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Industrial automation systems and integration — Integration of life-cycle data for process plants including oil and gas production facilities

Part 13: Integrated asset planning life-cycle

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee AMT/4, Industrial data and manufacturing interfaces.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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First edition
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Industrial automation systems and integration — Integration of life-cycle data for process plants including oil and gas production facilities

Part 13: Integrated asset planning life-cycle

Systèmes d'automatisation industrielle et intégration — Intégration de données de cycle de vie pour les industries de "process", y compris les usines de production de pétrole et de gaz —

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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 of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 184, *Automation systems and integration*, Subcommittee SC 4, *Industrial data*.

A list of all parts in the ISO 15926 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

ISO 15926 is an International Standard for the representation of process industries facility life-cycle information. This representation is specified by a generic, conceptual ontology that is suitable as the basis for implementation in a shared database or data warehouse. This ontology is defined in ISO 15926-2, and has an OWL (Web Ontology Language) representation defined in ISO/TS 15926-12. ISO 15926-2 and ISO/TS 15926-12 are intended to be used as a foundation for domain specific extensions defined in other parts of ISO 15926.

The ontology is designed to be used in conjunction with reference data, i.e. standard instances that represent information common to a number of users, production facilities, or both. The support for a specific life-cycle activity depends on the use of appropriate reference data in conjunction with the ontology.

This document specifies an extension to the generic, conceptual ontology to support integrated planning for assets throughout their life-cycle. The ontology enables the integration of planning data from different sources within a company database.

The ontology is represented in OWL. This document also specifies an XML schema definition (XSD) for a machine-readable exchange of data used for asset planning.

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Industrial automation systems and integration — Integration of life-cycle data for process plants including oil and gas production facilities —

Part 13: Integrated asset planning life-cycle

1 Scope

This document specifies an ontology for asset planning for process plants, including oil and gas production facilities. In addition, it specifies an XML schema, derived from the ontology, for exchange of data used for asset planning.

The following are within the scope of this document:

— portfolio, programme and project plans and schedules;

— operational modification and ongoing maintenance plans and schedules;

— calendars for plan execution;

— constraints on the temporal relationships between items within plans and schedules, including succession link, lag, free and total float;

— activity breakdown structures;

— locations of activities;

— resources required, including material, equipment and human resources, and their costs;

— interfaces to systems that process work orders and purchase orders;

— responsible organizations and people;

— progress tracking and resource usage;

— reference to standard classes of facility, activity and resource.

EXAMPLE Standard classes are defined in ISO 19008.

The following are outside the scope of this document:

— standard classes of facility, activity and resource;

NOTE ISO 19008 contains such standard classes.

— production planning;

— plan simulation and optimization;

— hazard identification and risk analysis;

— manning and training of personnel;

— budgeting and cost allocation.

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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/TS 15926-12:2018, *Industrial automation systems and integration — Integration of life-cycle data for process plants including oil and gas production facilities — Part 12: Life-cycle integration ontology*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 15926-12 and the following apply.

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

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

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

3.1.1
activity
individual that is something happening or changing

Note 1 to entry: The ISO/IEC/IEEE 15288:2015 definition of "activity" as "set of cohesive tasks of a process" implies a hierarchy in which processes contain activities, and activities contain tasks. Within this document, all are activities.

Note 2 to entry: The definition in the PMI Lexicon of Project Management Terms states that "activity" is an element of work performed during the course of a project. An activity normally has an expected duration, an expected cost, and expected resource requirements. Activities can be subdivided in tasks.

[SOURCE: ISO/TS 15926-12:2018, 3.1.1, modified — Notes to entry have been added.]

3.1.2
asset planning
planning that is for the construction, commissioning, refurbishment, maintenance, decommissioning, and disposal of assets, including the running down and starting up of production by assets

3.1.3
baseline schedule
schedule that is used by a planning activity as a reference basis for comparison to monitor and control progress on the planned activity

Note 1 to entry: The PMI Lexicon of Project Management Terms defines baseline schedule as "the approved version of a schedule model that can be changed using formal change control procedures and is used as the basis for comparison to actual results".

Note 2 to entry: A baseline schedule is a specialization of the ISO/IEC/IEEE 15288:2015 definition of "baseline" as "formally approved version of a configuration item, regardless of media, formally designated and fixed at a specific time during the configuration item's life-cycle".

[SOURCE: ISO 21500:2012, 2.3, modified]

3.1.4
calendar
pattern of working days and shifts that are available for scheduled activities

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3.1.5
current schedule
schedule of the planned activity that is currently specified as the agreed working schedule by a planning activity to the performer of the planned activity

Note 1 to entry: ISO 21500:2012 specifies that the role of a current schedule is to avoid adverse schedule impact.

3.1.6
decision gate
activity that approves continuation

Note 1 to entry: Continuation of work beyond a decision gate is contingent on the agreement of the decision-makers.

Note 2 to entry: Criteria for continuation of abandonment are established for each decision gate.

3.1.7
early finish
earliest possible point in time when the uncompleted portions of the activity can finish based on the schedule

[SOURCE: PMI Lexicon of Project Management Terms]

3.1.8
early start
earliest possible point in time when the uncompleted portions of the activity can start based on the schedule

[SOURCE: PMI Lexicon of Project Management Terms]

3.1.9
finish to finish
successor relationship in a plan that is from the finish of one activity to the finish of the next

3.1.10
finish to start
successor relationship in a plan that is from the finish of one activity to the start of the next

3.1.11
free float
period of time into which an activity in a plan can overrun without causing a delay to subsequent activities in the plan

3.1.12
frontline date
date on which the achieved progress on an activity was scheduled

3.1.13
lag
period in time that is specified for a plan succession link

Note 1 to entry: This corresponds to the attributes “lead” and “lag” which are defined in ISO 21500:2012.

3.1.14
late finish
latest point in time that an activity can finish based on the schedule

3.1.15
late start
latest point in time that an activity can start based on the schedule

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3.1.16
live schedule
schedule that has been revised from the current schedule to mitigate any delays

3.1.17
managed programme of work
activity that contains management and planning for the whole

3.1.18
milestone
event that is significant in a project, programme of work, or portfolio

[SOURCE: PMI Lexicon of Project Management Terms]

3.1.19
ontology
formal statement of an understanding of the world

Note 1 to entry: An ontology can be represented in any language. It need not be represented in a language specifically designed for ontologies, such as OWL. An ontology can have different representations.

Note 2 to entry: An ontology does not specify what data need to be recorded about the world.

Note 3 to entry: The ontology defined by this document is principally concerned with the world outside a computer system.

[SOURCE: ISO/TS 15926-12:2018, 3.1.3]

3.1.20
plan
specification of how an activity will be done

Note 1 to entry: A plan can include the following:

— a breakdown into component activities;

— resources required by component activities;

— durations of component activities;

— required dates for milestones;

— succession relationships and lags between component activities;

— calendars for activities, resources and lags;

— start and end dates for component activities.

Note 2 to entry: An unscheduled plan does not contain start and end dates for component activities. A schedule does contain start and end dates for component activities.

Note 3 to entry: Plan corresponds to the term design (noun) defined in ISO/IEC/IEEE 15288:2015, where the design is for an activity rather than for a system or system element.

Note 4 to entry: A plan can be more or less detailed.

Note 5 to entry: The PMI Lexicon of Project Management Terms defines “project management plan” as “the document that describes how the project will be executed, monitored and controlled, and closed.”

3.1.21
plan succession link
succession relationship between one activity or milestone and the next in a plan

Note 1 to entry: A plan succession link has the attributes “lead” and “lag” which are defined in ISO 21500:2012.

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3.1.22
planning
activity that is creating a plan

Note 1 to entry: Planning corresponds to the term design (verb) defined in ISO/IEC/IEEE 15288:2015, where a plan for an activity, rather than a design for a system or system element, is created.

3.1.23
project
activity with defined start and finish criteria undertaken to create a product or service in accordance with specified resources and requirements

Note 1 to entry: A continuing operational activity is not a project.

Note 2 to entry: A project has a beginning and end, and can be constrained by available time, funding and resources.

Note 3 to entry: In many cases an activity that is planned consists of parts of different projects with different objectives. Therefore the activity is not a project.

Note 4 to entry: Product here is a result of the project activity, not directly related to Product Breakdown Structure.

[SOURCE: ISO/IEC/IEEE 15288:2015, 4.1.33, modified — The word "endeavour" has been replaced with "activity" at the start of the definition and the Notes to entry have been modified.]

3.1.24
resource
individual that is used to perform an activity

Note 1 to entry: A resource can be material or staff time or equipment.

3.1.25
revised schedule
schedule that has been revised from the current schedule

3.1.26
revision shutdown
shutdown that is in order to make a change to a production activity

3.1.27
schedule
specification of an activity that contains all that is required as a basis for execution, and that specifies start and end dates for component activities

Note 1 to entry: A schedule is the end product of a planning activity at a point in time. A schedule can be revised as a project progresses.

Note 2 to entry: A schedule includes calendars, succession relationships, and all other constraints.

3.1.28
standard class
class whose specification for membership is owned or controlled by a standardization body and is publicly available

[SOURCE: ISO 15926-1:2004, 3.1.2, modified — The Note to entry and examples have been deleted.]

3.1.29
start to finish
successor relationship in which a successor activity cannot finish until a predecessor activity has started

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3.1.30
start to start
successor relationship in which a successor activity cannot start until a predecessor activity has started

3.1.31
subject of work
physical object that an activity is carried out upon

3.1.32
total float
period of time into which an activity in a plan can overrun without causing a delay to the completion of the plan as a whole

3.1.33
work order
managed programme of work that contains a request from one party to another for one or more activities to be performed

3.2 Abbreviated terms

COR	Code Of Resources
EF	Early Finish
ES	Early Start
FF	Finish to Finish
FNET	Finish No Earlier Than
FNLT	Finish No Later Than
FS	Finish to Start
LF	Late Finish
LS	Late Start
MFO	Must Finish On
MSO	Must Start On
OMG	Object Management Group
OWL	Web Ontology Language
PBS	Physical Breakdown Structure
RDF	Resource Description Framework
RDL	Reference Data Library
SAB	Standard Activity Breakdown
SAWSDL	Semantic Annotations for WSDL and XML Schema
SF	Start to Finish
SKOS	Simple Knowledge Organization System
SNET	Start No Earlier Than

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SNLT	Start No Later Than
SS	Start to Start
TURTLE	Terse RDF Triple Language
UML	Unified Modeling Language
IRI	Internationalized Resource Identifier
UTC	Coordinated Universal Time
W3C	The World Wide Web Consortium
XML	eXtensible Mark-up Language
XSD	XML Schema Definition

3.3 Symbols

This document contains examples with diagrams which show instantiations of ISO 15926. The concise notation is used for these diagrams as defined in Figure 1.

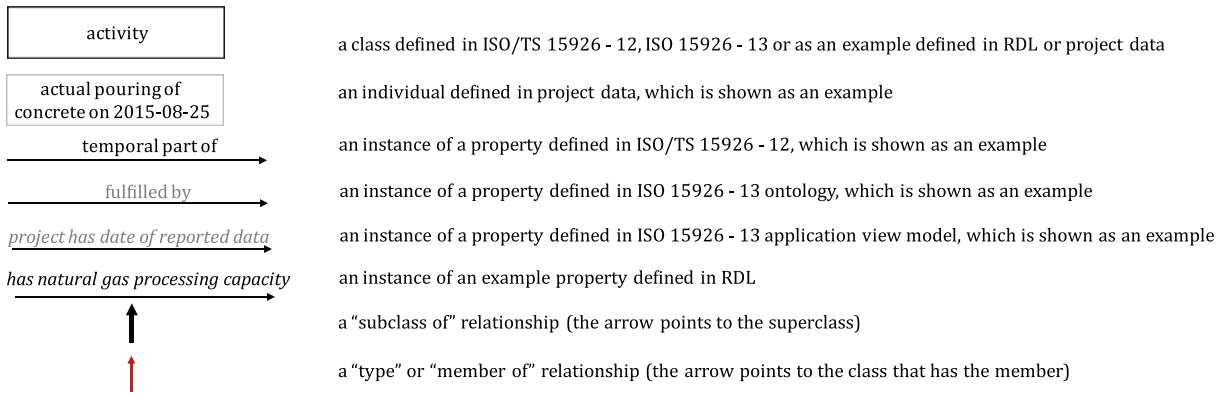

Figure 1 — Notation for the ISO 15926 instantiation examples

NOTE ISO/TS 15926-12 implements the ISO 15926-2 entity **composition of individual** by the OWL object properties **lci:hasPart** and **lci:partOf**. ISO/TS 15926-12 partially implements the ISO 15926-2 entity **class of composition of individual** by the OWL object properties shown in Figure 2.

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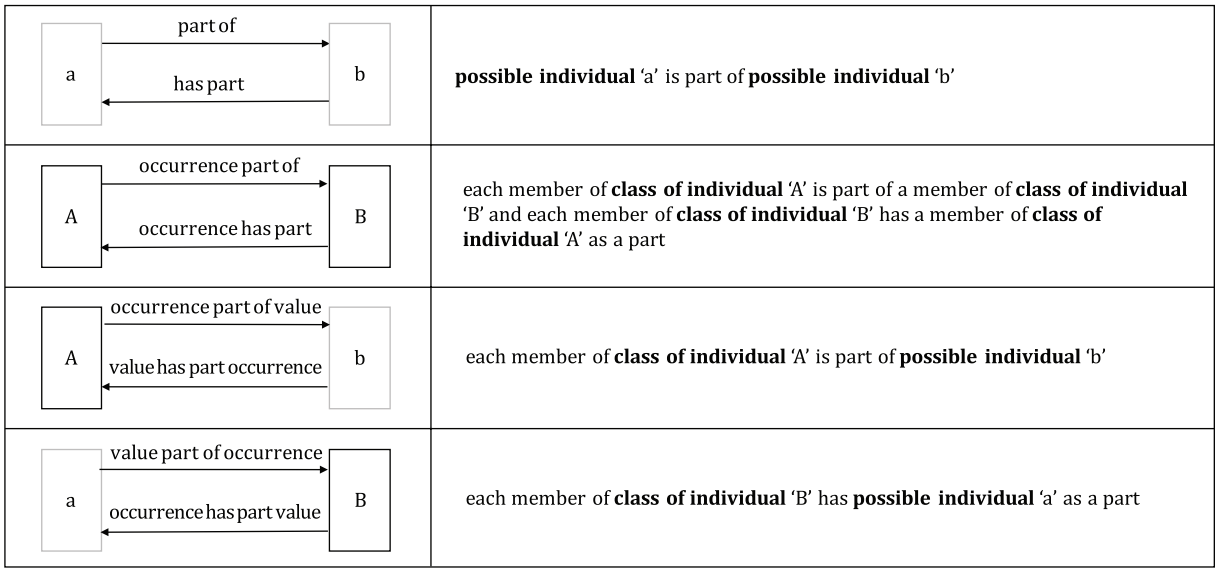

Figure 2 — Naming convention for composition and class of composition

The naming convention is used as follows:

— the **activity** 'actual pouring of concrete for the refurbishment of facility F-101' has **part of** relationship with the **activity** 'actual refurbishment of facility F-101';

— the **plan for activity** (a class) 'plan for pouring of concrete for the refurbishment of facility F-101 version 2' has an **class part of occurrence** relationship with the **plan for activity** 'plan for the refurbishment of facility F-101 version 2'.

The use of the composition properties is shown in Figure 3.

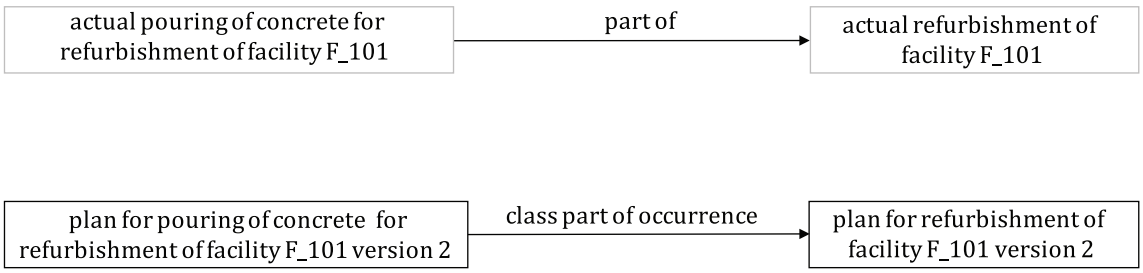

Figure 3 — Use of composition properties

4 Layers and extension of integrated asset planning life-cycle data

4.1 Layers for integrated asset planning life-cycle data

The approach to integrated asset planning life-cycle data defined by this document has the layers shown in Figure 4.

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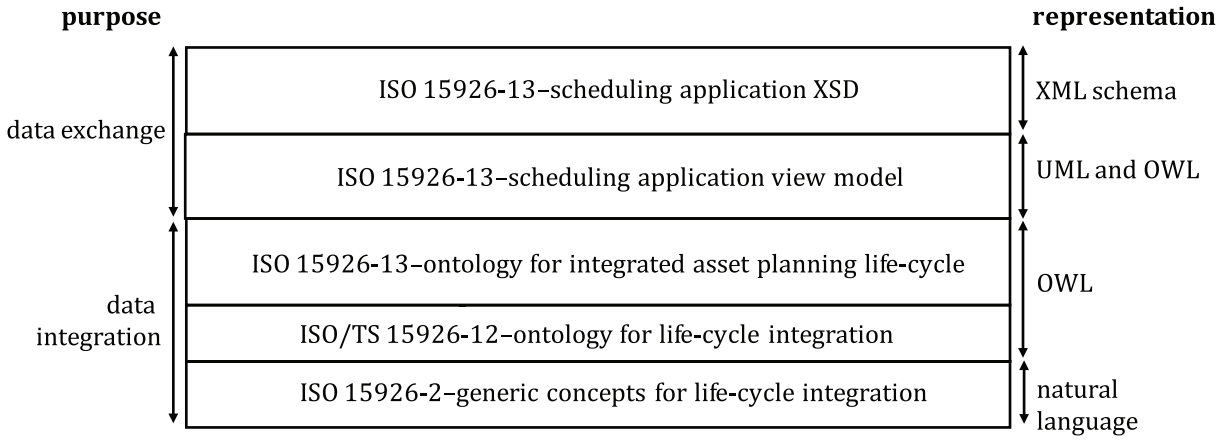

Figure 4 — Layers for integrated asset planning life-cycle

These layers are as follows:

— ISO 15926-2 defines the concepts that support the representation of engineering data throughout its life-cycle;

— ISO/TS 15926-12 represents the concepts defined in ISO 15926-2 using OWL;

— the ontology in this document imports ISO/TS 15926-12 and extends it with additional concepts required for planning.

This ontology can be used to define a database of planning data.

— The scheduling application view model in this document defines an external view of planning data that is appropriate for scheduling applications. This view model has a limited scope with a defined set of properties.

  The view model is expressed as UML diagrams, and in a scheduling application view ontology. This view ontology defines classes with epistemological constraints and template properties that hide objects which are not part of the view.

— The scheduling application XML schema in this document defines a physical file format for exchange between scheduling applications or between a scheduling application and a database of planning data. The XML schema is derived by algorithm from the OWL representation of the scheduling application view model.

4.2 The documentation of the layers

The documentation of the layers, starting at the bottom of Figure 4, is as follows.

— **Ontology for integrated asset planning life-cycle**: The planning ontology is described in Clause 5. Implementation of the planning ontology in OWL shall use the representation of the ontology in Clause A.1.

  NOTE 1 This clause contains numerous examples.

— **Scheduling application view model**: The scheduling application view is described in Clause 6. Implementation of the scheduling application view in OWL shall use the representation of the ontology in Clause A.3.

  NOTE 2 Although the scope of the ontology within this document is greater than that of the view, this clause can serve as an introduction to this document as a whole. The data planning diagrams in 6.4 are especially useful as an introduction.

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The template properties that hide objects which are not part of the view in the scheduling application view are listed in Clause 6. The OWL ontology for the scheduling application view is on the Web with a link in Clause A.3.

— **Scheduling application XML schema**: The scheduling application XML schema is derived from the scheduling application view ontology. The representation of planning data in XML for exchange with a scheduling application shall use the XML schema in Annex B.

4.3 Use of the layers

The layers are used as follows:

— **exchange of data**: Data can be exchanged as a document using the scheduling application XML schema, or as a serialization of data recorded using the scheduling application view model ontology.

NOTE 1 Possible serializations formats for data recorded using the ontology include TURTLE and JSON.

— **sharing of data**: Data can be shared by database implementations of the ontology for integrated asset planning life-cycle.

NOTE 2 Data recorded using the ontology can be held in a triple store.

NOTE 3 Usage scenarios are discussed in Annex F.

4.4 Extensions for particular engineering applications

The classes and relationships defined in ISO 15926-2 and this document may be extended for particular engineering applications.

NOTE 1 Extensions can be defined in other standard or community ontologies. The interfaces to reference data libraries are listed in Annex E.

EXAMPLE 1 ISO/TS 15926-4 defines “meter” and “pump”, which are specializations of the generic class “physical object” defined in ISO 15926-2. The class “pumping equipment” is an extension, which is defined in ISO 19008.

For an OWL implementation of this document, an extension for a particular engineering application may be contained in an imported ontology that has been integrated with ISO 15926 in accordance with ISO/TS 15926-6.

NOTE 2 Extensions for the process industry defined in ISO/TS 15926-4 are already integrated with ISO 15926. Extensions defined in other standards will need to be integrated with ISO 15926 by the user. Quality requirements for the integration of an ontology that extends ISO 15926 are defined in ISO/TS 15926-6.

EXAMPLE 2 ISO TS/15926-6 requires that each class is a subclass of a class defined within ISO 15926-2. This give a basic level of quality. An imported ontology for human resources has the classes “stress engineer”, “piping engineer”, and “instrumentation engineer”. Integration would make these classes subclasses of **person**. This would prevent incorrect use of these classes to classify a member of **activity** or **inanimate physical object**, because these classes are disjoint with **person**.

For an XML implementation of this document, a class or property that is an extension for a particular engineering application may be referenced as an **identified object**.

NOTE 3 An identified object can be identified by an IRI that provides a link to a reference data library. Alternatively can be merely given a label and text description.

4.5 Simplification for a scheduling application view

The scheduling application view model is a representation of the data at a particular instant in time.

NOTE The view model is a simplification of the full ontology for the integration of life-cycle asset planning, which has been obtained by removing objects that are needed to record how data changes with time.

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Two instantiations of the scheduling application view model for different times cannot be merged unless the data is transformed into a representation according to the full ontology for the integration of asset planning life-cycle. This is because the objects that distinguish between the different times are not part of the view model.

The scheduling application view model contains template view properties which:

— impose epistemological constraints to ensure that the data is complete for a scheduling application;

— hide objects in the ontology for the integration of life-cycle asset planning that are unnecessary for the scheduling application.

EXAMPLE A required **activity** has the template view property **activity has actual current percentage complete**. The **activity** "pouring of concrete for refurbishment of facility F_101" has a percentage complete of 50 % on 2015-11-05T18:00 and of 80 % complete on 2015-11-06T18:00. These two different percentages complete can be recorded in two different instantiations of the scheduling application view model. A single instantiation of the scheduling application view model is shown in Figure 5.

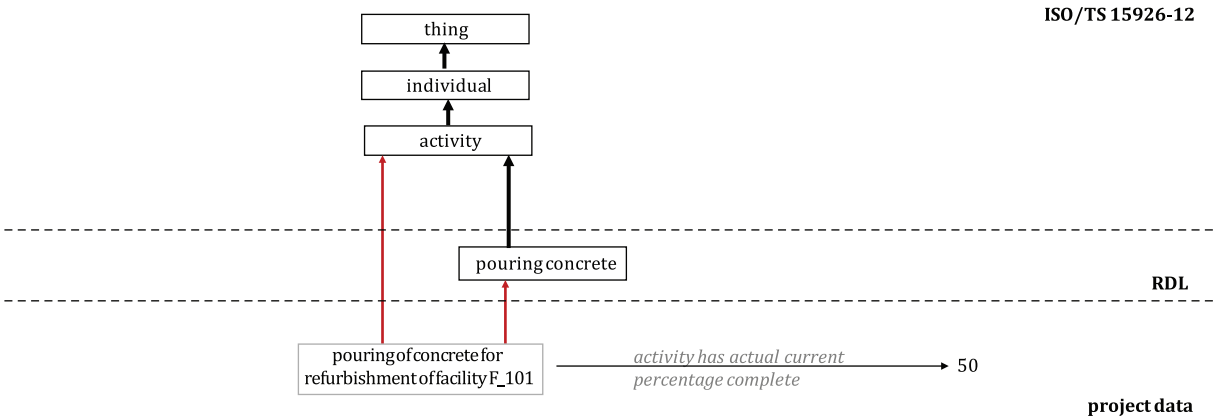

Figure 5 — An instantiation of the scheduling application view model

In order to record the two percentages complete within a single database, it is necessary to use the full ontology. The full ontology records that the required **activity** "required pouring of concrete for refurbishment of facility F_101" specified in the **schedule** is realized by an actual **activity** "actual pouring of concrete for refurbishment of facility F_101" which has different temporal parts terminating at 2015-11-05T18:00 and 2015-11-06T18:00 with different percentages complete. This is shown in Figure 6.

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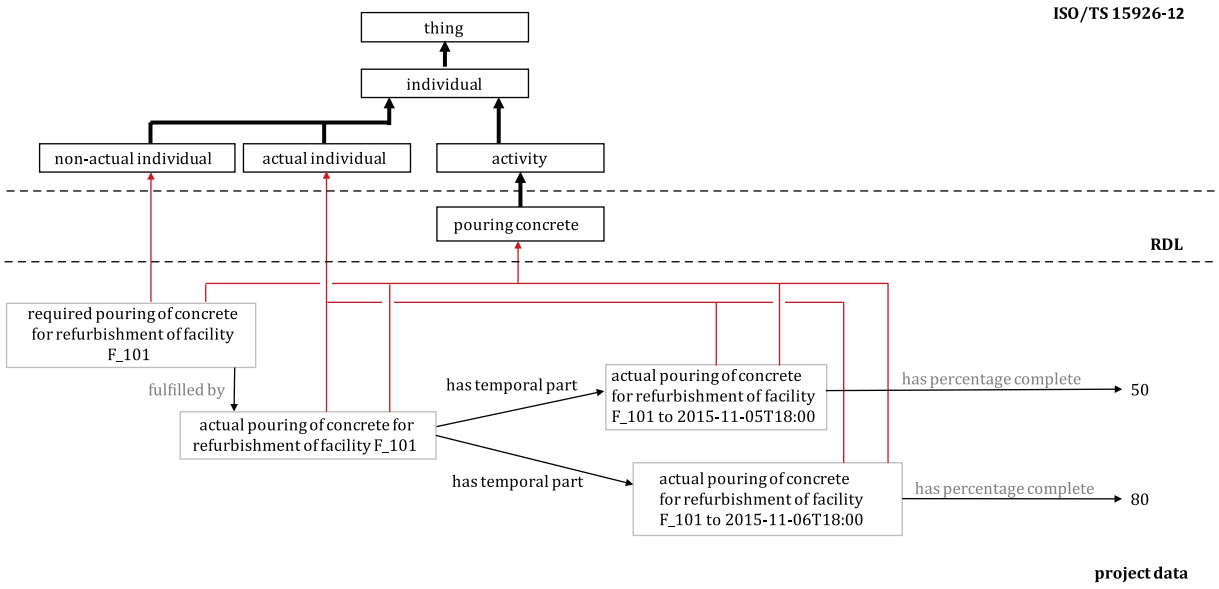

Figure 6 — Percentage complete changes with time

5 Representation of planning data

5.1 Basis of the approach

Planning data is about intended **activities** and their **specifications**, and about the recording of progress on the actual **activities** that fulfil the required **activities**.

The **specification** for a required activity has versions. A version of a **specification** is contained within a **schedule**.

The **specification** for a required **activity** specifies its parts, the interrelationships between the parts and the **resources** for the **activities**.

EXAMPLE The required **activity** "refurbishment of facility F-101" is defined by **specification** "specification for the refurbishment of facility F-101 version 2". This **specification** is contained within the **schedule** "schedule for the refurbishment of facility F-101 version 2.3".

The required **activity** "intended refurbishment of facility F-101" has the required parts "intended construction of foundations for refurbishment of facility F-101" and "required erection of steelwork for refurbishment of facility F-101". These part **activities** have **specifications** which are parts of the **specification** of the whole.

The objects and relationship are shown in Figure 7.

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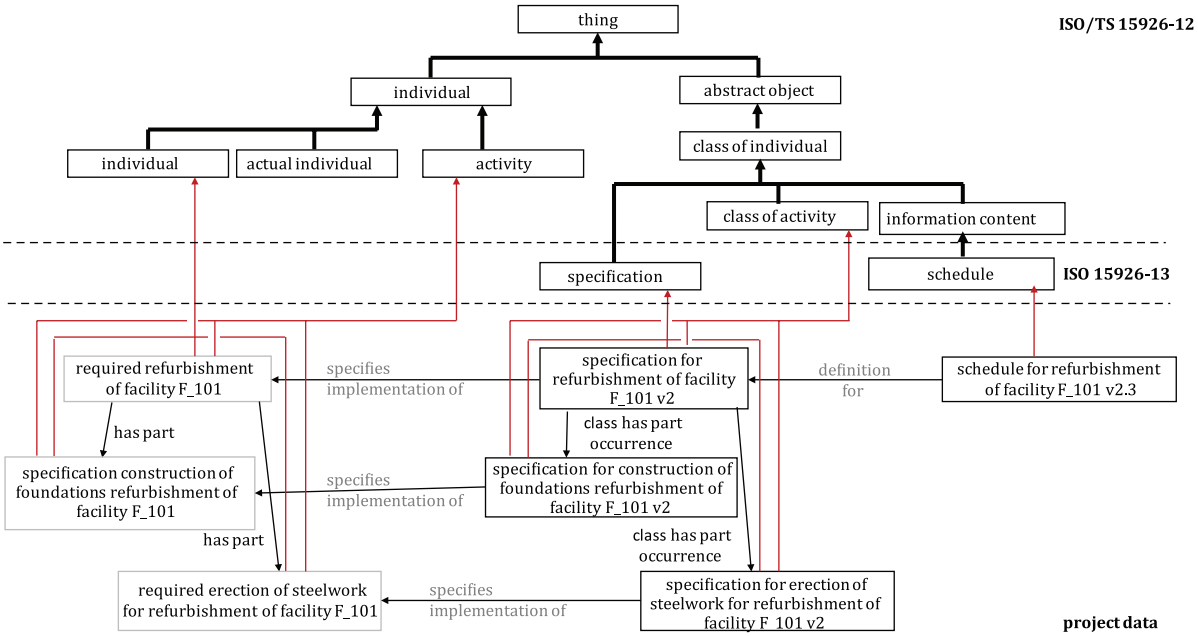

Figure 7 — Required activity, specification and parts

In Figure 7, the subclass relationships between the **specifications** and the class **activity** are not shown. The relationship **specifies implementation of** states that a proposed implementation of the requirement is a member of the class. The proposed implementation can be recorded explicitly if required, as shown in Figure 8.

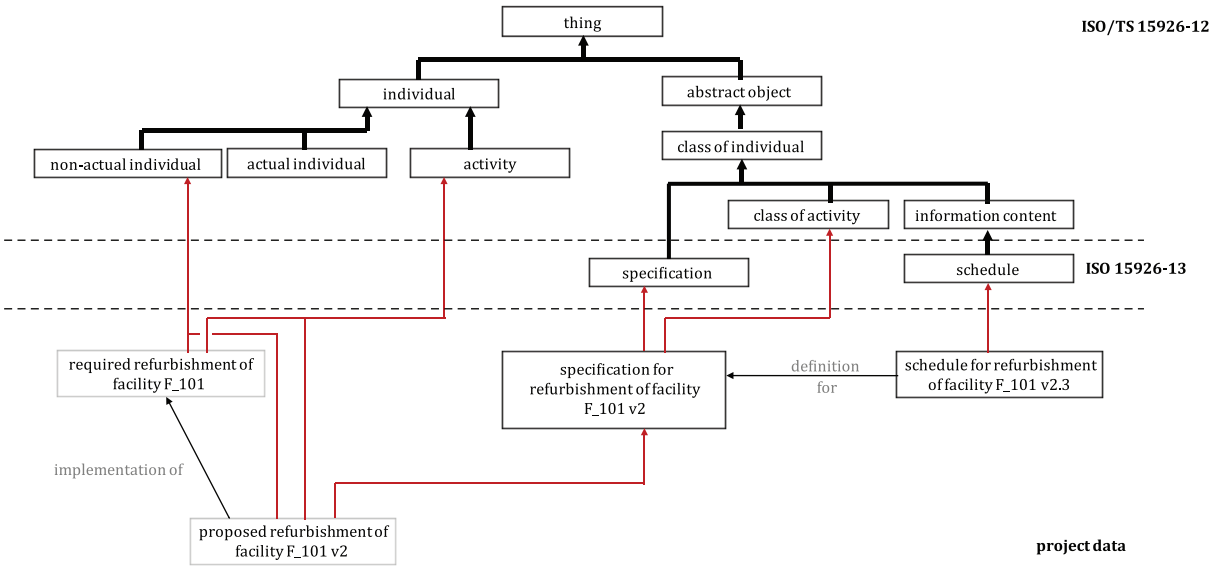

Figure 8 — Required activity, proposed implementation and specification

A single required **activity** may have different **specifications** contained in different **schedules**. Specifications may be updated as the actual **activity** that fulfils the requirement progresses.

An actual **activity** may be performed in accordance with a **specification**. This is shown in Figure 9.

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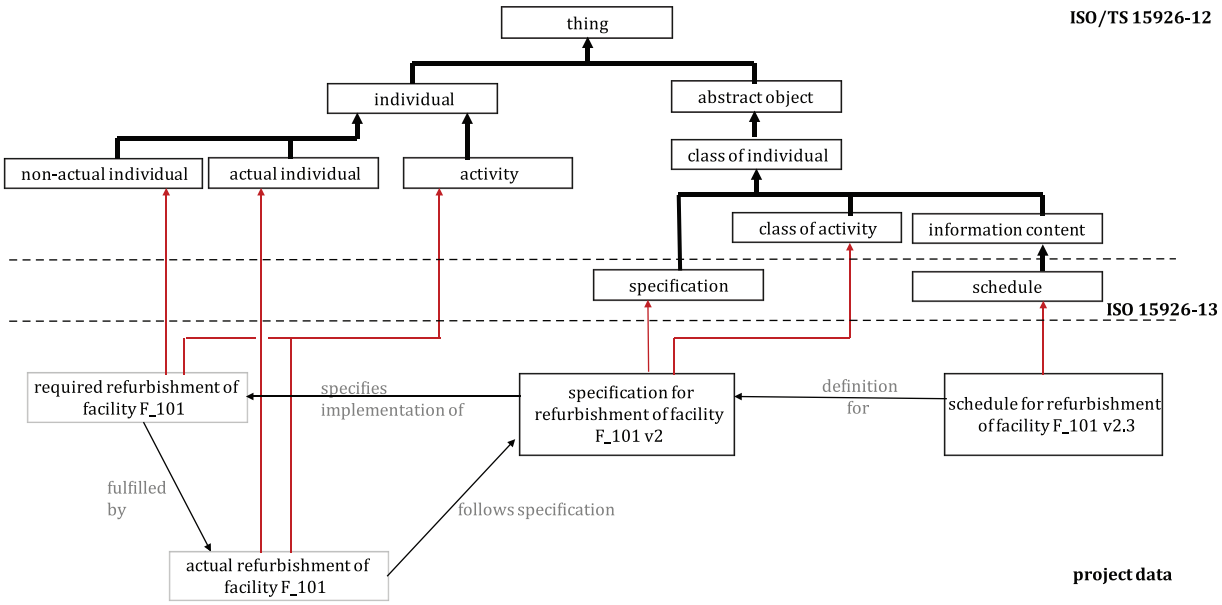

Figure 9 — Required activity, actual activity and specification

5.2 Fundamental planning objects

5.2.1 Objective of planning

A **planning** activity begins with a required **individual**. The required **individual** is something that is required to exist in the future. The **planning** is intended to define and control an **activity** that creates it.

NOTE The required **individual** is usually a **physical object**. It can be a new **physical object** or a new state of an existing **physical object**.

EXAMPLE UG Oil wishes to upgrade the existing natural gas processing system on platform UGE-1 from a capacity of 100 million ft^3 per day to a capacity of 180 million ft^3 per day.

UGE-1 with the increased capacity is a required future state. There is a required future upgrade activity that is intended to create this state. There is a **planning** activity that has the required future state as its objective.

The objects that record the required future state, the required **activity** to create it, and the **planning** activity are as follows:

— 'UGE-1': a **whole life asset** and **actual individual**;

— 'UGE-1 with increased natural gas capacity': a **state of asset** and a **non-actual individual**;

— 'UGE-1 natural gas capacity upgrade': an **activity**, **whole life individual** and **non-actual individual**;

— 'planning for UGE-1 natural gas capacity upgrade': a **planning** activity, **whole life individual** and **actual individual**.

These objects, with their classifications and relationships, are shown in Figure 10.

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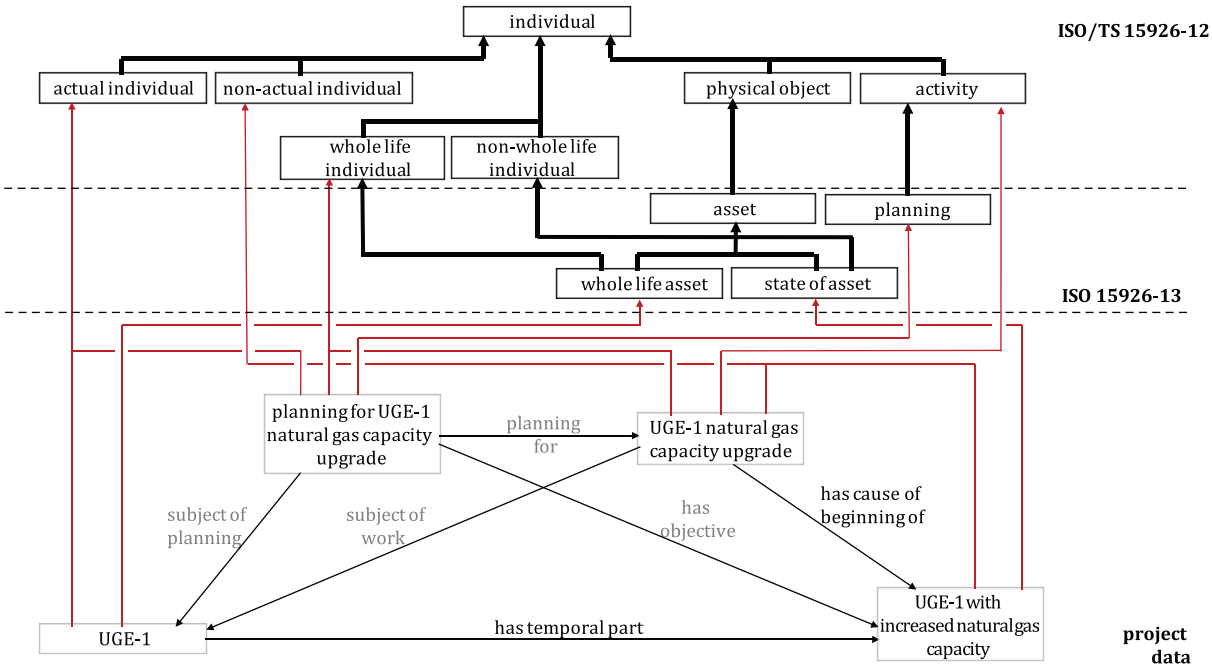

Figure 10 — Objective of planning

5.2.2 Required or proposed activity and specification

A required or proposed **activity** is defined by its relationships and classifications.

EXAMPLE 1 UG Oil wishes to upgrade the natural gas processing system on platform UGE-1 from a capacity of 100 million ft^3 per day to a capacity of 180 million ft^3 per day by the end of November 2016.

This statement of requirements can be split into:

— the required **activity**: "UGE-1 natural gas capacity upgrade" is completed before the end of November 2016;

— the required **activity** creates a required **state of asset** that is:

  — a **temporal part of** platform UGE-1';

  — has a natural gas processing capacity of 180 million ft^3 per day.

This statement of requirements is shown diagrammatically in Figure 11.

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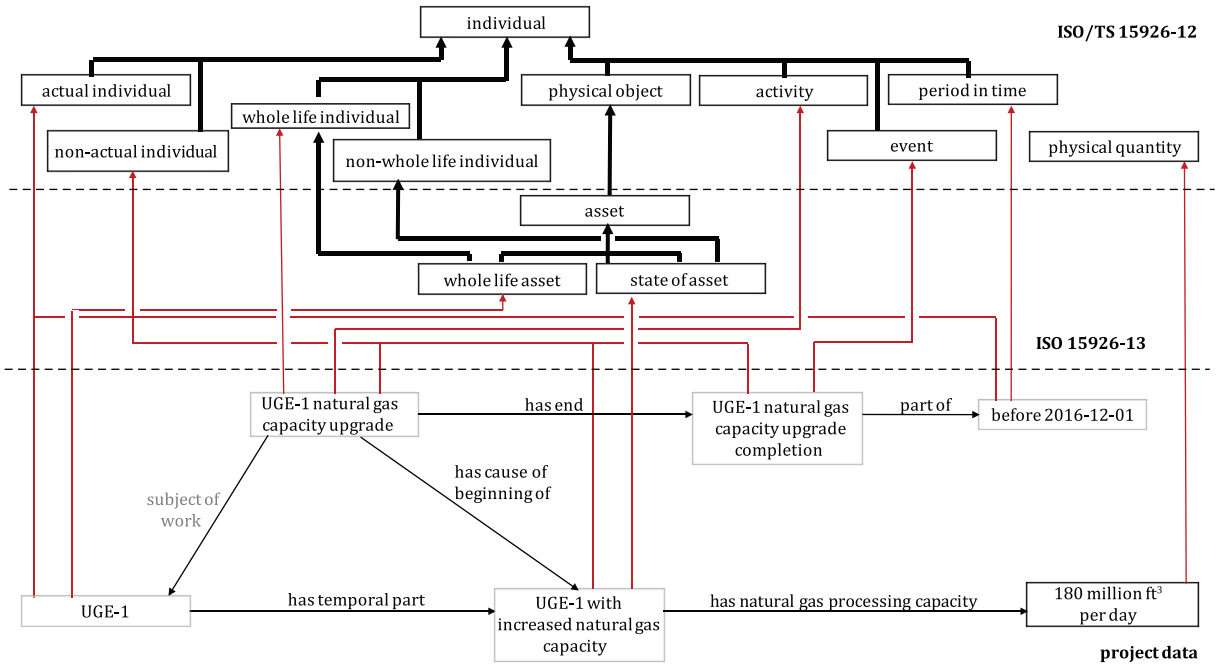

Figure 11 — Requirements for an activity

A **specification** expresses the relationships and classifications that define a required or proposed **activity** as a single classification.

NOTE The expression of the definition of a required or proposed **activity** as a single classification simplifies the representation of multiple versions of a definition.

As planning progresses, proposed **activities** that implement a requirement are defined. A **specification** for a proposed **activity** may contain:

— a breakdown of the overall **activity** into parts;

— a classification of the part **activities** with respect to an **activity breakdown structure**;

— **resources** required by the part activities, and their classification with respect to a **resource breakdown structure**;

— succession dependencies between part **activities**;

— proposed start and end times for the part **activities**.

EXAMPLE 2 UG Oil wishes to upgrade the natural gas processing system on platform UGE-1. The initial proposal increases the capacity from 100 million ft^3 per day to a 180 million ft^3 per day by the end of November 2016. Subsequently there is a new proposal to increase the capacity to 200 million ft^3 per day by the end of December 2016.

There are two specifications as follows:

— **specification** version 1 that is the subclass of:

  — activity completed before the end of November 2016;

  — activity that creates a state of UGE-1 with a natural gas capacity of 180 million ft^3 per day;

— **specification** version 2 that is the subclass of:

  — activity completed before the end of December 2016;

  — activity that creates a state of UGE-1 with a natural gas capacity of 200 million ft^3 per day.

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There is a **succeeded by** relationship between the two specifications. The objects and their relationships are shown in Figure 12.

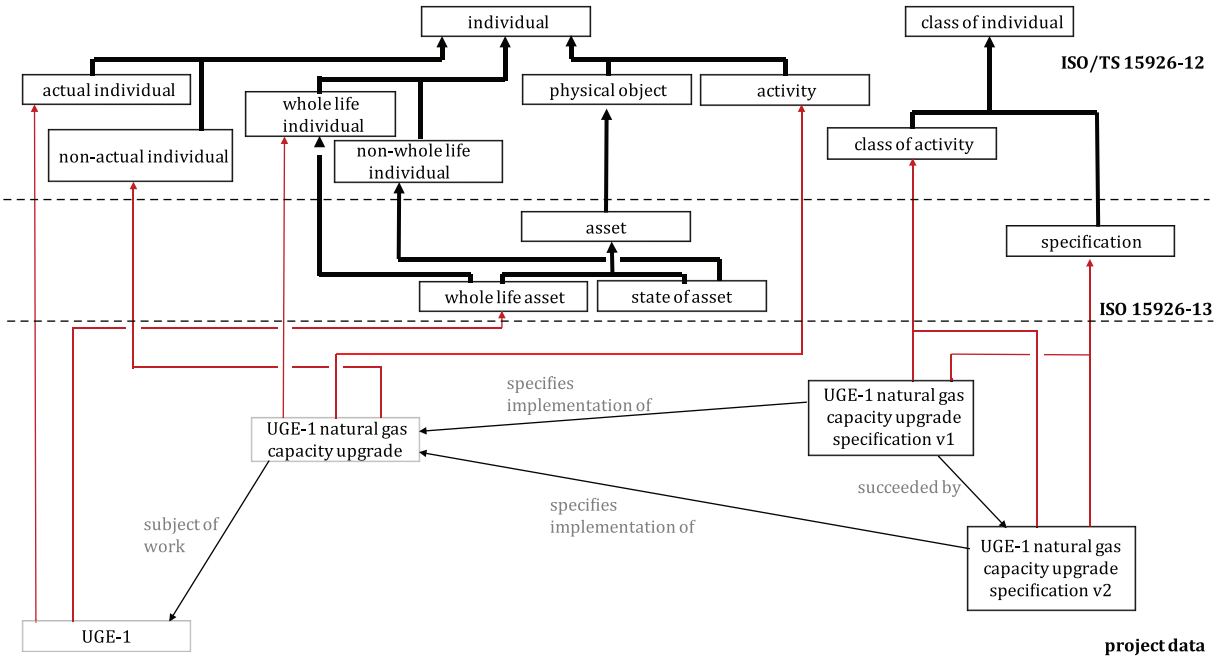

Figure 12 — Specifications and versions

5.2.3 Alternative specifications

Alternative proposed **activities** can be defined for a required **activity**. Each proposed **activity** has a **specification**. There is a **specification has alternative** relationship between two alternative **specifications**.

EXAMPLE Two alternative **specifications** are produced for the UGE-1 natural gas capacity upgrade to 200 million ft^3 per day by the end of December 2016 – specification version 2a and specification version 2b. Subsequently version 2b is issued as a part of **schedule** version 2.3.

There is a **specification has alternative** relationship between the two specifications. The objects and their relationships are shown in Figure 13.

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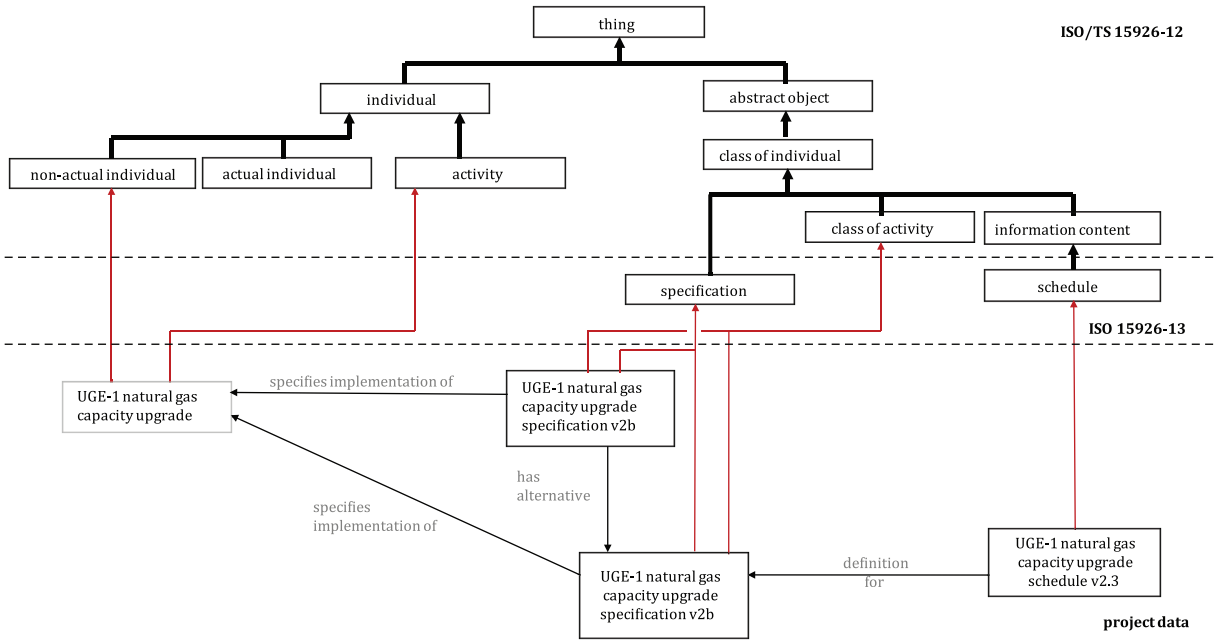

Figure 13 — Alternative specifications

5.3 Schedule

5.3.1 Definition of a schedule

A **schedule** is **information content** that defines the work to be done. A **schedule** defines the **specification** of a proposed **activity**.

NOTE 1 A **schedule** can be part of a contract and can contain other information that is relevant to the performance of the contract.

NOTE 2 A **schedule** can contain person readable documents, structured content such as spreadsheets, and formal content defined by standards such as this document.

A **schedule** and a **specification** that is defined by it are created by a **planning** activity.

NOTE 3 Within an overall **planning** activity, a **schedule** and a **specification** can be created by different people at different times.

EXAMPLE The **planning** activity "planning for the UGE-1 natural gas capacity upgrade" creates the **specification** version 2 of the work to be done in June 2016. This **specification** is included within **schedule** version 2.3, which is created in July 2016. The objects and their relationships are shown in Figure 14.

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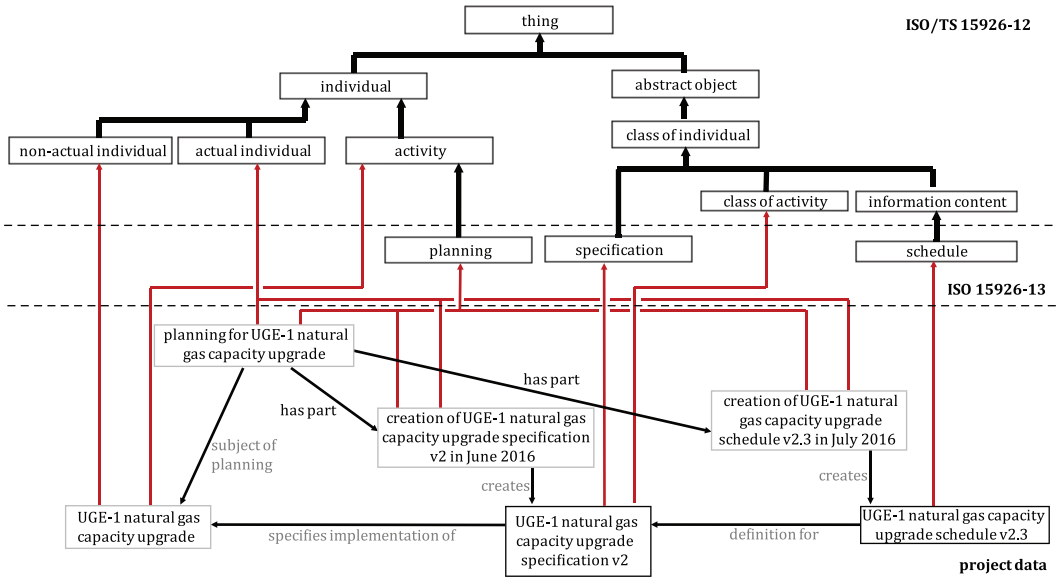

Figure 14 — Creation of a specification and schedule

5.3.2 Level of a schedule

A schedule exists at different levels in the planning process, and is classified according to its level.

NOTE Schedule levels are not standardized in this document, but can be defined in a Reference Data Library. Common schedule levels and their use are described in Annex D.

EXAMPLE 1 In the example in 5.3.1, the schedule version 2.3 is created in July 2016. This schedule is a level 3 "project coordination schedule". This is shown in Figure 15.

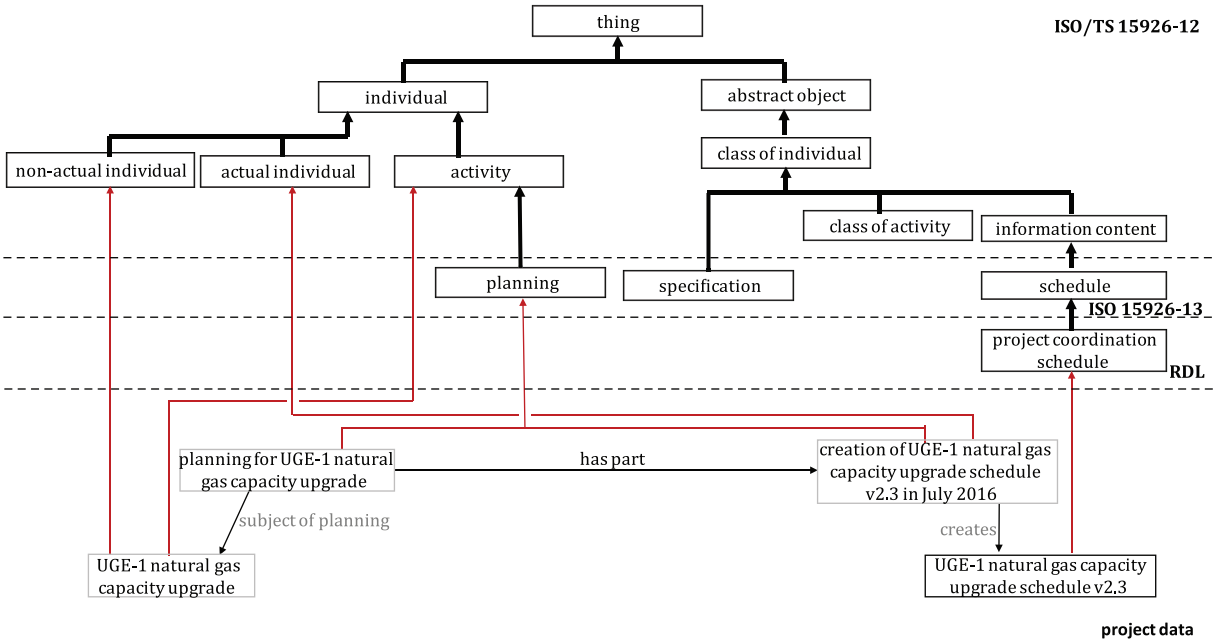

Figure 15 — Classification of a schedule by level

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Subclasses of schedule according to level, which are defined in a Reference Data Library are classified as members of **schedule level**.

EXAMPLE 2 The subclasses of schedule "project master schedule", "project summary schedule" and "project coordination schedule" are all members of schedule level. This is shown in Figure 16.

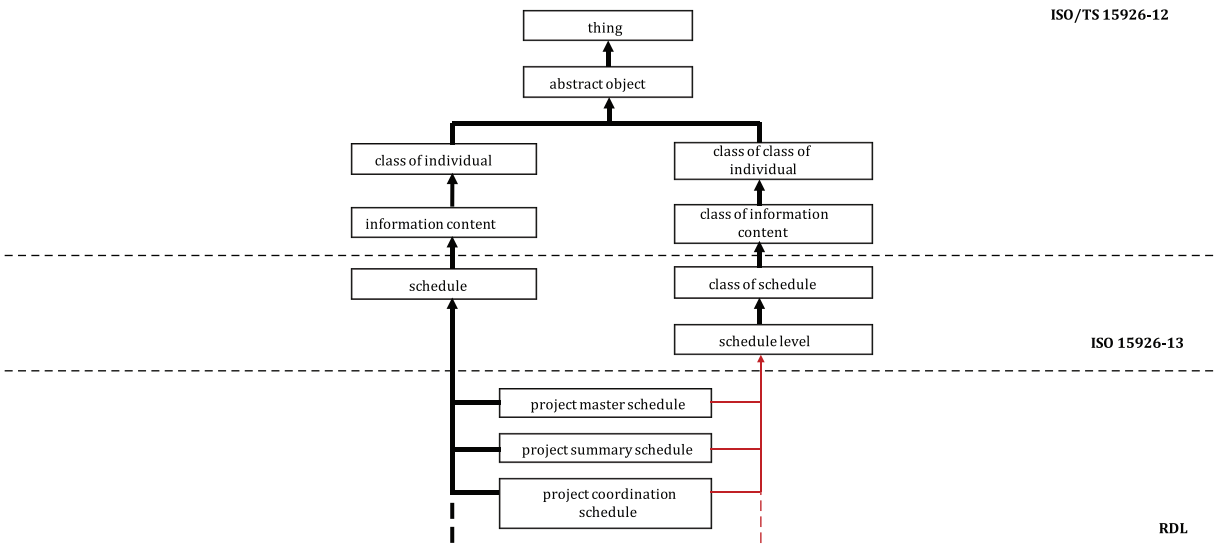

Figure 16 — Schedule level

A **schedule** that is specified to a level of detail appropriate for inclusion within a work order is a **schedule for work order**.

5.3.3 Role of a schedule

Different **schedules** have different roles with respect to a **planning** activity. A role is indicted by the relationship between the **planning** activity and the **schedule**. The following roles are defined by this document:

— **has baseline schedule**;

— **has current schedule**.

NOTE 1 Other roles can be defined within a Reference Data Library. Common roles include:

— has revised schedule;

— has live schedule.

A **schedule** does not always play the same role. The **schedule** does not change, but instead it is the **planning** activity that changes. Therefore the role is stated by the relationship with the **planning** activity.

NOTE 2 A relationship, such as **current schedule**, is usually with a temporal part of the overall **planning** activity.

EXAMPLE The 'UGE-1 natural gas capacity upgrade schedule version 2.3'' is set as the baseline by the planning activity on 1st July 2016 and is initially both current and the baseline. It is replaced as the current schedule by version 2.4 on 13th September 2016. Objects are as follows:

— 'planning for UGE-1 natural gas capacity upgrade': a **planning** activity and an **actual individual**;

— 'planning for UGE-1 natural gas capacity upgrade from 1st July 2016': a **planning** activity and an **actual individual**;

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— ‘planning for UGE-1 natural gas capacity upgrade from 1st July to 13th September’: a **planning** activity and an **actual individual**;

— ‘planning for UGE-1 natural gas capacity upgrade from 13th September’: a **planning** activity and an **actual individual**;

— ‘UGE-1 natural gas capacity upgrade schedule version 2.3’: a **schedule**;

— ‘UGE-1 natural gas capacity upgrade schedule version 2.4’: a **schedule**.

These objects, with their classifications and relationships, are shown in Figure 17.

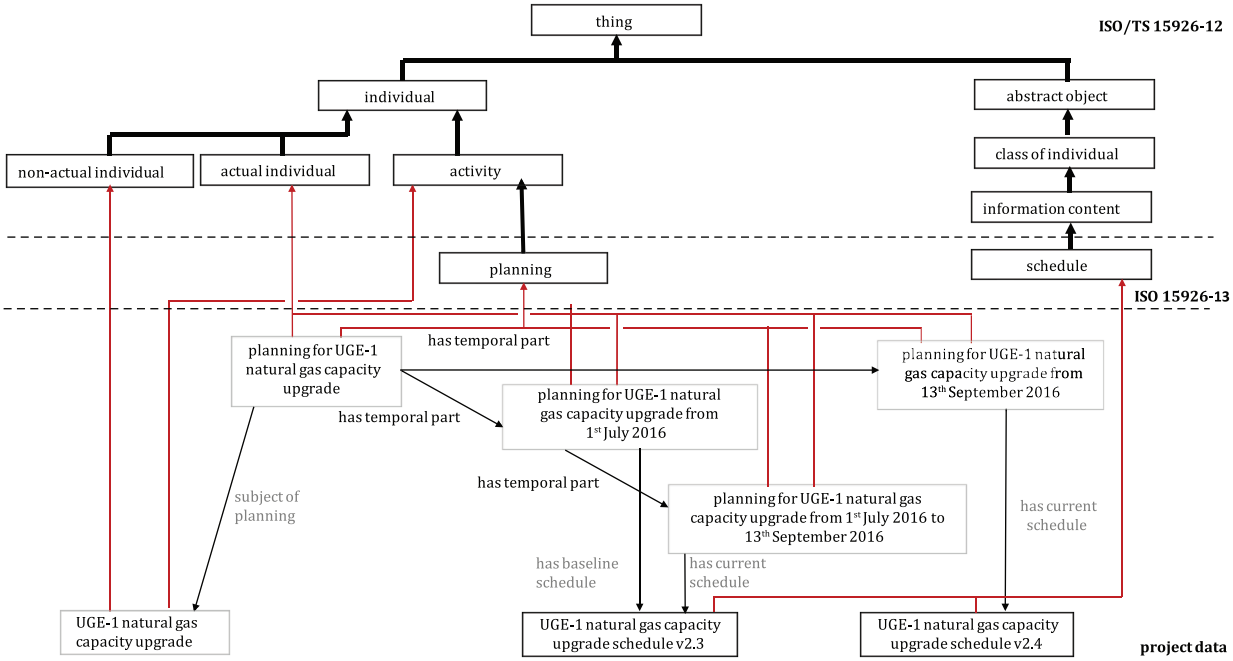

Figure 17 — Baseline and current schedules

The periods in time during which a **schedule** is a baseline or current are recorded by the start and end times of the **planning** activities with which they have a **has baseline schedule** or **has current schedule** relationship.

5.4 Planning activity

The way in which the **specifications** and **schedules** for a required **activity** change with time is recorded by their relationships with the **planning** activity.

EXAMPLE 1 This is shown in Figure 17.

The following may be recorded for any **activity**:

— the **period of time** during which it takes place;

— the **person** or **organization** that performs it;

— the **information objects** that are referenced by it.

EXAMPLE 2 On 4th November 2016, a “project summary schedule” is created from a “project coordination schedule”. Objects are as follows:

— ‘UGE-1 natural gas capacity upgrade’: an **activity** and **non-actual individual**;

— ‘planning for UGE-1 natural gas capacity upgrade’: a **planning** activity and an **actual individual**;

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— 'creation of UGE-1 natural gas capacity upgrade project summary schedule on 4th November 2016': a **planning** activity and an **actual individual**;

— 'UGE-1 natural gas capacity upgrade project coordination schedule v2.3 – 2016-11-04': a **schedule**;

— 'UGE-1 natural gas capacity upgrade project summary schedule v2.3 – 2016-11-04': a **schedule**.

These objects, with their classifications and relationships, are shown in Figure 18.

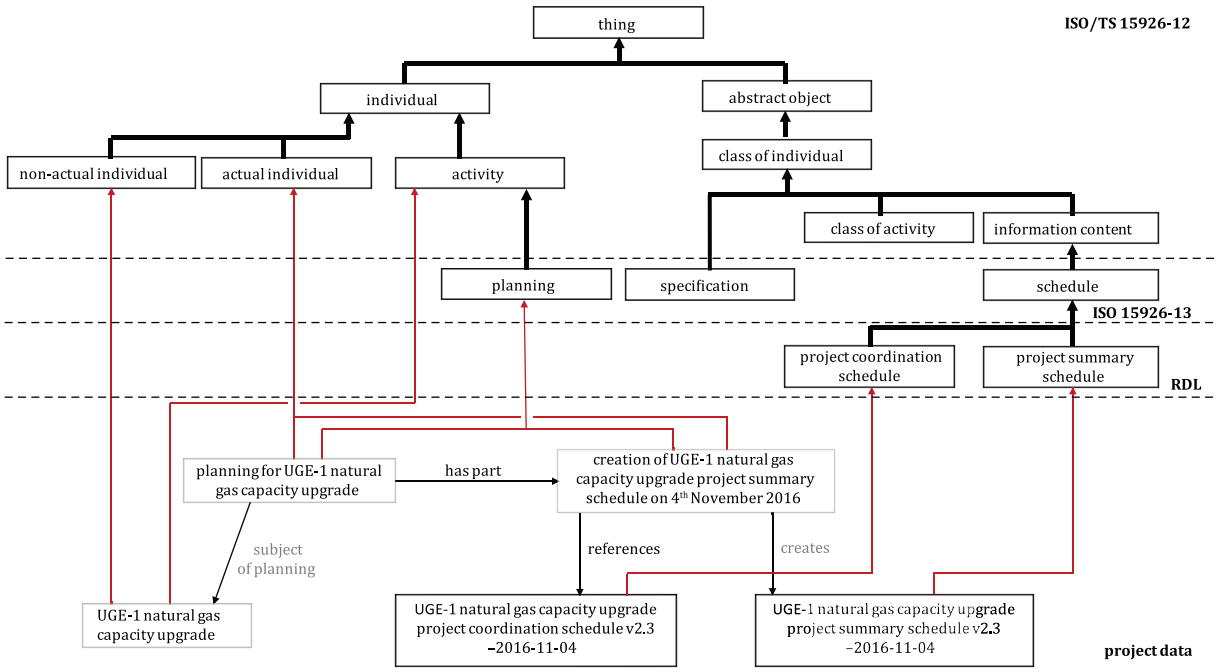

Figure 18 — Creation of a Project Summary Schedule

5.5 Actual activity that fulfils a requirement

A **planning** activity creates a **specification** for a proposed implementation of the requirement.

An actual **activity** has a **follows specification** relationship with the **specification**.

NOTE 1 A **follows specification** relationship does not state that the **activity** is a member of the class defined by the **specification**. It merely states that this is what is intended.

An **actual activity** has a **fulfils** relationship with the required **activity**.

NOTE 2 A **fulfils** relationship does not state that the actual **activity** fulfils the requirement. It merely states that this is what was obtained.

As work progresses:

— properties of the actual **activity**, such as percentage complete, resources used, and expenditure, are recorded;

— the **planning** activity revises the specification followed by the actual activity.

The properties of the actual **activity** change with time and are recorded for temporal parts of the actual **activity**.

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A **planning** activity has a **monitors** relationship with an actual **activity** that follows the **specification**.

EXAMPLE The 'actual UGE-1 natural gas capacity upgrade' **fulfils** the required 'UGE-1 natural gas capacity upgrade'. The temporal part 'actual UGE-1 natural gas capacity upgrade to 13th September 2016' **follows specification** 'UGE-1 natural gas capacity upgrade specification version 2' contained in 'UGE-1 natural gas capacity upgrade schedule version 2.3'. On the 13th September 2016, the 'actual UGE-1 natural gas capacity upgrade' is 50 % complete.

The objects that record the required **activity**, the actual **activity** and its percentage complete, the **planning** activity; the **specification** and the **schedule** are as follows:

— 'UGE-1 natural gas capacity upgrade': an **activity** and **non-actual individual**;

— 'actual UGE-1 natural gas capacity upgrade': an **activity** and **actual individual**;

— 'actual UGE-1 natural gas capacity upgrade to 13th September 2016': an **actual activity**;

— 'planning for UGE-1 natural gas capacity upgrade': a **planning** activity and an **actual activity**;

— 'UGE-1 natural gas capacity upgrade specification version 2': a **specification**;

— 'UGE-1 natural gas capacity upgrade schedule version 2.3': a **schedule**.

These objects, with their classifications and relationships, are shown in Figure 19.

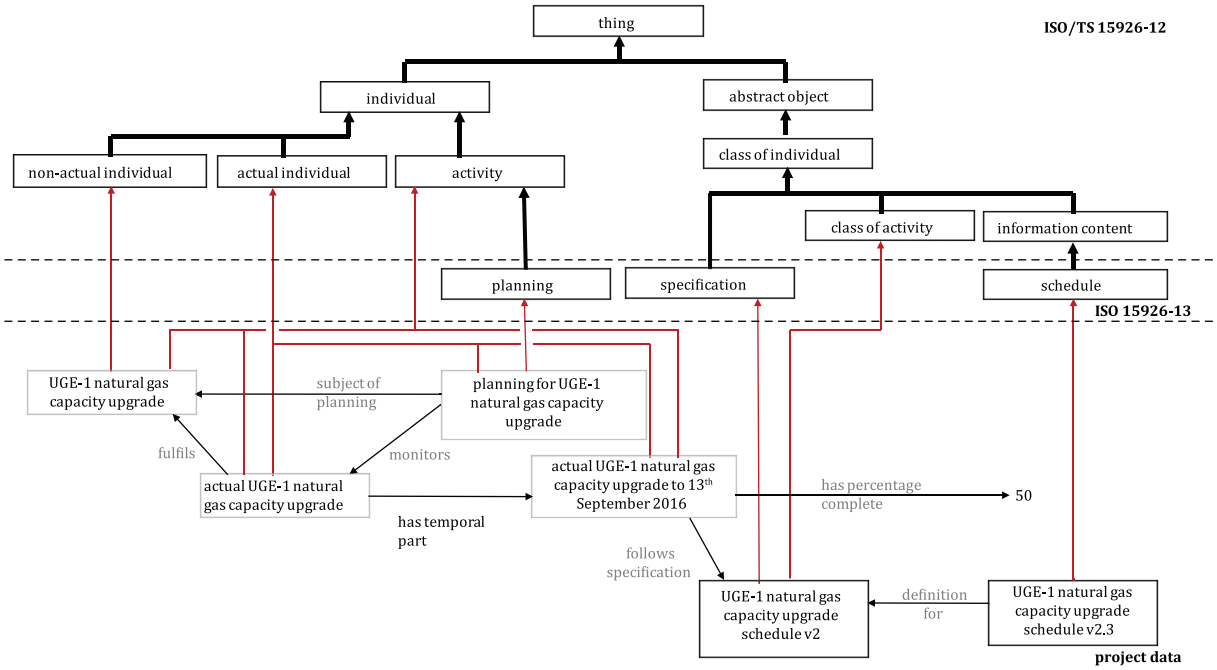

Figure 19 — Actual activity to fulfil a requirement

5.6 Decomposition of an activity

5.6.1 Parts of activities and their level

An **activity** has smaller part **activities**. An **activity** is classified according to its size and level.

NOTE 1 Classifications of **activity** according to size and level, such as "project", "project phase", "work package" and "task", are not standardized in this document, but can be defined in a Reference Data Library. Common **activity** levels and their use are described in Annex 0.

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NOTE 2 Planning software requires an explicit statement of the "top" **activity** and the parts that need to be scheduled. In the "Scheduling Application View" defined in 5.17, the two level structure is made explicit by classifying the "top" **activity** as **project** and the parts that need to be scheduled as **activity in project**.

Whole-part relationships between activities that are not relevant to the scheduling, such as the relationship between an activity in project and a project phase or work package, are recorded in the "Scheduling Application View" by an **activity part of** relationship.

EXAMPLE The required project 'refurbishment of facility F_101' has the work package 'pouring concrete for refurbishment of facility F_101' as a part.

Objects are as follows:

— 'refurbishment of facility F_101': a "project" and **activity**;

— 'pouring concrete for refurbishment of facility F_101': a "work package" and **activity**.

These objects, with their classifications and relationships, are shown in Figure 20.

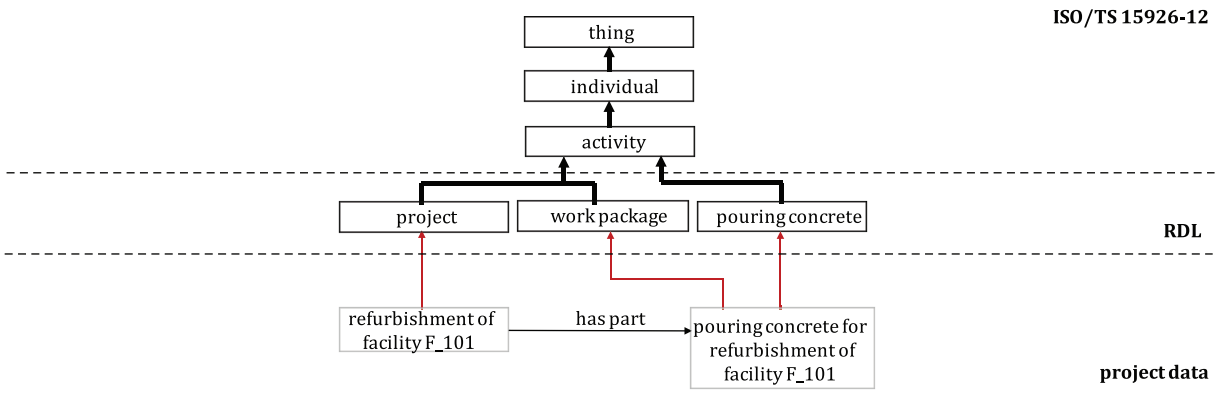

Figure 20 — Project and work package

5.6.2 Decomposition of a specification

A **specification** specifies the parts of an **activity**.

EXAMPLE 1 The relationships **class has part occurrence** between **specifications** P and A states that a member of P has a member of A as a part, and that a member of A is a part of a member of P.

NOTE Whether a decomposition of a required **activity** is recorded by **has part** relationships between **activities**, by **class has part occurrence** relationships between **specifications**, or both is a choice. For the "Scheduling Application View", the choice is defined in Clause 6.

EXAMPLE 2 The **specification** 'refurbishment of facility F_101 specification version 2' specifies that a member of 'pouring concrete for the refurbishment of facility F_101 specification version 2' is a part.

Objects are as follows:

— 'refurbishment of facility F_101': an **activity**;

— 'refurbishment of facility F_101 specification version 2': a **specification** and **class of activity**;

— 'pouring concrete for refurbishment of facility F_101': an **activity**;

— 'pouring concrete for refurbishment of facility F_101 specification version 2': a **specification** and **class of activity**.

These objects, with their classifications and relationships, are shown in Figure 21.

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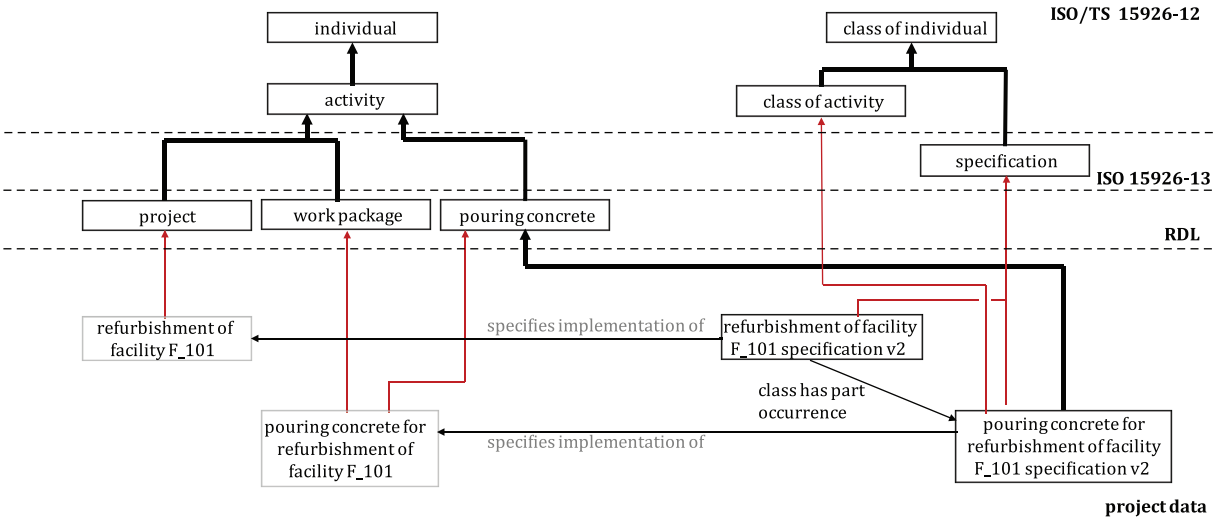

Figure 21 — Specification and decomposition

5.7 Classifications of an activity

5.7.1 Activity purpose and activity breakdown

An **activity** may be classified according to its purpose.

NOTE 1 Classes of **activity** according to purpose are not standardized in this document but can be defined in a Reference Data Library. Such classes are often domain specific. Classes of activity according to purpose which are of significance to oil and gas exploration and production include:

— drilling;

— well isolating;

— well servicing;

— well transfer;

— production activity revision.

An **activity** that is a part of a whole may be classified by an **activity breakdown class**.

NOTE 2 **Activity breakdown classes** are not standardized in this document but can be defined in a Reference Data Library.

EXAMPLE **Activity breakdown classes** are defined in ISO 19008.

5.7.2 Activity management objective

An **activity** can be classified according to business objective. Such subclasses of **activity** are members of **class of activity by business objective**.

NOTE **Classes of activity according to business objective** are not standardized in this document but can be defined in a Reference Data Library. Such classes are often domain specific. **Classes of activity according to business objective** which are of significance to oil and gas exploration and production include:

— increase oil and gas recovery;

— maintain business as usual;

— make incremental improvement;

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