CHALMERS

Data format mapping between SPINE and ISO/TS 14048

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Contents

Comparison of conceptual models

Crucially, the SPINE and ISO/TS 14048 data formats are describing the same world, and they are using the same conceptual model to describe this world (see figure 1).

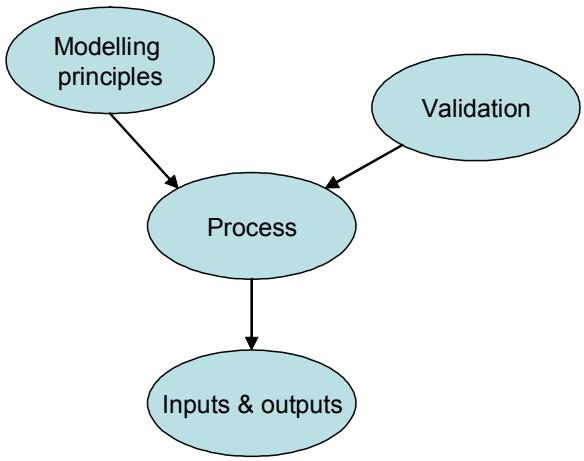

Figure 1 SPINE and ISO/TS 14048 are based on the same conceptual model.

Both formats are focusing on models of technical systems. The concept for this is named Process in ISO/TS 14048 and *Activity* in SPINE. Using the ISO-language a process is a model-representation of a well-defined part of a technical system with a definite system scope and boundary. The process has inputs and outputs flowing over the system boundaries referred to as Inputs and outputs in ISO/TS 14048 and *Flow* in SPINE. A process or activity have as many inputs and outputs as has been identified for the technical system, each representing a substance or energy flow that are entering in to or leaving out from the boundary of the system. When creating the model of the technical system, i.e. the process, some modelling principles are applied. After the process has been documented, the quality of the modelling and the documentation are validated in different ways.

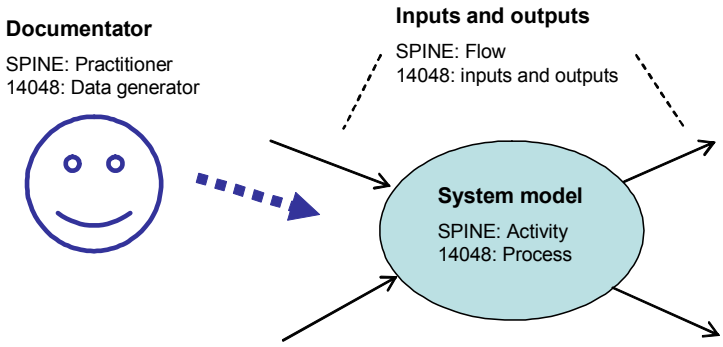

Figure 2 Comparison of naming of most important concepts.

The person who is documenting the process and inputs and outputs is referred to as a Data generator in ISO/TS 14048 and *Practitioner* in SPINE.

Improvements in ISO/TS 14048 compared to SPINE

There are many minor differences between SPINE and ISO/TS 14048, and there are some major improvements in the latter.

Specification of the receiving environment

In SPINE it is only possible to describe the media that an input or output impacts using one dimension, while two dimensions have been used in ISO/TS 14048. This is an improvement since it now is possible to specify both the environment where the input or output meets the technical system, air, water, soil, etc., as well as the environment where the cause-effect chain of an input or output actually begins, i.e. type of land, type of water, etc.

Arbitrary statistical function

In SPINE it is possible to attach statistical information to a value by specifying min, max and standard deviation for the value. In ISO/TS 14048 any function can be used to specify such statistical information for a numerical value, such as normal, beta or logarithmic distributions or actual series of sample-values.

Enhanced specification of field contents

ISO/TS 14048 has a larger number of fields than SPINE. This is because more subject-headers and subtitles for the documentation requirements of LCA have been assigned more explicitly in ISO/TS 14048 than in SPINE.

Data format mapping between ISO/TS 14048 and SPINE

The data format mapping is presented in table 1.

Table 1

Legend:

Reference no.
The reference number of ISO/TS 14048 data field as stated in ISO/TS 14048 Annex A

Data field
The name of the ISO/TS 14048 data field

T - data type

L	Label
ST	Short text
FT	Free text
R	Real
Int	Integer
MR	Mathematical rule
MV	Mathematical value
DF	Date format
DI	Date interval
Pic	Picture
Dir	Direction
6, 20, 255, etc.	Varchar with corresponding maximum length

N - Nomenclature

X	Exclusive nomenclature
I	Inclusive nomenclature
R	Nomenclature by reference in other related attribute
U	User defined nomenclature

O - Allowed occurrences

1	One occurrence
N	Unlimited number of occurrences

From SPINE
The name of the submitting data field in SPINE that is mapped to the ISO/TS 14048 data field.

To SPINE
The name of the receiving data field in SPINE that the ISO/TS 14048 data field mapped to. If the word “append” is present, it indicates that more ISO/TS 14048 fields are mapped to one and the same target SPINE field. “List” indicates that the fields should be stored as a list as the target field only have one occurance while there are multiple source fields.

Mapping value
Indicates if the mapping is satisfying or if data distorsion occurs

Refe-rence no.	ISO/TS 14048				SPINE					Mapping Value
	Data field	T	N	O	From SPINE	To SPINE	T	N	O	
1	**Process**			1					1	OK
1.1	**Process description**			1					1	OK
1.1.1	Name	L		1	ObjectOfStudy.Name	ObjectOfStudy.Name	100		1	OK
1.1.2	Class			U					1	OK
1.1.2.1	Name	L	R	1	ObjectOfStudy.Sector	First instance to ObjectOfStudy.Sector if "Sector" is found in Reference to nomenclature, else append to Inventory.Notes as list	40	U	1	OK
1.1.2.2	Reference to nomenclature	ST		1	"SPINE@CPM1997ObjectOfStudy. Sector"	Sector.Notes if "Sector" is found in Reference to nomenclature, else Inventory.Notes (append)	FT		1	OK
1.1.3	Quantitative reference			1					1	OK
1.1.3.1	Type	ST	I	1	"See process.process_description. technology.technical_content _and_functionality"	Inventory.FUExplanation (append)	FT		1	OK
1.1.3.2	Name	ST		1	"See process.process_description. technology.technical_content _and_functionality"	Inventory.FUExplanation (append)	FT		1	OK
1.1.3.3	Unit	ST	I	1	"See process.process_description. technology.technical_content _and_functionality"	Inventory.FUExplanation (append)	FT		1	OK
1.1.3.4	Amount	R		1	-	Inventory.FUExplanation (append)	FT		1	OK
1.1.4	Technical scope	ST	I	1	ObjectOfStudy.Category	ObjectOfStudy.Category	20	I	1	OK
1.1.5	Aggregation type	ST	X	1	-	Inventory.Data (append)	FT		1	OK Aggregation is rarely done in one dimension only
1.1.6	Technology			1					1	OK
1.1.6.1	Short technology descriptor	ST		1	ObjectOfStudy.ActivityType	ObjectOfStudy.Function (append) Importer manually chooses the ObjectOfStudy.ActivityType as "Process" or "Transport" or NULL	15	U	1	OK
1.1.6.2	Technical content and functionality	FT		1	ObjectOfStudy.Function ObjectofStudy.Owner Inventory.FunctionalUnit Inventory.FUExplanation	ObjectOfStudy.Function (append)	FT		1	OK
1.1.6.3	Technology picture	Pic		1	Static picture file generated from information in tables SubSystemPosition FlowConnectionKnee	URL to picture file (could be stored in local file system) in ObjectOfStudy.Function (append)	FT		1	OK

1.1.6.4	Process contents			1					1	OK
1.1.6.4.1	Included processes	L		U	ObjectOfStudy.Id and ActivityId (concatenated) referred to by Componentship.SubSystem	The corresponding Activity.Id of the imported subsystem referred by Componentship.SubSystem	30		U	OK
1.1.6.4.2	Intermediate product flows			U					U	OK
1.1.6.4.2.1	Source process	L		1	ObjectOfStudy.Id and ActivityId (concatenated) referred by FlowConnection.SupplierActId	The corresponding Activity.Id of the imported subsystem referred by FlowConnection.SupplierActId	30		1	OK
1.1.6.4.2.2	Input and output source	Int		1	FlowConnection.OutFlowNumber	FlowConnection.OutFlowNumber	Int		1	OK
1.1.6.4.2.3	Input and output destination	Int		1	FlowConnection.InFlowNumber	FlowConnection.InFlowNumber	Int		1	OK
1.1.6.4.2.4	Destination process	L		1	ObjectOfStudy.Id and ActivityId (concatenated) referred to by FlowConnection.ConsumerActId	The corresponding Activity.Id of the imported subsystem referred by FlowConnection.ConsumerActId	30		1	OK
1.1.6.5	Operating conditions	FT		1	"See process.process_description. technology.technical_content _and_functionality"	ObjectOfStudy.Function (append)	FT		1	OK

1.1.6.6	Mathematical model			1					1	OK
1.1.6.6.1	Formulae	MR		U	If data exists in FlowConnection Ratios, all fields of FlowConnection except FlowConnection.SystemId are mapped as a list to the superior system only. I.e.: FlowConnection.ConsumerActId FlowConnection.InFlowNumber FlowConnection.SupplierActId FlowConnection.OutFlowNumber FlowConnection.InRatio FlowConnection.InRatioUpper FlowConnection.InRatioLower FlowConnection.OutRatio FlowConnection.OutRatioUpper FlowConnection.OutRatioLower --- If data exists in ActivityParameter, all fields of ActivityParameter except ActivityParameter.SystemId and ActivityParameter.MetaId are mapped as a list to the superior system only. I.e.: ActivityParameter.SubSystemId ActivityParameter.tType ActivityParameter.tValue ActivityParameter.ValueMin ActivityParameter.ValueMax ActivityParameter.StandardDev ActivityParameter.Unit And the post in QMetaData referred by ActivityParameter.MetaId. i.e: QMetaData.DataType QMetaData.Method QMetaData.DateConcieved QMetaData.LitteratureRef QMetaData.Notes	ObjectOfStudy.Function (list) (append)	FT		U	OK FlowConnection and ActivityParameter are not used in any currently known implementation of SPINE.
1.1.6.6.2	Name of variable	MV		U	-	ObjectOfStudy.Function (list) (append)	FT		1	The SPINE format does not provide support for unambiguously connecting a name of variable with value of variable, why this construction will not be used.
1.1.6.6.3	Value of variable	R		U	-	ObjectOfStudy.Function (list) (append)	FT		1	The SPINE format does not provide support for unambiguously connecting a name of variable with value of variable, why this construction will not be used.

1.1.7	Valid time span			1					1	OK
1.1.7.1	Start date	DF		1	-	Inventory.TimeBoundary (append)	FT		1	Data type mismatch - reference to other field not possible
1.1.7.2	End date	DF		1	-	Inventory.TimeBoundary (append)	FT		1	Data type mismatch - reference to other field not possible
1.1.7.3	Time-span description	FT		1	Inventory.TimeBoundary	Inventory.TimeBoundary (append)	FT		1	OK
1.1.8	Valid geography			1					1	OK
1.1.8.1	Area name	ST	I	U	"See process.process_description. valid_geography. Area_description"	Inventory.GeographicalBoundary (list) (append)	FT		1	OK
1.1.8.2	Area description	FT		1	Inventory.GeographicalBoundary	Inventory.GeographicalBoundary (append)	FT		1	OK
1.1.8.3	Sites	ST		U	JuridicalPerson (all fields) referred by ObjectOfStudy.Site	Inventory.GeographicalBoundary (list) (append)	FT		1	OK
1.1.8.4	GIS reference	L	I	U	"See process.process_description.valid_geography. Area_description"	Inventory.GeographicalBoundary (list) (append)	FT		1	OK
1.1.9	Data acquisition			1						OK. See also 1.2.14 Documentation
1.1.9.1	Sampling procedure	FT		1	"See process.inputs_and_outputs .documentation.data_treatment"	General QMetaData.Method (append)	FT		1	OK
1.1.9.2	Sampling sites	ST		U	-	General QMetaData.Method (list) (append)	FT		1	OK
1.1.9.3	Number of sites	R		1	-	General QMetaData.Method (append)	FT		1	OK
1.1.9.4	Sample volume			1						OK
1.1.9.4.1	Absolute	ST		1	-	General QMetaData.Method (append)	FT		1	OK
1.1.9.4.2	Relative	R		1	-	General QMetaData.Method (append)	FT		1	OK

1.2	**Inputs and outputs**			U					U	OK
1.2.1	Identification number	Int		1	Flow.FlowNumber	Flow.FlowNumber	Int		1	OK
1.2.2	Direction	Dir	X	1	Flow.SubType - nomenclature translation to match ISO/TS 14048	Flow.SubType - add post with the value "State" to Flow.SubType nomenclature corresponding to "Non-flow-related aspects" in Direction nomenclature	6	X	1	OK
1.2.3	Group	L	I	1	Flow.Category	Flow.Category - add post to FlowType.Category nomenclature if not present	20	X	1	OK
1.2.4	Receiving environment	L	X	1	Flow.ImpactMedia (where superior = Global), NULL if Flow.ImpactMedia = "Other"	Flow.ImpactMedia if Receiving environment specification is empty	60	X	1	OK
1.2.5	Receiving environment specification	L	I	1	Flow.ImpactMedia	Flow.ImpactMedia Add post to Environment if not present in nomenclature	60	I	1	OK

1.2.6	Environment condition	FT		1	Environment.Notes "More information may be found in modelling_and_validation.modelling_choices.criteria_for_excluding_elementary_flows"	Inventory.NatureBoundary (list) (append)	FT		1	OK. Inventory.NatureBoundary refers to Activity
1.2.7	Geographical location	ST		1	Geography.AreaName including the full hierarchical nomenclature path Geography.AreaType Geography.Notes referred by Flow.ImpactRegion	Geography.AreaName referred by Flow.ImpactRegion Add post to Geography if not present in nomenclature	255	X	1	OK. The Geography.AreaName field data type definition is changed from varchar(40) to varchar(255)
1.2.8	Related external system			1					1	OK
1.2.8.1	Origin or destination	ST		1	"See inputs_and_outputs.documentation.data_treatment"	Specific QMetaData.Notes	FT		1	OK
1.2.8.2	Transport type	ST		1	"See process.inputs_and_outputs.documentation.data_treatment"	Specific QMetaData.Notes	FT		1	OK
1.2.8.3	Information reference	ST		1	"See process.inputs_and_outputs.documentation.data_treatment"	Specific QMetaData.Notes	FT		1	OK
1.2.9	Internal location	FT		1	"See process.inputs_and_outputs.documentation.data_treatment"	Specific QMetaData.Notes	FT		1	OK
1.2.10	Name			1					1	OK
1.2.10.1	Name text	L	R	1	Substance.DefaultName referred by Flow.SubstanceId	Substance.DefaultName referred by Flow.SubstanceId Add post to Substance if not present in nomenclature	150	U	1	OK. The Substance.DefaultName field data type definition is changed from varchar(40) to varchar(150) in SPINE
1.2.10.2	Reference to nomenclature	ST	I	1	"SPINE@CPM1997Substance"	Substance.Notes referred by Flow.SubstanceId (append)	FT		1	OK. SPINE is designed for one single substance nomenclature, ISO/TS for an unlimited number of substance nomenclatures.
1.2.10.3	Specification of name	ST		1	Substance.Notes referred by Flow.SubstanceId	Substance.Notes referred by Flow.SubstanceId	FT		1	OK. Notes may contain any relevant data for the substance.
1.2.11	Property			U					U	Conceptually OK
1.2.11.1	Name	L		1	FlowProperty.tType	FlowProperty.tType Add post to PropertyType if not present PropertyType.Category = "imported from ISO/TS 14048"	40		1	OK
1.2.11.2	Unit	L	Y	1	FlowProperty.Unit	FlowProperty.Unit	10		1	OK
1.2.11.3	Amount	R		1	FlowProperty.Quantity	FlowProperty.Quantity	40		1	Possible data loss of "FlowProperty .QuantityMin", "FlowProperty .QuantityMax" and "FlowProperty .StandardDev" Data type mismatch: impossible to map non-numeric values, such as "YES", "NO", "red", "recyclable" etc.

1.2.12	Amount			U						Import is only applicable if one or more of the SPINE parameter names "Quantity", "QuantityMin", "QuantityMax and "StandardDev" can be identified in the ISO/TS 14048 data set. The identification must be done by the importer.
1.2.12.1	Name	L	I	1	"SPINE95Quantity"	N/A	-	-	-	Data loss
1.2.12.2	Unit			1						OK
1.2.12.2.1	Symbol or name	L	I	1	Flow.Unit	Flow.Unit Add post to Unit nomenclature if not present	10		1	OK
1.2.12.2.2	Explanation	ST		1	Unit.Notes	Unit.Notes (add Notes column to Unit table if not present)	FT		1	OK
1.2.12.3	Parameter			U					4	Possible data loss
1.2.12.3.1	Name	L	I	1	"Quantity" or "QuantityMin" or "QuantityMax or "StandardDev"	N/A	-	I	1	Possible data loss
1.2.12.3.2	Value	R		1	Flow.Quantity or Flow.QuantityMin or Flow.QuantityMax or Flow.StandardDev respectively	Flow.Quantity or Flow.QuantityMin or Flow.QuantityMax or Flow.StandardDev respectively if one or more of the corresponding parameters can be identified by the importer in the ISO/TS 14048 data set	255		1	Possible data loss
1.2.13	Mathematical relations			1						OK
1.2.13.1	Formulae	MR		U	"See process.process_description. technology.technical_content _and_functionality"	ObjectOfStudy.Function (as a list)	FT		1	OK
1.2.13.2	Name of variable	MV		U	-	ObjectOfStudy.Function (as a list)	FT		1	OK
1.2.13.3	Value of variable	R		U	-	ObjectOfStudy.Function (as a list)	FT		1	OK
1.2.14	Documentation			U					2	OK. One allowed occurrence per Flow, and one per Activity
1.2.14.1	Data collection	L		1	QMetaData.DataType	QMetaData.DataType Add post to QMetaDataType.Name nomenclature if not present	100	U	1	OK
1.2.14.2	Collection date	DI		1	QmetaData.DateConceived	QMetaData.DateConceived	23		1	OK
1.2.14.3	Data treatment	FT		1	QMetaData.Method QMetaData.Notes QMetaData.Represents List of PropertyType.Notes	QMetaData.Method	FT		1	OK. See also 1.1.9 Data acquisition for general QMetaData
1.2.14.4	Reference to data source	ST		U	QMetaData.LitteratureRef	QMetaData.LitteratureRef (list)	FT		1	QMetaData.LitteratureRef may contain more than 1 reference in the same field

2	**Modelling and validation**			1					1	OK. The system modeller and system value are both described in the modelling and validation. Corresponds in general to parts of Inventory.
2.1	Intended application	FT		1	Inventory.IntendedUser Inventory.GeneralPurpose Inventory.DetailedPurpose	Inventory.DetailedPurpose	FT		1	OK
2.2	Information sources	ST		U	inventory.Publication	Inventory.Data (list) (append)	FT		1	OK. Context data not supported in ISO/TS 14048 why information sources preferably are documented directly in relation to their corresponding data value. Any additional information source references may appear in the Inventory.Data field, but this is not an extensive list.
2.3	Modelling principles			1					1	OK
2.3.1	Data selection principle	FT		1	"See modelling_and_validation.other.information"	Inventory.Data (append)	FT		1	OK
2.3.2	Adaptation principles	FT		1	"See modelling_and_validation.other.information"	Inventory.Data (append)	FT		1	OK
2.3.3	Modelling constants			U						OK
2.3.3.1	Name	ST	I	1	"See process.process_description.technology.technical_content_and_functionality"	ObjectOfStudy.Function (append)	FT		1	OK
2.3.3.2	Value	R		1	-	ObjectOfStudy.Function (append)	FT		1	OK
2.4	Modelling choices			1					1	OK
2.4.1	Criteria for excluding elementary flows	FT		1	Inventory.NatureBoundary	Inventory.NatureBoundary (append)	FT		1	OK
2.4.2	Criteria for excluding intermediate product flows	FT		1	Inventory.OtherBoundaries	Inventory.OtherBoundaries (append)	FT		1	OK
2.4.3	Criteria for externalizing processes	FT		1	"See modelling_and_validation.modelling_choices.criteria_for_excluding_intermediate_product_flows"	Inventory.OtherBoundaries (append)	FT		1	OK
2.4.4	Allocations performed			1					1	OK
2.4.4.1	Allocated co-products	ST		1	"See modelling_and_validation.allocations_performed.allocation_explanation"	Inventory.Allocations (append)	FT		1	OK
2.4.4.2	Allocation explanation	FT		1	Inventory.Allocations	Inventory.Allocations (append)	FT		1	OK

2.4.5	Process expansion			1					1	OK
2.4.5.1	Process included in expansion	ST		1	"See modelling_and_validation. process_expansion.process_ expansion_explanation"	Inventory.LateralExpansion	FT		1	OK
2.4.5.2	Process expansion explanation	FT		1	Inventory.LateralExpansion	Inventory.LateralExpansion	FT		1	OK
2.5	Data quality statement	FT		1	"See modelling_and_validation. other_information"	Inventory.Data (append)	FT		1	OK
2.6	Validation			U					1	OK
2.6.1	Method	FT	I	1	"See modelling_and_validation. other_information"	Inventory.Data (list) (append)	FT		1	OK The nomenclature can be disregarded with the motivation that: 1. A free-text typed data field is not suitable to act within a foreign key construction in a relational database 2. It serves no urgent purpose
2.6.2	Procedure	FT		1	"See modelling_and_validation. other_information"	Inventory.Data (list) (append)	FT		1	OK
2.6.3	Result	FT		1	"See modelling_and_validation.other.information"	Inventory.Data (list) (append)	FT		1	OK
2.6.4	Validator	ST		1	Juridical Person (all fields) referred by Inventory.Reviewer	Inventory.Data (list) (append)	FT		1	OK. SPINE can only refer to one Reviewer
2.7	Other information	FT		1	Inventory.Data Inventory.Notes Inventory.Applicability	Inventory.Notes (append)	FT		1	OK

3	**Administrative information**			1						OK
3.1	Identification number	L		1	ObjectOfStudy.Id & Activity.Id	Inventory.Notes (append) New ObjectOfStudy.Id and Activity.Id are created upon import to SPINE	FT		1	OK. Original data set identifier is stored for transparency when mapping to SPINE. Data conversion always implies data distortion and hence the data set is different after conversion. A new data set identifier is hence created upon conversion.
3.2	Registration authority	L		1	"CPM (Center for Environmental Assessment of Product and Material Systems), Chalmers University of Technology, Göteborg, Sweden"	Inventory.Notes (append)	FT		1	OK
3.3	Version number	Int		1	1	Inventory.Notes (append)	FT		-	OK. Data published in SPINE@CPM rarely change, why no explicit version control is defined within SPINE@CPM.
3.4	Data commissioner	ST		1	JuridicalPerson referred by Inventory.Commissioner	JuridicalPerson.MailAddress referred by Inventory.Commissioner	200	U	1	OK
3.5	Data generator	ST		1	JuridicalPerson referred by Inventory.Practitioner	JuridicalPerson.MailAddress referred by Inventory.Practitioner	200	U	1	OK
3.6	Data documentor	ST		1	"See modelling_and_validation. information_sources"	Inventory.Publication (also publication) (append)	FT		1	OK
3.7	Date completed	DF		1	Inventory.DateCompleted	Inventory.DateCompleted	10		1	OK
3.8	Publication	ST		1	"See modelling_and_validation. information_sources"	Inventory.Publication (also data_documentor) (append)	FT		1	OK
3.9	Copyright	ST		1	Inventory.Copyright	Inventory.Copyright	60		1	OK
3.10	Access restrictions	ST		1	Inventory.Availability	Inventory.Availability	255		1	OK

Appendix A. Mapping of nomenclatures

This chapter describes the specific mapping rules applied to attributes that have a corresponding nomenclature. Specific attention must be taken towards ISO/TS 14048 exclusive nomenclatures and nomenclaturised attributes in SPINE that are required in order to be compatible with SPINE@CPM information system.

A.1 Exclusive nomenclatures

aggregation_type

referring to the attribute
data_documentation_of_process.process.process_description.aggregation_type

Corresponding SPINE nomenclature:

This attribute does not exist explicitly in SPINE

Mapping:

data_documentation_of_process.process.process_description.aggregation_type is mapped to the *Inventory.Data* field in SPINE. Since the aggregation is rarely done in one single dimension it may be confusing to interpret this attribute why it is not found to be a problem to leave the aggregation_type nomenclature out from the mapping.

direction

referring to the attribute
data_documentation_of_process.process.inputs_and_outputs.direction

Corresponding SPINE nomenclature:

FlowType.Type referring to the attribute *Flow.SubType*
FlowType.Type differs slightly from direction. The value: "Non-flow-related aspects" is missing in *FlowType.Type.*

Mapping:

data_documentation_of_process.process.inputs_and_outputs.direction is mapped 1 to 1 to the the *Flow.SubType* field. The name “State” is added to the *FlowType.Type* nomenclature and then mapped to “Non-flow-related aspects”. The reason that “State” and not “Non-flow-related aspects” is added to the *FlowType.Type* nomenclature is that there is a field length limitation of 6 characters in the current data model.

receiving_environment

referring to the attribute:
data_documentation_of_process.process.inputs_and_outputs.receiving_environment

Corresponding SPINE nomenclature:

Environment.Name where the attribute *Environment.Superior* name equals to "Global"; referred by the attribute *Flow.ImpactMedia*. The reference may be indirect by the hierarchical structure of the *Environment* table[1].
Environment differs slightly from recieving_environment. The name "Other" is present in *Environment.Name* where the *Environment.Superior* is "Global".

Mapping:

data_documentation_of_process.process.inputs_and_outputs.receiving_environment is mapped 1 to 1 to the the *Flow.ImpactMedia* field via the hierarchical structure of the *Environment* table. If the *Environment.Name* is the value "Other" then NULL is mapped from SPINE to ISO/TS 14048, and the explanation is mapped to the data_documentation_of_process.process.inputs_and_outputs. receiving_environment_specification attribute.

A.2 Inclusive nomenclatures

quantitative_reference.type

referring to the attribute:
data_documentation_of_process.process.process_description.quantitative_reference.type

Corresponding SPINE nomenclature:

The attribute and concept differs substantially between the formats

Mapping:

All attributes describing the data_documentation_of_process.process.process_description.quantitative_reference including data_documentation_of_process.process.process_description .quantitative_reference.type are appended to *ObjectOfStudy.Function.*

technical_scope

referring to the data field:
data_documentation_of_process.process.process_description.technical_scope

Corresponding SPINE nomenclature:

ProcessType.Category referring to the attribute *ObjectOfStudy.Category*
ProcessType.Category differs slightly from technical_scope. *ProcessType.Category* contains more than the recommended names for technical_scope.

[1] Compare to the nomenclature receiving_environment_specification

Mapping:

data_documentation_of_process.process.process_description.technical_scope is mapped 1 to 1 to the *ObjectOfStudy.Category*. If a value is not present in the target nomenclature it is added when performing the mapping.

area_name

referring to the attribute:
data_documentation_of_process.process.process_description.valid_geography.area_name

Corresponding SPINE nomenclature:

The attribute and concept differs substantially between the formats

Mapping:

ISO/TS 14048 to SPINE:
data_documentation_of_process.process.process_description.valid_geography .area_name is appended as a list to *Inventory.GeographicalBoundary*
SPINE to ISO/TS 14048:
Inventory.GeographicalBoundary is mapped to data_documentation_of_process .process.process_description.valid_geography.area_description

GIS_reference

referring to the attribute:
data_documentation_of_process.process.process_description.valid_geography.gis_reference

Corresponding SPINE nomenclature:

The attribute and concept differs substantially between the formats

Mapping:

ISO/TS 14048 to SPINE:
data_documentation_of_process.process.process_description.valid_geography .gis_reference is appended as a list to *Inventory.GeographicalBoundary*
SPINE to ISO/TS 14048:
Inventory.GeographicalBoundary is mapped to data_documentation_of_process .process.process_description.valid_geography.area_description

group

referring to the attribute:
data_documentation_of_process.process.inputs_and_outputs.group

Corresponding SPINE nomenclature:

FlowType.Category referring to the attribute *Flow.Category.*
FlowType.Category differs slightly from group.

Mapping:

data_documentation_of_process.process.inputs_and_outputs.group is mapped 1 to 1 to *Flow.Category.* If the value is not present in the target nomenclature, it is added when performing the mapping.

receiving_environment_specification

referring to the attribute:
data_documentation_of_process.process.inputs_and_outputs.receiving_environment_specification

Corresponding SPINE nomenclature:

Environment.Name referred by the attribute *Flow.ImpactMedia* [2]. *Environment.Name* differs slightly from recieving_environment_specification.

Mapping:

SPINE to ISO/TS 14048:
data_documentation_of_process.process.inputs_and_outputs.receiving_environment_specification attribute is mapped to the *Flow.ImpactMedia* attribute if not empty. If empty it is not mapped.
ISO/TS 14048 to SPINE:
If a data set contains a post in inputs_and_outputs with a receiving_environment_specification name that is not specified in the *Environment.Name* table, the missing name is added to the *Environment.Name* nomenclature with the *Environment.Superior* field as the receiving_environment.

name.reference_to_nomenclature

referring to the attribute:
inputs_and_outputs.name.reference_to_nomenclature

Corresponding SPINE nomenclature:

None

Mapping:

The idea to have a nomenclature for nomenclatures is useful, but requires a worldwide administration to define the valid names. Until that happens the inputs_and_outputs.name.reference_to_nomenclature is mapped to *Substance.Notes.*
The name of the SPINE@CPM substance nomenclature:
"SPINE@CPM1997Substance" is mapped to inputs_and_outputs.name.reference_to_nomenclature.

[2] Compare to the nomenclature receiving_environment

amount.name

referring to the attribute:
data_documentation_of_process.process.inputs_and_outputs.amount.name

Corresponding SPINE nomenclature:

The attribute and concept of differs between the formats

Mapping:

The name of the amount from SPINE is always "SPINE95Quantity".
Import to SPINE is only applicable if one or more of the SPINE parameter names "Quantity", "QuantityMin", "QuantityMax and "StandardDev" can be identified in the ISO/TS 14048 data set. The identification should be done by the importer.

parameter.name

referring to the attribute:
data_documentation_of_process.process.inputs_and_outputs.amount.parameter.name

Corresponding SPINE nomenclature:

The quantitative attributes of the table *Flow*; namely: *Flow.Quantity, Flow.QuantityMin, Flow.QuantityMax, Flow.StandardDev*.

Mapping:

SPINE to ISO/TS 14048:
The name of the parameters from SPINE is always "Quantity", "QuantityMin", "QuantityMax", and "StandardDev". Attributes that doesn't contain any data are not converted.
ISO/TS 14048 to SPINE:
Import to SPINE is only applicable if one or more of the SPINE parameter names "Quantity", "QuantityMin", "QuantityMax and "StandardDev" can be identified in the ISO/TS 14048 data set. The identification should be done by the importer. If others than these parameters are found these will not be imported and will hence be lost upon conversion.

unit.symbol_or_name

referring to the attributes:
data_documentation_of_process.process.inputs_and_outputs.property.unit
data_documentation_of_process.process.inputs_and_outputs.unit.symbol_or_name
data_documentation_of_process.process.process_description.quantitative_reference.unit

Corresponding SPINE nomenclature:

Unit.Name referred by the attribute *Flow.Unit, FlowProperty.Unit*, *Substance.DefaultUnit, SubstanceProperty.Unit,* and *ActivityParameterType.Unit*

Mapping:

data_documentation_of_process.process.inputs_and_outputs.property.unit and data_documentation_of_process.process.inputs_and_outputs.unit.symbol_or_name are mapped to *FlowProperty.Unit* and *Flow.Unit* respectively. Any value appearing in the data field in the data_documentation_of_process.process.inputs_and_outputs.property and/or data_documentation_of_process.process.inputs_and_outputs.unit.symbol_or_name attribute is added to the corresponding *Unit.Name* nomenclature if not already present.

data_documentation_of_process.process.process_description.quantitative_reference.unit is mapped to *ObjectOfStudy.Function ,* see quantitative_reference.type.

When mapping from SPINE to ISO/TS 14048, *ObjectOfStudy.Function* is mapped to data_documentation_of_process.process .process_description_technical_content_and_functionality

modelling_constants.name

referring to the attribute:
data_documentation_of_process.modelling_and_validation.modelling_principles.modelling _constants.name

Corresponding SPINE nomenclature:

This attribute does not exist in SPINE

Mapping:

ISO/TS 14048 to SPINE:

All attributes in data_documentation_of_process.modelling_and_validation .modelling_principles.modelling_constants including data_documentation_of_process .modelling_and_validation.modelling_principles.modelling_constants.name are appended as a list to *ObjectOfStudy.Function.*

SPINE to ISO/TS 14048:

ObjectOfStudy.Function is mapped to data_documentation_of_process.process .process_description_technical_content_and_functionality

method

referring to the attribute:
data_documentation_of_process.modelling_and_validation.validation.method

Corresponding SPINE nomenclature:

This attribute does not exist in SPINE

Mapping:

ISO/TS 14048 to SPINE:

All attributes in data_documentation_of_process.modelling_and_validation.validation including data_documentation_of_process.modelling_and_validation.validation.method are appended as a list to *Inventory.Data.*

SPINE to ISO/TS 14048:

Inventory.Data is mapped to data_documentation_of_process.modelling_and _validation.other_information

A.3 SPINE nomenclature, including user defined nomenclature

A.3.1 Nomenclatures related to mandatory attributes in SPINE

The attributes referring to the nomenclatures in this chapter are required for the data set to be compatible with the SPINE@CPM information system.

ActivitySubtype.Name

ActivitySubtype.Name relates to the attributes *ObjectOfStudy.ActivityType* and *Activity.Subtype.*

Corresponding ISO/TS 14048 nomenclature:

None (i.e *ActivitySubtype.Name* is a user defined nomenclature)

Mapping:

ObjectOfStudy.ActivityType is mapped to data_documentation_of_process.process.process_description.technology.short_technology_descriptor. When converting from ISO/TS 14048 to SPINE the importer must provide the information for the *ObjectOfStudy.ActivityType*, as "Process" or "Transport".

FlowType.Type

See chapter A.1 - direction

FlowType.Category

See chapter A.2 - group

Environment.Name

See chapter A.2 - receiving_environment_specification

Geography

Geography.AreaName relates to the attribute *Flow.ImpactRegion*

Corresponding ISO/TS 14048 nomenclature:

None (i.e *Geography.AreaName* is a user defined nomenclature)

Mapping:

Geography.AreaName including the full hierarchical path*, Geography.AreaType, Geography.Notes,* referred by *Flow.ImpactRegion* is mapped to data_documentation_of_process.process.inputs_and_outputs.geographical_location Any value appearing in the data field in the data_documentation_of_process.process.inputs_and_outputs.geographical_location attribute is added to the corresponding *Geography.AreaName* nomenclature if not already present.

Substance

Substance.DefaultName relates via *Substance.Id* to the attribute *Flow.SubstanceId*

Corresponding ISO/TS 14048 nomenclature:

The nomenclature from which the inputs_and_outputs.name.name_text is collected is stated in the inputs_and_outputs.name.reference_to_nomenclature field. (The inputs_and_outputs.name.reference_to_nomenclature is itself defined in ISO/TS 14048 as having a nomenclature, but this will not influence the mapping unless a routine of how to treat this nomenclature is agreed upon worldwide).

Mapping:

Substance.DefaultName is mapped to data_documentation_of_process.process.inputs_and_outputs.name.name_text where the data_documentation_of_process.process.inputs_and_outputs.name.reference_to_nomenclature is always "SPINE@CPM1997Substance".
Any value appearing in the data field in the data_documentation_of_process.process.inputs_and_outputs.name.name_text attribute is added to the corresponding *Substance.DefaultName* nomenclature if not already present. data_documentation_of_process.process.inputs_and_outputs.name.reference_to_nomenclature and data_documentation_of_process.process.inputs_and_outputs.name.reference_to_nomenclature are both mapped to *Substance.Notes*.

Unit.Name

See chapter A.2 - unit.symbol_or_name

A.3.2 Nomenclatures related to optional attributes in SPINE

JuridicalPerson

JuridicalPerson relates to the attributes *ObjectOfStudy.Site, ObjectOfStudy.Owner, Inventory.Practitioner, Inventory.Reviewer,* and *Inventory.Commissioner*.

Corresponding ISO/TS 14048 nomenclature:

None (i.e *JuridicalPerson* is a user defined nomenclature)

Mapping:

When exporting from SPINE@CPM via ISO/TS 14048 all the fields in one record in the *JuridicalPerson* table will be concatenated into the corresponding ISO/TS 14048 attributes.

Inventory.Practitioner is mapped 1 to 1 to data_documentation_of_process.administrative_information.data_generator

Inventory.Reviewer is mapped to data_documentation_of_process.modelling_and_validation.validation.validator data_documentation_of_process.modelling_and_validation.validation.validator is appended as a list to *Inventory.Data*

Inventory.Commissioner is mapped 1 to 1 to data_documentation_of_process.administrative_information.data_commissioner

ObjectOfStudy.Owner has no explicit corresponding ISO/ST 14048 attribute and is mapped to data_documentation_of_process.process_description.technology .technical_content_and_functionality

ObjectOfStudy.Site is mapped to data_documentation_of_process.process.process_description.valid_geography.sites. data_documentation_of_process.process.process_description.valid_geography.sites is appended as a list to *Inventory.GeographicalBoundary*

It is very likely that the data about the same *JuridicalPerson* in different data sources will differ regarding the exact typing of characters of the names and/or addresses. Therefore, whenever data is imported into SPINE@CPM from an ISO/TS 14048 data set it is possible that a record about the juridical person already exists in SPINE@CPM with a different typing of names and/or addresses. If there is not an exact match between the typing when importing, a new record will be inserted in SPINE@CPM, which may result in more than one record referring to the same juridical person.

ProcessType

See chapter A.2 - technical scope

Sector

Sector.Name relates to the attribute *ObjectOfStudy.Sector*

Corresponding ISO/TS 14048 nomenclature:

None (i.e *Sector.Name* is a user defined nomenclature)

Mapping:

ObjectOfStudy.Sector is mapped to data_documentation_of_process.process.process_description.class.name where the data_documentation_of_process.process.process_description.class.reference_to _nomenclature is always "SPINE@CPM1997ObjectOfStudy.Sector". If "Sector" is found in the first instance of data_documentation_of_process .process.process_description.class.reference_to _nomenclature as a sub-string then the first instance of the data_documentation_of_process.process.process _description.class.name is mapped to *ObjectOfStudy.Sector*. All the data_documentation_of_process.process.process_description.class.name and data_documentation_of_process.process.process_description.class.reference_to _nomenclature is mapped to *Inventory.Notes*.

Appendix B
SPINE (LCI)-attributes excluded from the mapping

Activity:
- Aggregated
- Finished
- *Category*

Allocation

BaseFlow

FlowConnection
- InRatio
- InRatioUpper
- InRatioLower
- OutRatio
- OutRatioUpper
- OutRatioLower

FlowProperty
- QuantityMin
- QuantityMax
- StandardDev
- MetaId

FlowType
- Notes

ProcessType
- Notes

PropertyType
- Notes

Composition

Substance
- MassEquivalence
- SubstanceProperty
- UnitEffect

Appendix C
Unique identification and version control of data sets.

If any changes whatsoever from the original ISO/TS 14048 formatted data set occur, the data set is different from the original. Data changes include data conversion distortions and correction of figures and spelling errors. It is desirable that the original ISO/TS 14048 data set identifier is sustained if a data set is communicated between databases. However, data conversion almost *always* implies data distortion which means that the data set is not identical after conversion. This means that it is questionable if the unique identifier should be preserved after conversion.

The SPINE@CPM organisation endeavours to maintain a well defined data administration which includes keeping consistency of data sets *within* SPINE@CPM. However, it cannot be taken for granted that consistency is kept before data enters into SPINE@CPM and after data is communicated to another organisation with another information system.

Format analysis

The process concept in ISO/TS 14048 is a combination of the *ObjectOfStudy* and *Activity* concepts in SPINE. An *ObjectOfStudy* can contain zero or more *Activities* but a specific *Activity* can only be related to exactly one *ObjectOfStudy*. There is no explicit data field to document the version of an *ObjectOfStudy* or *Activity* in SPINE.

An *ObjectOfStudy* is in SPINE uniquely identified by one attribute:
ObjectOfStudy.Id
This term constitute the key to access all the data related to one unique SPINE *ObjectOfStudy* in SPINE@CPM (including all related *Activities*).

An *Activity* is in SPINE uniquely identified by one attribute:
Activity.Id
This term constitute the key to access all the data related to one unique SPINE *Activity* (including the single related *ObjectOfStudy*). Note that the *ObjectOfStudy.Id* is a true foreign key to *Activity*, i.e. An *Activity* cannot exists in SPINE without a reference to an *ObjectOfStudy*.

A process is in ISO/TS 14048 uniquely identified by the three attributes:
data_documentation_of_process.administrative_information.identification_number
data_documentation_of_process.administrative_information.registration_authority
data_documentation_of_process.administrative_information.version_number
These three terms constitute the key to access all the data related to one unique ISO/TS 14048 formatted process.

Identification mapping ISO/TS 14048 to SPINE

Since a data conversion almost always implies data distortion it is not good practice to sustain the original data set identifier after conversion. However it is useful to store the original identifier to increase the transparency of a converted data set.

When data is converted from ISO/TS 14048 into SPINE the original ISO/TS 14048 identifier data:

data_documentation_of_process.administrative_information.identification_number
data_documentation_of_process.administrative_information.version_number
data_documentation_of_process.administrative_information.

is therefore saved at the end of the *Inventory.Data* field with the syntax described in the example below:

Example

---------Begin ISO/TS 14048 original identifier do not edit---------
[identification_number]IMI-20020901-123IMI-20020902-456
[version_number]1
[registration_authority]CPM - Centre for Assessment of Product and Material Systems, Chalmers University of Technology Göteborg, Sweden
---------End ISO/TS 14048 original identifier do not edit---------

Upon data conversion, a check is done if there exists an identical string as described in the example above in any of the *Inventory.Data* fields in the receiving SPINE formatted database. If this is the case, it is assumed that the ISO/TS 14048 data set has already been imported into the SPINE database. The person performing the conversion must then decide if the existing data set in the SPINE database shall be kept or be overwritten. If the data is to be overwritten or if the exact string is not found in the receiving SPINE database, the data is inserted and a new unique *ObjectOfStudy.Id* and *Activity.Id* is created.

All original ISO/TS 14048 data sets imported into SPINE@CPM are systematically stored as files which can be retrieved if needed.

Identification mapping SPINE to ISO/TS 14048

When mapping the unique identity of a SPINE *Activity* data set from SPINE@CPM the following apply:

- data_documentation_of_process.administrative_information.identification_number correspond to *ObjectOdStudy.Id* concatenated with *Activity.Id*
- The version_number is always 1
- The registration_authority is "CPM - Centre for Assessment of Product and Material Systems, Chalmers University of Technology Göteborg, Sweden"

Example

Existing SPINE data:
ObjectOfStudy.Id = IMI-20020901-123
Activity.Id = IMI-20020902-456

After data conversion into ISO/TS 14048:
data_documentation_of_process.administrative_information.identification_number = IMI-20020901-123IMI-20020902-456
data_documentation_of_process.administrative_information.version_number = 1
data_documentation_of_process.administrative_information.registration_authority = "CPM - Centre for Assessment of Product and Material Systems, Chalmers University of Technology Göteborg, Sweden"

ISO/TS 14048 allows any subset of data_documentation_of_process to be communicated. This gives a possibility to export an *ObjectOfStudy* from SPINE@CPM that doesn't contain any *Activitiy*. In this case only the *ObjectOfStudy.Id* will be exported to the data_documentation_of_process.administrative_information.identification_number.

Version control within SPINE@CPM

Before a data set is inserted into SPINE@CPM it is reviewed, and necessary alterations are made such as obvious spelling errors and clarifications of inconsistencies according to the SPINE@CPM review process [4]. The only time it would be useful to apply a version control of a data set is if is changed after it is inserted and published in the SPINE@CPM database. Since this situation is rarely occurring within SPINE@CPM, no specific administration routines are defined at this time to implement version control of data sets. If this situation does happen, the person who makes the change adds appropriate information about the changes in the *Inventory.Notes* field. However the data in the fields: *ObjectOfStudy.Id*, *Activity.Id* and *Inventory.DateCompleted* is not changed. When converting a data set from SPINE@CPM to ISO/TS 14048 the version is always 1. Since there is no version control within SPINE@CPM this means that, if the data set is converted to ISO/TS 14048 before and after the change, the unique identifier will be the same, but the data content is slightly different[3].

The *Inventory.Data* attribute in SPINE has a one to one mapping to the data_documentation_of_process.modelling_and_validation.other_information attribute in ISO/TS 14048. If a SPINE@CPM data set that was originally converted from an ISO/TS 14048 formatted data set is converted back into ISO/TS 14048, the information in the *Inventory.Data* field including the original ISO/TS 14048 identifier is mapped to the data_documentation_of_process.modelling_and_validation.other_information attribute.
If this new ISO/TS 14048 data set is converted back again into SPINE@CPM the *Inventory.Data* field will contain both the first data identifier and the second, with the

[3] The cost of implementing a rigorous version control administration is at this time expected to be too high compared to the estimated benefits. However, when the SPINE@CPM database is converted to a format based directly on ISO/TS 14048, the data set identification and version control routines will be reviewed and redefined.

second at the very end of the *Inventory.Data* field. This is a way to keep track of the conversion history of the data set.

The different stages related to the import and export of ISO/TS 14048 formatted data sets to and from SPINE@CPM is illustrated in figure 3.

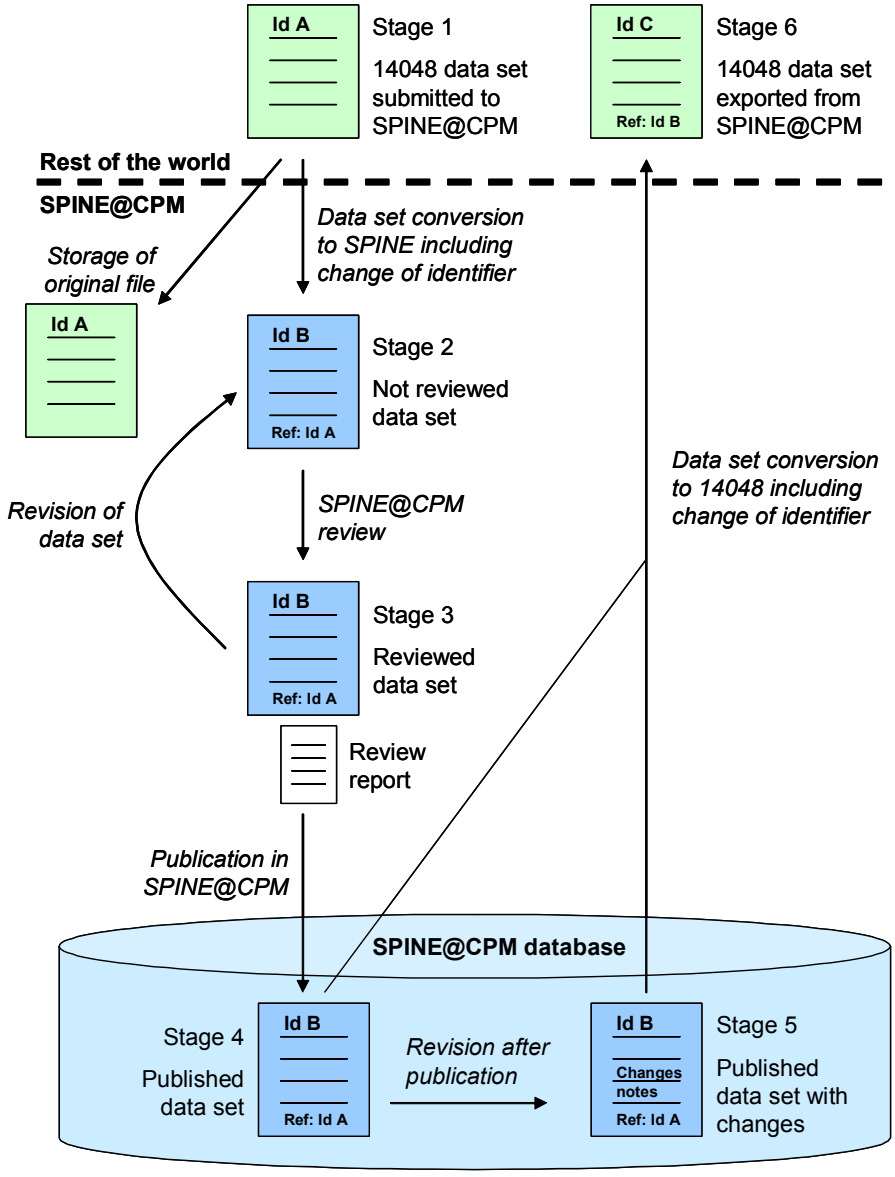

Figure 3. Stages of a data set. The data set identifier changes only upon data conversion between the formats. A reference to the original data set is always documented to a converted data set. Only published data can be retrieved from SPINE@CPM. At rare occasions a data set is revised after publication (stage 4 to stage 5). This does not imply a change of the data set identifier in SPINE@CPM.

References

1. ISO/TS 14048:2002; *"Environmental management – Life Cycle Assessment – Data documentation format"*, ISO/TC 207/SC 5/WG 2/TG N 20, SIS
2. Carlson R., Löfgren G., Steen B.; *"SPINE, A Relation Database Structure for Life Cycle Assessment"*; Göteborg; IVL-REPORT; September 1995
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4. Pålsson A-C.; "Review of LCI-data at SPINE@CPM"; CPM Internal Report 1999