists of expressions (constants, function symbols, and relation symbols) chosen to represent the basic concepts of the ontology.

[ISO 18629-1]

3.1.12
manufacturing
function or act of converting or transforming material from raw material or semi-finished state to a state of further completion

[ISO 15531-1]

3.1.13
manufacturing process
structured set of activities or operations performed upon material to convert it from the raw material or a semifinished state to a state of further completion

NOTE Manufacturing processes may be arranged in process layout, product layout, cellular layout or fixed position layout. Manufacturing processes may be planned to support make-to-stock, make-to-order, assemble-to-order, etc., based on strategic use and placements of inventories.

[ISO 15531-1]

3.1.14
monomorphism
one to one mapping between sets preserves some relation on the elements of the set

[ISO 18629-13]

3.1.15
primitive concept
lexical term that has no conservative definition

[ISO 18629-1]

3.1.16
primitive lexicon
set of symbols in the non-logical lexicon which denote primitive concepts

NOTE Primitive lexicon is divided into constant, function and relation symbols.

[ISO 18629-1]

3.1.17
process
structured set of activities involving various enterprise entities, that is designed and organised for a given purpose

NOTE The definition provided here is very close to that given in ISO 10303-49. Nevertheless ISO 15531 needs the notion of structured set of activities, without any predefined reference to the time or steps. In addition, from the point of view of flow management, some empty processes may be needed for a synchronisation purpose although they are not actually doing anything (ghost task).

[ISO 15531-1]

3.1.18
product
Thing or substance produced by a natural or artificial process

[ISO 10303-1]

3.1.19
resource
any device, tool and means at the disposal of the enterprise to produce goods or services

NOTE 1 Adapted from ISO 15531-1 The concept of resource as defined in ISO 15531-1 includes an assumption seeing that resources except raw material, products and components that are considered from a system theory point of view as parts of the environment of the system and then do not belong to the system itself. That is not the case here. Furthermore ISO 15531-1 definition encompasses ISO 10303-49 definition but is included in the definition that applies for this part of ISO 18629 (In addition to ISO 15531 resources of this part of ISO 18629 resources include raw materials and consumables as well as in ISO 18629-14).

NOTE 2 Resources as they are defined here include human resources considered as specific means with a given capability and a given capacity. Those means are considered as being able to be involved in the manufacturing process through assigned tasks. That does not include any modelling of an individual or common behaviour of human resource excepted in their capability to perform a given task in the manufacturing process (e.g.: transformation of raw material or component, provision of logistic services). That means that human resources are only considered, as the other, from the point of view of their functions, their capabilities and their status (e.g.: idle, busy). That excludes any modelling or representation of any aspect of individual or common «social» behaviour.

[ISO 15531-1]

3.1.20
theory
set of axioms and definitions that pertain to a given concept or set of concepts

NOTE this definition reflects the approach of artificial intelligence in which a theory is the set of assumptions on which the meaning of the related concept is based.

[ISO 18629-1]

3.2 Abbreviations

— **KIF** Knowledge Interchange Format.

4. General information on ISO 18629

The parts 41 to 49 of ISO 18629[1] specify definitional extensions needed to give precise definitions and the axiomatization of non-primitive concepts of ISO 18629. Definitional extensions are extensions of ISO 18629-11 and ISO 18629-12 that introduce new items for the lexicon. The items found in definitional extensions can be completely defined in terms using theories of ISO 18629-11 and ISO 18629-12. The definitional extensions provide precise semantic definitions for elements used in the specification of individual applications or types of applications for the purpose of interoperability. Definitional extensions exist in the following categories:

— Activity Extensions;

— Temporal and State Extensions;

— Activity Ordering and Duration Extensions;

— Resource Roles;

— Resource Sets;

— Processor Activity Extensions.

Individual users or groups of users of ISO 18629 may need to extend ISO 18629 for specifying concepts that are currently absent in parts 41 to 49 of ISO 18629. They shall use the elements presented in ISO 18629 for doing so. User-defined extensions and their definitions constitute definitional extensions but shall not become part of parts 41 to 49 of ISO 18629.

[1] Certain parts are under development

Note: User-defined extensions must conform to ISO 18629 as defined in ISO 18629-1:2004, 5.1 and 5.2.

Parts 41 to 49 of ISO 18629 provide:

— the semantic definitions, using concepts in ISO 18629-11 and ISO 18629-12, of elements that are specific to the six concepts outlined above;

— a set of axioms for constraining the use of elements in definitional extensions.

The parts 41 to 49 of ISO 18629 do not provide:

— definitions and axioms for concepts that are part of the ISO 18629-11 and ISO 18629-12;

— elements that are not defined using the elements in ISO 18629-11 and ISO 18629-12;

— user-defined extensions.

5. Organization of this part of ISO 18629

The fundamental theories that constitute this part of ISO 18629 are:

— Strong partially ordered activities;

— Duration constraints for activity occurrences;

— State-based duration;

— Time-based duration;

— Duration based on state and time;

— Ordering and duration constraints on activity occurrences;

— Ordering and duration constraints on embedded activity occurrences;

— Spoilage preconditions for activities;

— Scheduled embedding constraints;

— Duration-based effects;

— Effects of activities based on duration and state;

— Complex sequence ordering relations.

All definitional extensions in this part of ISO 18629 are extensions of the ISO 18629-13, itself an extension of ISO 18629-12 and ISO 18629-11.

6. Strong partially ordered activities

This clause characterizes all definitions pertaining to Strong partially ordered activities.

6.1 Primitive lexicon of the Strong partially ordered activities

No primitive relations are introduced by the lexicon of Strong partially ordered activities.

6.2 Defined lexicon for concepts of Strong partially ordered activities

The following relations are defined in this clause:

— (same_bag ?s1 ?s2 ?a);

— (snapshot ?s1 ?s2 ?a);

— (rotate ?s ?a);

— (reflect ?s ?a);

— (flip ?s ?a);

— (turn ?s ?a);

— (bag ?occ);

— (strong_poset ?occ);

— (choice_poset ?occ);

— (complex_poset ?occ).

Each concept is described by informal semantics and a KIF axiom.

6.3 Core theories required by Strong partially ordered activities

This extension requires:

— soo.th;

— act_occ.th;

— complex.th;

— atomic.th;

— subactivity.th;

— occtree.th;

— psl_core.th.

6.4 Definitional extensions required by Strong partially ordered activities

No definitional extensions are required by Strong partially ordered activities.