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Industrial automation systems and integration — Process specification language —

Part 11: PSL core

Systèmes d'automatisation industrielle et intégration — Langage de spécification de procédé —
Partie 11: Noyau PSL

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Foreword

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ISO 18629-11 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration,* Sub-committee SC4, *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 information related to manufacturing during all the stages of a production process.

This part provides a description of the core elements of the language defined within the International Standard.

This part of ISO 18629 and all other parts in ISO 18629 are independent of any specific process representation or model proposed in a software application in the domain of manufacturing management. Collectively, they provide a structural framework for improving the interoperability of these applications.

Industrial automation systems and integration -- Process specification language -- Part 11: PSL core

1 Scope

This part of ISO 18629 provides a representation of the concepts of PSL core using a set of axioms written in the basic language of ISO 18629.

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

— the representation of the concepts common to all processes.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated basic 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) - Specification of basic notation*

ISO 10303-1, *Industrial automation systems and integration - Product data representation and exchange - Part 1: Overview and fundamental principles*

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

ISO 15531-42:2005, *Industrial automation systems and integration - Industrial manufacturing management data - Part 42:Time model*

3 Terms, definitions, and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
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]

3.1.2
conservative definition
definition that specifies necessary and sufficient conditions that a term shall satisfy and that does not allow new inferences to be drawn from the theory

[ISO 18629-1]

3.1.3
core theory
set of predicates, function symbols and individual constants, associated with some axioms, the primitive concepts of the ontology

3.1.4
data
a representation of information in a formal manner suitable for communication, interpretation, or processing by human beings or computers

[ISO 10303-1]

3.1.5
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]

3.1.6
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]

3.1.7
grammar
specification of how logical symbols and lexical terms can be combined to make well-formed formulae

[ISO 18629-1]

3.1.8
individual
element of an interpretation domain, in logic, considered as not divisible without loss of identity

EXAMPLE an individual constant is a symbol that is used to refer to some fixed individual object : it is the equivalent in logic of the "name" in the everyday language. In first-order logic, arguments of predicates are always individual constants.

NOTE 1 for further information, see [5].

NOTE 2 this term is commonly used in formal logic.

NOTE 3 in first order logic, the only individuals are individual constants.

3.1.9
information
facts, concepts, or instructions

[ISO 10303-1]

3.1.10
interpretation
universe of discourse and assignment of truth values (TRUE or FALSE) to all sentences in a theory

NOTE See annex C for an example of an interpretation.

3.1.11
language
combination of a lexicon and a grammar

[ISO 18629-1]

3.1.12
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]

3.1.13
linear ordering
set of elements with a binary relation between any two elements that is transitive, irreflexive and antisymmetric

EXAMPLE the less-than relation in mathematics : $3 < 5$.

3.1.14
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]

3.1.15
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]

3.1.16
model
combination of a set of elements and a truth assignment that satisfies all well-formed formulae in a theory

NOTE 1 The word "model" is used, in logic, in a way that differs from the way it is used in most scientific and everyday contexts: if a sentence is true in a certain interpretation, it is possible to say that the interpretation is a model of the sentence. The kind of semantics presented here is often called model-theoretical semantics.

NOTE 2 A model is typically represented as a set with some additional structure (partial ordering, lattice, or vector space). The model then defines meanings for the terminology and a notion of truth for sentences of the language in terms of this model. Given a model, the underlying set of axioms of the mathematical structures used in the set of axioms then becomes available as a basis for reasoning about the concepts intended by the terms of the language and their logical relationships, so that the set of models constitutes the formal semantics of the ontology.

[ISO 18629-1]

3.1.17
ontology
a lexicon of specialised terminology along with some specification of the meaning of terms in the lexicon

NOTE 1: structured set of related terms given with a specification of the meaning of the terms in a formal language. The specification of meaning explains why and how the terms are related and conditions how the set is partitioned and structured.

NOTE 2: The primary component of a process specification language such as ISO 18629 is an ontology The primitive concepts is the ontology according to ISO 18629 are adequate for describing basic manufacturing, engineering, and business processes.

NOTE 3: The focus of an ontology is not only on terms, but also on their meaning. An arbitrary set of terms is included in the ontology, but these terms can only be shared if there is an agreement about their meaning. It is the intended semantics of the terms that is being shared, not simply the terms.

NOTE 4: Any term used without an explicit definition is a possible source of ambiguity and confusion. The challenge for an ontology is that a framework is needed for making explicit the meaning of the terms within it. For the ISO 18629 ontology, it is necessary to provide a rigorous mathematical characterisation of process information as well as a precise expression of the basic logical properties of that information in the ISO 18629 language.

[ISO 18629-1]

3.1.18
point in time

location of something noticeable within a time domain

EXAMPLE 1 Wednesday, 15th of March, 2003.

EXAMPLE 2 9.30 a.m.

[ISO 15531-42]

3.1.19
primitive concept
lexical term that has no conservative definition

[ISO 18629-1]

3.1.20
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]

3.1.21
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]

3.1.22
product
a thing or substance produced by a natural or artificial process

[ISO 10303-1]

3.1.23
proof theory
set of theories and lexical elements necessary for the interpretation of the semantics of the language

NOTE It consists of three components: the PSL-Core, the Outer Core and the extensions.

[ISO 18629-1]

3.1.24
PSL-Core
set of axioms for the concepts of activity, activity-occurrence, time-point, and object

NOTE The motivation for PSL-Core is any two process-related applications shall share these axioms in order to exchange process information, and hence is adequate for describing the fundamental concepts of manufacturing processes. Consequently, this characterisation of basic processes makes few assumptions about their nature beyond what is needed for describing those processes, and the PSL-Core is therefore rather weak in

terms of logical expressiveness. In particular, PSL-Core is not strong enough to provide definitions of the many auxiliary notions that become necessary to describe all intuitions about manufacturing processes.

[ISO 18629-1]

3.1.25
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]

3.1.26
universe of discourse

the collection of concrete or abstract things that belong to an area of the real world, selected according to its interest for the system to be modelled and for its corresponding environment.

[ISO 15531-1]

3.2 Abbreviations

For the purpose of this part of ISO 18629, the following abbreviations apply:

— **BNF** Backus-Naur form

— **KIF** Knowledge Interchange Format

— **PSL** Process Specification Language

4 ISO 18629 general

ISO 18629 specifies a language for the representation of process information. It is composed of a lexicon, an ontology, and a grammar for process descriptions.

NOTE 1 PSL is a language for specifying manufacturing processes based on a mathematically well defined vocabulary and grammar. As such, it is different from the schemas and product representations provided in the standards ISO 10303, ISO 13584 [2], and ISO 15926 [3], it is also different from the representation provided by ISO 15531, but strongly related to it and complementary . In the context of an exchange of information between two software applications, PSL identifies each process independently of its behaviour. For example, an object identified as a resource within one process can be recognised as the same object even though it is identified as a product within a second process.

NOTE 2 PSL is based on first order logic; as such, it follows significantly different methods for specifying semantics for modelling concepts than those used in ISO 10303. The meaning of the concepts defined within PSL follows from sets of axioms and definitions provided within each extension of PSL-Core. A set of supporting notes and examples are provided within each part to aid the understanding of the language.

