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Standardized product ontology register and transfer by spreadsheets –
Part 5: Interface for activity description

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Enregistrement d'ontologie de produits normalisés et transfert par tableurs –
Partie 5: Interface pour la description des activités

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Standardized product ontology register and transfer by spreadsheets –
Part 5: Interface for activity description

Enregistrement d'ontologie de produits normalisés et transfert par tableurs –
Partie 5: Interface pour la description des activités

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

STANDARDIZED PRODUCT ONTOLOGY REGISTER AND TRANSFER BY SPREADSHEETS –

Part 5: Interface for activity description

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The text of this International Standard is based on the following documents:

CDV	Report on voting
3D/257/CDV	3D/287/RVC

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.

A list of all parts in the IEC 62656 series, published under the general title *Standardized product ontology register and transfer by spreadsheets*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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STANDARDIZED PRODUCT ONTOLOGY REGISTER AND TRANSFER BY SPREADSHEETS –

Part 5: Interface for activity description

1 Scope

This part of IEC 62656 specifies a method for representing activities and relations among the activities by a tabular ontology representation, called “parcellized activity model” or PAM for short, which is a specialized use of a generic tabular ontology data model, known as the parcellized ontology model (POM) defined in Part 1 of the IEC 62656 series. The activities that can be described by this document include part or whole of an enterprise, an organization or a collection of services, a set of events or processes which interact with each other by exchanging physical or non-physical entities. This part of IEC 62656 also defines a method for uniquely identifying activities, or their homologues happenings in a certain sequence. In addition, this document identifies flows of information, objects or materials exchanged among activities, where each of the activities is represented by a class and each flow by a relation.

Consequently, this document enables characterization, classification, and identification of a set of activities as part of a normalized ontology. And this enables registering of a pattern of activities as a set of metadata and uploading it onto the IEC 61360 Common Data Dictionary (CDD), maintained as an online database of the electrotechnical concepts.

Additionally, this part of IEC 62656 provides a method to integrate ontologies of products and activities including services, in a single model. This means a product can be analyzed in its operational context for service. Such an integrated view will help people of different technical backgrounds to see and share knowledge about the extent of an enterprise that requires the products and services as indispensable resources. Such a data representation will also help analyse the key functionalities of an enterprise and its available resources, with clear definitions, limitations and interactions among them, when people are required to respond or react to a new external condition or situation in a short time frame, in particular, at an emergency or natural hazard.

Meanwhile, this part of IEC 62656 does not intend to provide a detailed algorithmic description of a flow of information, timing chart of processes, or sequential ordering of events that will be necessary in a software design or programming phase of an information system that handles activities or events. These detailed specifications of the algorithms and associated construction of the data structures are left to the realm of software engineering methodology and tools where there are so many schools and styles already, such as UML (Unified Modelling Language), BPMN, SysML, DFD, IDEF, and other CASE (Computer Aided Software Engineering) tools.

This International Standard neither intends to standardize nor introduce a new method of graphic description for activities or processes. Ideally, an ontology of activities modelled by this International Standard must be expressible by a number of existing graphical presentation tools and process description languages for activities.

Nevertheless, some graphical presentations in the style of such tools or languages are helpful for making the people understand the content of the PAM, and therefore, they are used in this International Standard. In most of the cases, IDEF-0 is preferred for the purpose, because it describes both activities and flows of things among the activities, but any other choices of tools or languages can be made, wherever they are appropriate and relevant.

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.

IEC 61360-2:2012, *Standard data element types with associated classification scheme for electric components - Part 2: EXPRESS dictionary schema*

IEC 61360-4, *Standard data element types with associated classification scheme for electric components – Part 4: IEC reference collection of standard data element types and component classes* (available at <http://cdd.iec.ch/>)

IEC 62656-1, *Standardized product ontology register and transfer by spreadsheets – Part 1: Logical structure for data parcels*

IEC 62264-3:2007, *Enterprise control system integration – Part 3: Activity models of manufacturing operations management*

ISO 13584-24, *Industrial automation systems and integration – Parts library – Part 24: Logical resource: Logical model of supplier library*

ISO 13584-42:2010, *Industrial automation systems and integration – Parts library – Part 42: Description methodology: Methodology for structuring part families*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 13584-24 and IEC 62656-1, as well as the following 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 activity

organizational, logical or conceptual unit for performing a set of specific actions or functionalities

Note 1 to entry: An activity can be just for performing one action or functionality, and in an extreme case, for zero action or functionality, meaning the activity is just an endpoint for terminating activities.

Note 2 to entry: An activity is not necessarily a process in time sequence in the PAM. Two or more activities may concurrently work and interact with each other.

3.1.2 arrow

mapping from one category of things to another, yielding an information flow, a movement of physical items, a change of states from one state to another, or a directional correspondence from one collection of things to another, which is embodied as a functional relation

Note 1 to entry: Arrow as an information construct in this part of IEC 62656 embodies an mathematical entity named "arrow" originating in the category theory of mathematics, which is synonymous with function, but maps elements of one collection specified as "domain" to another collection specified as "codomain", with a strong sense of direction.

Note 2 to entry: Arrows can also be used in a formula, such as in $F : X_1 \times X_2 \times \dots \times X_n \rightarrow X_{n+1}$ where an

arrow exists as the mapping F from an n -ary set $X_1 \times X_2 \times \dots \times X_n$ to X_{n+1} .

3.1.3

arrow overloading

specialization of an arrow by narrowing or detailing either one of or both of the domain and codomain of the arrow, being considered as a function

Note 1 to entry: Overloading of an arrow typically takes place on the frame boundary of a diagram in a lower node of an activity.

3.1.4

aspect

way things appear, are looked at or expressed as an association among properties, classes, or ontological elements in general, by the use of a relation

Note 1 to entry: A property may belong to one or several aspects.

3.1.5

branching point

forking point

point from which an arrow forks out into two or more arrows

3.1.6

connection point

point at which arrows or lines fork out, or at which several arrows or lines meet each other

Note 1 to entry: Both branching point and junction points are included in the connection points.

3.1.7

IDEF0

Integration Definition for Function Modelling

graphical language to model decisions, actions, and activities of an organization or system, defined in the IDEF series of data modelling methods

Note 1 to entry: IDEF0 was once adopted as Federal Information Processing Standard (FIPS) 183 by ANSI (American National Standards Institute). However, it was withdrawn from FIPS in 2012, for it is no longer necessary to designate only one method among many as the graphical language for modelling activities.

Note 2 to entry: This note applies to the French language only.

3.1.8

ontology

shared and formal modelling of knowledge about a domain

3.1.9

parcellized ontology model

POM

formal specification of being of things as a concept, including state of things and configuration of things, by their properties and relations, formed in a set of relational tables each of which represents a category of the ontological entities

Note 1 to entry: Parcellized ontology model is formally specified in IEC 62656-1.

Note 2 to entry: Examples of the categories of the ontological entities are class, property, relation, datatype, unit of measurement, etc., which are essential constructs for the description of being.

Note 3 to entry: This note applies to the French language only.

3.1.10**parcellized activity model****PAM**

specialized use of the parcellized ontology model defined in IEC 62656-1 for representing an activity as part of an ontology

Note 1 to entry: This note applies to the French language only.

3.1.11**service**

activity performed or being performed for the purpose of someone or something

Note 1 to entry: Usually an activity is performed else than for oneself or for itself.

3.1.12**subactivity**

subcomponent of an activity

Note 1 to entry: One activity can be broken down into several subactivities. They can be a set of diachronical divisions of an activity, as well as a set of synchronical divisions of an activity. For example, a collaborative work done by different task forces of an enterprise.

3.1.13**transcendent arrow**

arrow that enters into an activity and interacts with some or all of its subactivities

Note 1 to entry: A transcendent arrow may be forking into multiple arrows or joining another in a lower node frame.

3.2 Abbreviations

For the purposes of this document, the following abbreviations apply.

BPML	Business Process Modelling Language
BPEL	Business Process Execution Language
BPMN	Business Process Modelling Notation
CDD	Common Data Dictionary
DFD	Data Flow Diagram
KPI	Key Performance Indicator
POM	Parcellized Ontology Model
SysML	Systems Modelling Language
UML	Unified Modelling Language

4 Overview**4.1 Activity described as an ontology**

According to an acknowledged web resource, ontology is an explicit and formal specification of conceptualization in a domain. If ontology is such, then an activity should be definitely a part of the ontology. For an activity usually has an objective, ways and means to achieve the objective, person or organization to be engaged, time, financial constraints and requirements to be observed. In addition, an activity has a relationship to other activities, having them as prior or posterior activities with which it may exchange information, goods or material. Such an activity may have child or subactivities that assume part of the role or objectives of the main activity. Moreover, some patterns of activities are repeatedly performed, so they can be considered as a model and its instances. Furthermore, an activity is often a collaborative process conducted in plural languages by different peoples of different countries on different continents, with a plethora of cultural backgrounds and traditions. In consequence, there are ample needs and necessities to share understanding about activities in an internationally

normalized manner with their identification, canonical properties and concepts being expressed in a machine sensible way.

The parcellized activity model (PAM) is a specialized use of the parcellized ontology model (POM), defined in IEC 62656-1, for the purpose of modelling an activity or a set of activities and possible interactions among them, with the data structure provided by the latter standard. In the PAM, activities are expressed by classes whilst the flows of information, goods and materials among activities are expressed by functional relations, with which not just information flow but also the flow of products, materials and personnel can be included into the scope of the model. This contrasts clearly with some other activity models that allow only the information to be exchanged among the activities. However, the PAM is not intended as a language for graphical presentation of the activities; for such a purpose there are already BPML, BPEL, BPNM, IEDF0 and DFD, etc. Neither, the model is intended as a means to write a flow chart or algorithmic diagram for designing a specific software application. Rather it is designed to share a common understanding about the characteristics of activities and the relations among them as a set of metadata, in other words, classes and properties of an ontology expressible in a standard format of ontology, which allows text based queries. Yet the metadata are also expected to be in a way translatable and graphically reproducible in at least one of the graphical presentation languages of activities, or in an appropriate combination of them. Here, the language we selected for primary translation is IDEF0. But the PAM is not a data model exclusive to the language. Rather, it is designed as a means to coordinate ontologies of products, services and activities together. Thus it is a prerequisite that the description by the PAM must be well coordinated with the ontologies of products and materials that have been stored and maintained in the common metadata registry of IEC, i.e., the IEC 61360-4 DB, or so called “IEC CDD” or sometimes more simply, “CDD”(Common Data Dictionary), for which the Parcel series of standards provides input and output interfaces and its model extension.

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4.2 Use cases and key technical concepts

The principal applications of this document might be in the field of engineering. However, importance of guiding or assisting people in visiting places by handy electrotechnic means is not limited to the engineering, but well recognized for a wide range of industrial activities, including process automation, agriculture, fishery, hazard prevention, jurisdiction, defence, transportation, medicine, nursery and tourism. Whilst a pattern of specialized engineering activities is comprehensible only within a limited number of experts of the domain, a holiday visit to an art museum can be understood by much a larger audience or readers. Thus, for illustration purpose, an activity to “see fine arts at museum” is picked up for the first example in 4.3 as an exemplary use case, because most of the readers must have visited some museum more than once to see fine arts in their lifetime. And we expect they must have had a similar experience, seeing different genres of arts at different locations where local people speak different languages. En suite, we deliver a use case that lies in the midst of the process automation, i.e., an ontological description of a segment of the activities of enterprise-control system integration, described in IEC 62264-3, which latter is often touted as a cornerstone of the smart manufacturing.

Figure 1 illustrates how a touristic activity to see fine arts at a museum can be modelled as an ontology. Under a generic activity named “See fine arts at museum”, there are two types of hierarchy; one is a “specialization tree” or so called “is-a” tree that has a small open triangle at the head of the relation line in the diagram, another is a “composition tree” or “part-of” tree that shows how an activity can be decomposed into sub-parts, which is represented by a relation line with a black diamond at the head. Of course, properties that are held by a generic activity shall be inherited into specialized activities in the case of specialization hierarchy. In the given case, the activity to “see fine arts at museum” may have, for example, “language(s) for arts description”, “admission fee”, “open hours”, and “genres of arts” and they are uniformly inherited into specialized activities, such as an activity to “see fine arts at American museum”, to “see fine arts at French museum”, to “see fine arts at Japanese museum”, and to “see fine arts at Spanish museum” in the same way. Ultimately at all leaf nodes, be it an activity to see arts at a globally renowned big French museums like Musée du Louvre or Musée d'Orsay, or to see some select arts at a Japanese city local museum of a reasonable scale, like the ones at Kagoshima city museum of arts, the properties are inherited from the

generic activity to “see fine arts at Museum” in the same manner. Only the parametric values of them are different. In addition to those inherited properties, there shall be some native properties that distinguish one activity from another. In exception of those properties, basic components of the activities of the generic activity, depicted as yellow boxes in Figure 1, are the same as those specialized activities at leaf nodes; for basically at every museum, you have to get a ticket or pass, then get admitted into an exhibition, visit some art halls in series, then you may exit from the exhibition at one of the art halls. Note that an arrow means people spread among activity boxes (marked in yellow) move from one activity at the source of an arrow to another at the destination of the arrow, rather than a description of a sequence of actions for one person.

Figure 2 shows a typical example of a set of standardized industrial activities extracted from IEC 62264-3 (Figure 14 in the original) that is expressed by means of DFD. Figure 3 is a figure in IDEF0 which corresponds to Figure 2, and in line with the PAM specification according to IEC 62656-5. According to IEC 62264-3, all production activities in manufacturing can be patterned after the model depicted in Figure 2, and each specialized manufacturing should be adequately explained by a specialization of the diagram. Here, the readers should not misconstrue the objective of this use case; it is not intended to claim that the content of IEC 62264-3 is replaceable by a functionality of the PAM. Rather it is simply to state that significant part of the semantic content of IEC 62264-3 can be translated and reproduced in a form of ontology data and can be stored and maintained in IEC CDD by means of the PAM, which enables interaction and cross references with the related product definitions stored in the CDD. Incidentally, the readers are reminded that the internal communication flows, such as operational commands, depicted in Figure 2 between the current level (level 3) of enterprise-control and the level 1 and level 2 functions according to the respective definitions in IEC 62264-3 are removed from Figure 3 because they shall be elaborated when the “Production execution management” indexed as A5 in Figure 3 is unfolded into subactivities in the PAM, as a base node for unfolding. Since the PAM itself is not a graphic presentation language for activities, the figures and diagrams are the work created by tools and applications that interpret the ontology data according to IEC 62656-5. Nevertheless, In Annex C, a set of sample data according to IEC 62656-5 are included (Figure C.1 through Figure C.), which semantically correspond to Figure 3. In addition, some actual examples of auto-generated figures from the PAM are shown in Annex C (Figure C.4 and Figure C.5).

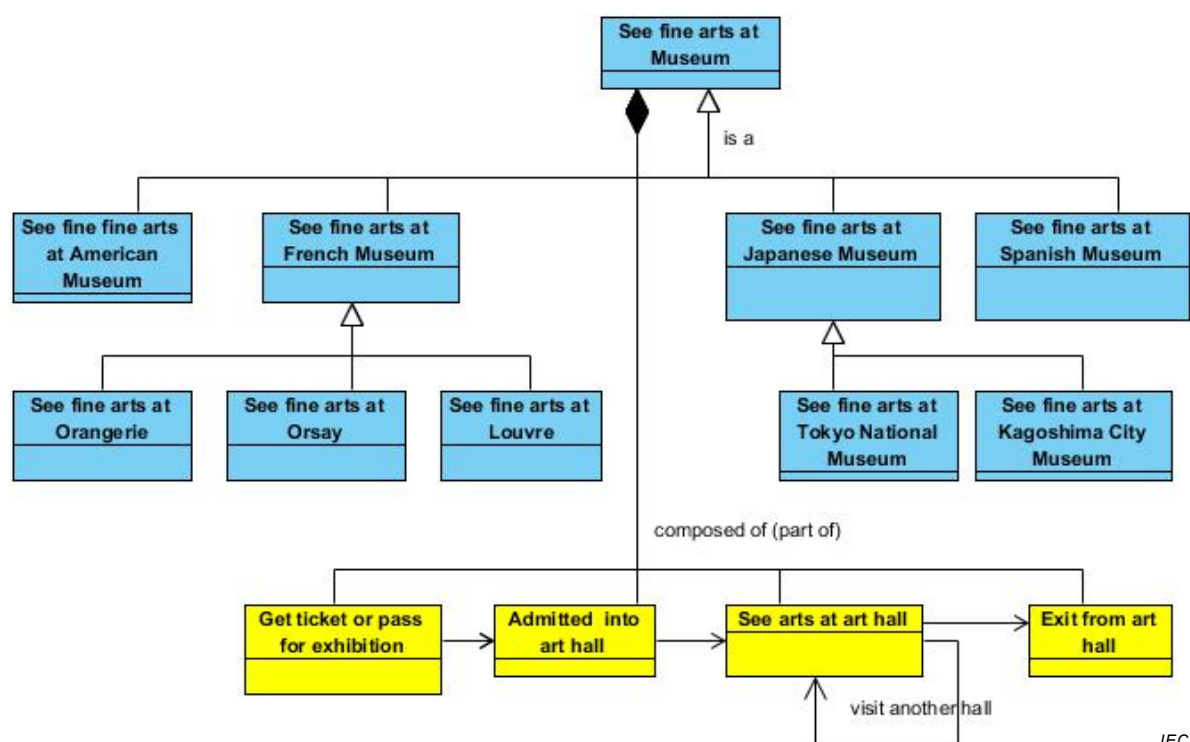
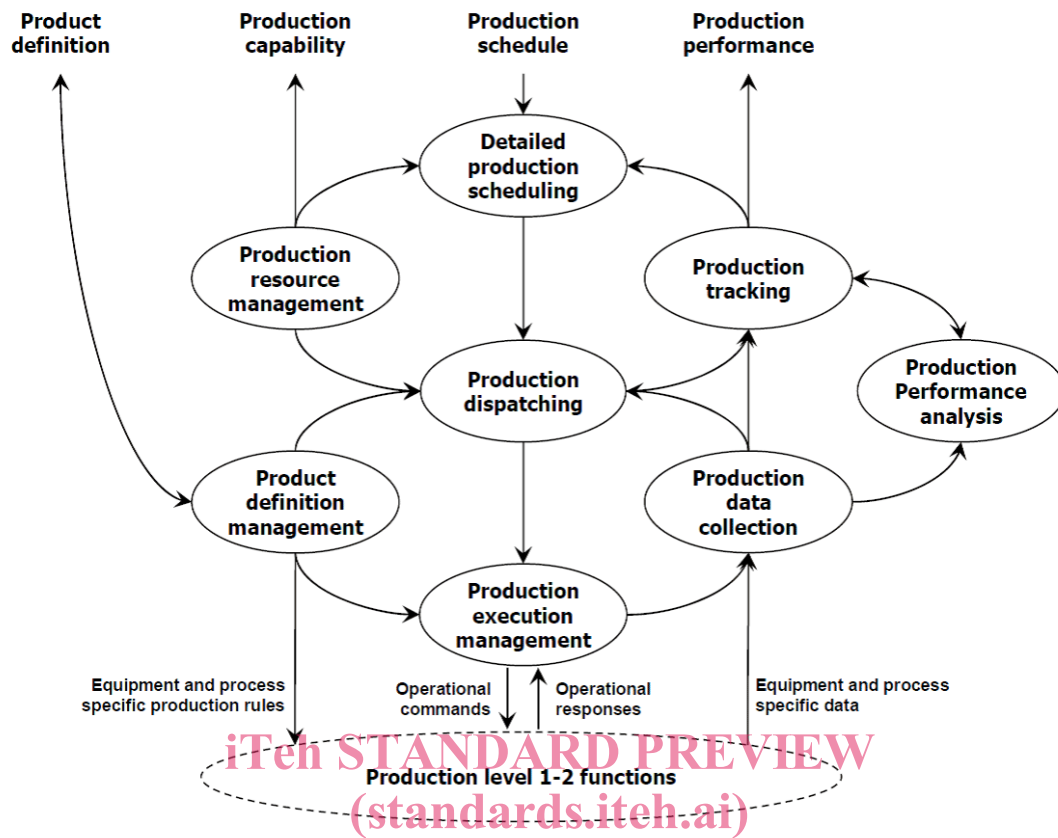


Figure 1 – See fine arts at Museum



IEC 62656-5:2017
 Figure 2 – Production operations management (extracted from IEC 62264-3)
<https://standards.itech.ai/catalog/standards/sist/17a90868-7511-4c7a-bcd1-0de2dd3dd323/iec-62656-5-2017>

IEC



Figure 3 – Production operations management modelled in PAM and depicted as IDEF-0 diagram