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Introduction and guide to LCA data documentation using the CPM documentation criteria and the ISO/TS 14048 data documentation format

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1 Introduction

This report describes how to work with documentation of Life Cycle Inventory (LCI) data according to the CPM data documentation criteria using the ISO/TS 14048 data documentation format. The CPM data documentation criteria are a quality agreement that specifies how data should be documented to allow a data user to assess the applicability and the usefulness of the data. Together with the ISO/TS data documentation format the criteria supplies a specification of which information in the format that should be documented. Since the development of the criteria in 1996, they have been used in practical work within both within industry and academia for documentation of environmental data when e.g. building the Swedish national LCA database or company internal databases for different applications.

This report is focused on LCA applications, and thus the terminology, descriptions and examples are based on LCA applications. It can also be used in other applications where data describing a technical system needs to be handled, reported and communicated. The criteria and the ISO/TS 14048 data documentation format can thus be used for a wider range of applications than just LCA, for example to support environmental product declarations (EPD), environmental management systems (EMS) and environmental reporting.

The report has been developed as a part of the work to translate SPINE tools and material into the ISO/TS 14048 data documentation format and is an adaptation and revision of CPM report 1999:1, where documentation is described in terms of the SPINE documentation format [1]. This adaptation has been made to describe how to practically work with documentation according to the CPM data documentation criteria using the ISO/TS 14048 data documentation format.

1.1 Reading instructions

The report is intended to be used both as a practical guide and as a reference when working with data documentation:
- Chapter 2 contains a description of how life cycle inventory data is defined
- Chapter 3 is intended to give an overview of data quality
- Chapter 4 gives a short introduction to the ISO/TS 14048 data documentation format
- Chapter 5 supplies a detailed description and guide on how to work with data documentation according to the CPM data documentation criteria, using the ISO/TS 14048 data documentation.
- Chapter 6 gives some general guidance when working practically with documentation
- Chapter 7 describes some aspects to consider to achieve sufficient documentation
- Appendix 1 includes the nomenclatures that are recommended to use in the documentation
- Appendix 2 gives a complete example of a process documented in the ISO/TS 14048 data documentation format from [ref]
- Appendix 3 supplies a quick guide for the documentation

1.2 Further reading

Below is other reports developed as part of the work to translate SPINE tools and material to ISO/TS 14048:

- *Flemström K, Pålsson A-C. "An interpretation of the CPM data quality requirements in terms of ISO/TS 14048 data documentation format", CPM-report 2003:4*
  Report describing how the CPM data quality requirements (the CPM data documentation criteria) is interpreted in the terms of the technical specification

ISO/TS 14048:2002(E) and ISO 14041:1998(E). The report is an adaptation of CPM report 1999:9 “An interpretation of the CPM use of SPINE in terms of the ISO 14041 standard”

- *Flemström K., Pålsson A-C. “Quick guide when switching data documentation format from SPINE to ISO/TS 14048”, CPM-report 2003:5*
  Report intended to facilitate for users familiar with LCI data documentation using the SPINE format to start using the ISO/TS 14048.

- *Carlson R., Erlandsson M., Flemström K., Pålsson A-C., Tidstrand U., Tivander J. “Data format mapping between SPINE and ISO/TS 14048”, CPM-report 2003:8*
  Report that describes and defines the 2-way mapping between ISO/TS 14048 and SPINE.

Other related CPM reports regarding the ISO/TS 14048 data documentation format are:

- *Carlson R, Pålsson A-C, “First examples of practical application of ISO/TS 14048 Data documentation format”, CPM report 2001:8*
  Report containing eleven processes documented in the ISO/TS 14048 data documentation format
- *Carlson R., Tivander J.; "Data definition and file syntax for ISO/TS 14048 data exchange", CPM Report 2001:9*
  Report intended to support implementation of electronic data exchange or data storage formats based on ISO/TS 14048
- *Carlson R. ”Slutrapport projekt II:F:13 Standardisering” CPM Rapport 2001:18 (in Swedish)*
  Report describing the CPM work and contributions in the standardisation of ISO/TS 14048

2 Life cycle inventory data – a model of a technical system

Life Cycle Inventory (LCI) data is data describing environmentally relevant inputs and outputs of a defined model of a technical system (see figure 1). The inputs and outputs consist of energy and matter that is used in the technical system to fulfil a well-defined function of the system, expressed by a functional unit. For example, the technical system can be a production site where polyethylene is produced. The function of the system can thus be defined as "production of polyethylene", and the functional unit as e.g. 1 kg polyethylene. Examples of relevant inputs and outputs are natural resources, raw materials, energyware, ancillary material, products, by-products, emissions to air, water and soil, residues etc. In ISO/TS 14048 a model of a technical system is referred to as a *Process*, and the inputs and outputs to the process are referred to as *Inputs and outputs*.

The scope of the technical systems that are studied in LCA range from individual process steps or production lines within a site, entire plants, transports and transportation routes, and complex composite systems such as production systems for specific products from cradle to gate.

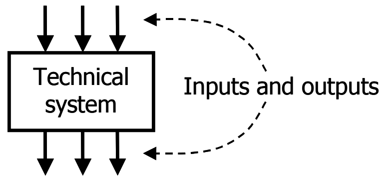

Figure 1: A model of a technical system

A model of a technical system can have an inner structure, i.e. be composed of models of technical systems, e.g. as a combination of unit processes (see figure 2). For example, when performing a LCA study, a flow model of the studied product system is accomplished by linking models of smaller technical systems together in a flow chart. The models are linked to each other by their inputs and outputs. Other types of flow models may also be constructed and used in LCA. For example, a model of a production line within a site may be composed of models of the included process steps. In addition to flow chart models, the models with an inner structure may consist of a number of similar models of technical systems when forming an average, for example an industrial average for a specific product, based on information about the different production sites included in the average.

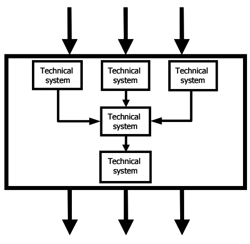

Figure 2: A model of a technical system, composed of models of technical systems

Models of technical systems are acquired through modelling of a real technical system. A model is generally acquired for a specific intended application and purpose. During the modelling many different subjective choices are made which the modeller and data user need to be aware of, since all of these choices have a large influence on the result, e.g. choices regarding what inputs and outputs that are considered environmentally relevant and that should be included, which quantitative reference that should be chosen, what to include and what to exclude within the model, which data sources to use, etc. In order to another person to interpret and understand the model, all choices made during modelling of the technical system need to be sufficiently documented.

An approach describing the different tasks involved when designing a model of a technical system has been developed at Chalmers. The approach is called PHASETS (PHASEs in the design of a model of a Technical System) [2]. PHASETS consists of six phases, where each phase describe defined work tasks in acquisition, compilation and reporting of environmental data for a technical system; from specification of parameter and measurement system, compilation of measurement values, compilation of a model of a technical system to final reporting. Within each phase in PHASETS, information from earlier phases is compiled, i.e. information and data is reported upwards in the structure, to the preparation of a final report. PHASETS phases are:

0. *Defining an entity for a selected parameter;* The choice of entity to measure and the setting up of the measurement system defines the simplest concept; that is, the meaning of a measured value;
1. *Sampling an individual value;* The sampling results in a value for the simplest concept, that is, a measured value;
2. *Forming a frequency function from a set of sample values;* The frequency function aggregates sets of measured values into statistically expressed concepts;
3. *Synthesising a model of a technical system;* The systems synthesis further aggregates the frequency functions from phase 2 into structured models of technical systems;
4. *Aggregating models of technical systems;* The models of technical systems synthesised in phase 3 may be aggregated into complex concepts describing, for example, averages or cradle to gate systems;
5. *Communicating information between different contexts;* between any two phases 0–4 the resulting data and information, is communicated from the generator to the consecutive phase.

Information may also be reported downwards in the structure; for specification of questions and requirements on the information that is acquired and compiled, and for feedback of the work.

When working practically with PHASETS, one generally starts at phase 5 with defining the information needs and requirements for the reporting. Then one continues to phase 3 and 4 to make a draft model of a technical system. Based on the draft model, quantitative data for the selected parameters are acquired and compiled in phases 0 to 2. The information is then compiled into the final model (in phase 3-4) and reported in phase 5.

PHASETS can be used to structure environmental data handling for different purposes and has been especially designed to be the basis in an efficient and quality assured environmental information system. The structure can be used to design routines for acquisition and reporting of credible environmental information and data, to co-ordinate environmental data handling for different applications, to assess and control costs for environmental data acquisition and to develop and manage secrecy handling of environmental information. PHASETS has been successfully used in the Swedish forest industry together with the CPM data documentation criteria to achieve quality assurance of the handling environmental data within production sites [3].

3 Data quality requirements and assessment

Data quality may be generally defined as "characteristics of data that bears on their ability to satisfy stated requirements" [4]. In most LCAs, data describing many different types of technical systems is acquired. Depending on the purpose of the study, requirements is put on data quality and what type of data that can be used in the LCA. The requirements may concern both qualitative and quantitative aspects such as e.g. to what extent the data describes the studied technology, the precision of the data etc. Data quality assessment is thus a complex task, where a multitude of aspects needs to be considered. The quality of any specific LCI-data set is therefore dependent on the context in which it is used. A data set representing a technical system that may be relevant in one application may be irrelevant or even wrong in a different application, even though certain aspects of the system would apply equally well in both applications. For instance, two systems may deliver the same product but be different in all other aspects.

Therefore, the quality of any given LCI-data set in a specific application may only be determined through a thorough knowledge of the system and of the data. Sufficient documentation of the data is fundamental to avoid misuse and misinterpretation of the data. The possibility to assess the quality can thus be considered as a measure of the quality of the data, i.e. the quality of the documentation of the data is in itself a quality aspect. Transparent documentation of the data implies a good basis to judge both the qualitative and quantitative aspects of data quality. This is the only feasible approach to ensure that data quality requirements are met.

3.1 The CPM data documentation criteria – a quality agreement

The CPM data documentation criteria are a quality agreement that specifies how data should be documented, to allow different users to be able to assess and decide the applicability of a certain data set for the application in which he or she intends to use it. This should enable the user to correctly use the information. In this sense data quality is considered to correspond to documentation quality. If the data is not documented or the documentation is difficult to interpret, it is impossible to assess any other aspect of data quality. Thus, the term data quality has been well-defined in the data documentation criteria.

In short, documentation of models of technical systems may be considered to consist of 6 separate, but closely integrated sections (see figure 3). The type of information within each section regards different choices made during the modelling and data acquisition. To fulfil the CPM data documentation criteria, all sections should be documented.

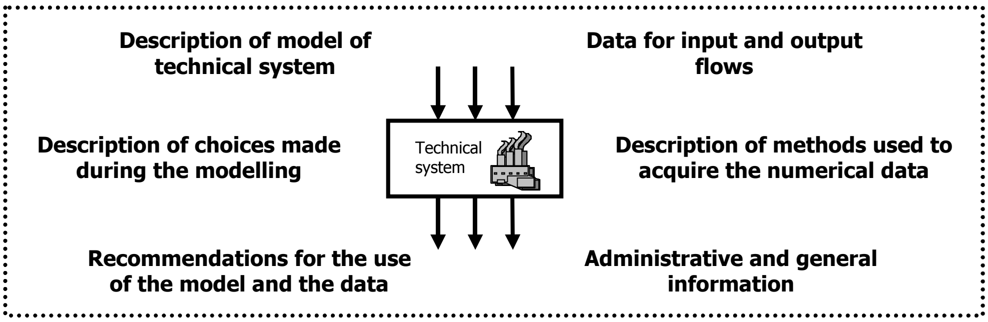

Figure 3. The CPM data documentation criteria (in short), based on [1]

The criteria were published in 1997 and were developed within CPM – the Centre for Environmental Assessment of Product and Material Systems, a joint research forum between industry and Chalmers University of Technology in Sweden [5]. The criteria was defined during the establishment the Swedish LCA database, SPINE@CPM, in a consensus-process where the CPM companies participated, i.e. ABB, Akzo Nobel Surface Chemistry, Perstorp, SCA, Stora (now Stora Enso), Vattenfall and AB Volvo. The criteria are central for the CPM database, which is a quality-assured database. The CPM database was developed to reduce costs of performing individual LCA studies, to increase the availability and quality of LCA data [6].

The criteria were originally expressed in terms of the SPINE data documentation format. As part of the work to translate SPINE tools and material into ISO/TS 14048, the CPM data documentation criteria have been interpreted in terms of ISO/TS 14048 data documentation format. Details about the interpretation can be found in the CPM report 2003:4 [7]. In the translation from SPINE to ISO/TS 14048, the original definition and meaning of the CPM data documentation criteria is maintained.

Since the publication of the CPM data documentation criteria, they have been used in practical work for different applications within companies and other organizations, and have proven very effective. For example, the criteria have been used as basis in the forming of LCA data networks, such as the national network Sirii [8], and in company internal databases for different environmental management purposes, and as basis for documentation and review in the Swedish system for certified environmental product declarations (EPD) [9]

3.2 Dimensions of data quality

When working with documentation of data and data quality assessment it is helpful to structure the different aspects of quality. Generally data quality can be categorised into the dimensions *reliability*, *accessibility* and *relevance*. All three dimensions are equally important to be able to assess the quality and the applicability of a specific data set.

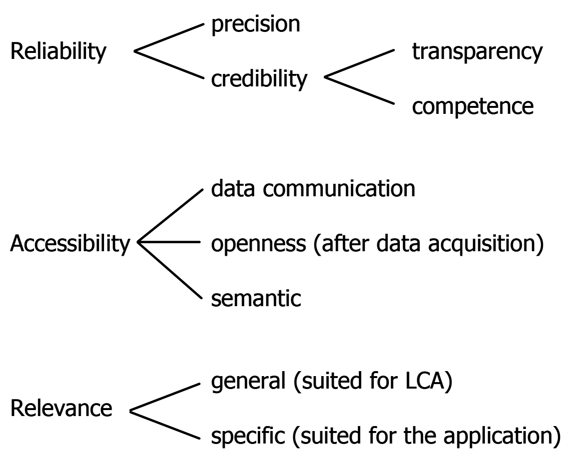

Figure 4: Dimensions of data quality [10]

3.2.1 Reliability

To be able to draw conclusions from the result when using the data, the data should be reliable. The reliability of data depends on the *precision* of data and the *credibility* of the origin of the data.

The *precision* of data concerns the numerical accuracy and the uncertainty of data. This quality aspect, though important, is not sufficient if all other aspects of data quality are explicitly not known.

The *credibility* of the origin of the data concerns how credible the data is determined to be. For example, any statement regarding precision is useless, unless the data origin may be considered credible. Credibility may be achieved through *transparency* and *competence.* If the data cannot be transparently reviewed it is impossible to assess its credibility. Also, the credibility of data depends on if the data has been acquired by someone with competence regarding the technology and the system that is described by the data. For instance, a data set describing a specific plant would generally be considered more credible if the data is acquired by someone working within the plant, who are well familiar with the process, than if the data is acquired by someone who is not situated at the plant and is not familiar with the process.

3.2.2 Accessibility

Accessibility of data has generally not been considered as a quality aspect, but more as a general problem in LCA. However, if the data is not accessible for the data users no other quality aspects can be considered. The accessibility of data concerns *data communication*, *openness* after data acquisition and *semantic*.

Data communication is an important aspect of accessibility. In order for data to be useful, it needs to be mobile, i.e. it needs to be efficiently communicated between the data suppliers and the data users. This may be done in many different ways such as via mail, questionnaires, specific formats etc. Data communication may however only be done depending on the *openness* after data acquisition. If aspects regarding openness, e.g. secrecy, is not solved or handled adequately, the accessibility of data will be obstructed.

The *semantic* aspect of data is also a vital component of the accessibility of data. Data are generally acquired within a specific context, for example within a company. When the data are communicated within this specific context, terminology and other aspects regarding e.g. the technology are implicit and do not generally need explanation. However, if the data is to be communicated to someone who operates in a different context, the terminology and other implicit aspects must be explicitly explained, for the data to be understood and accessible.

3.2.3 Relevance

Regardless of all other aspects of data quality, if the data is not relevant for the context in which it will be used it is not useful. For any specific data set relevance can be divided into two groups; *general* (suited for LCA) and *specific* (suited for a specific application). The general issue, i.e. that the data is suited for LCA, regards that the data describes a model of a technical system relevant for LCA in accordance with the definition in section “LCI-data, a model of a technical system”. The specific issue, i.e. that the data is suited for the specific application, regards whether or not the data is relevant for the application in which it is used.

3.3 Data quality requirements according to ISO 14041:1998 (E)

The CPM documentation criteria and the dimensions of data quality support data quality assessment when performing or reviewing an LCA study. According to ISO 14041:1998(E) [11] the following data quality requirements should be considered when performing an LCA:

- time related coverage
- geographical coverage

- technology coverage

Also, further descriptors to define the nature of the data should be given, and the following parameters should be considered at an appropriate level of detail:

- precision
- completeness
- representativeness
- consistency
- reproducibility

These requirements may be grouped into the quality dimensions in the following way:

Quality dimension	*ISO 14041:1998(E) requirement*
Reliability	Precision, Consistency
Accessibility	Reproducibility, Consistency
Relevance	Time related coverage, Geographical coverage, Technology coverage, Completeness, Representativeness

The relevance dimension is thus considered as an important aspect of data quality according to ISO 14041.

A detailed specification on how the ISO 14041:1998 (E) requirements have been interpreted within the CPM group, based on ISO/TS 14048 is found in CPM report 2003:4 [7].

4 The ISO/TS 14048 data documentation format

The technical specification ISO/TS 14048, specifies and describes a data documentation format [4]. The format is part of the ISO 14040 series of standards describing life cycle assessment and is aimed to support transparent documentation, interpretation, review and reuse of LCA data and LCA results.

The technical specification provides requirements of a structure for a data documentation format, to be used for unambiguous and transparent documentation and exchange of LCA and LCI data. It supports transparent reporting, interpretation and review of data collection, data calculation, data quality and data reporting. It also facilitates data exchange between data users in different contexts etc. ISO/TS 14048 outlines and specifies a form for users to report LCA data within industries, institutes etc.

A model of a technical system is in ISO/TS 14048 referred to as *Process*. The data documentation format for description of a process consists of three parts (see figure 5):

- *Process*, which contains the description of properties of the modelled process with regard to technology, time-related and geographical coverage etc. The Process part also includes inputs and outputs to the modelled process.
- *Modelling and validation*, which contains the description of prerequisites for the modelling and the validation of the process e.g. modelling choices describing which processes and flows that have been excluded.
- *Administrative information,* which contains general and administrative information related to the administration of the documentation of the process e.g. data commissioner, date completed, copyright etc.

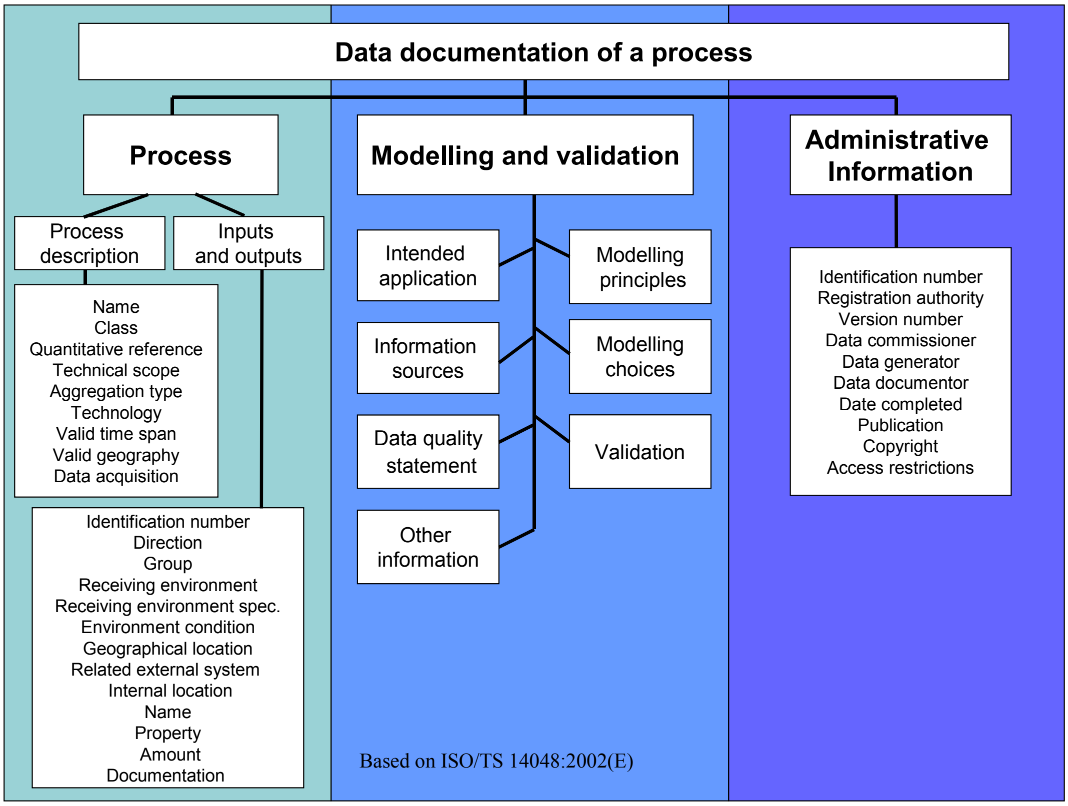

Figure 5: Illustration of structure of the major part in the ISO/TS 14048 data documentation format (based on ISO/TS 14048)

The technical specification can both be used for documenting individual processes and processes that consist of a combination of documented processes. A documented individual process can thus be reused in several different combined processes (see figure 6).

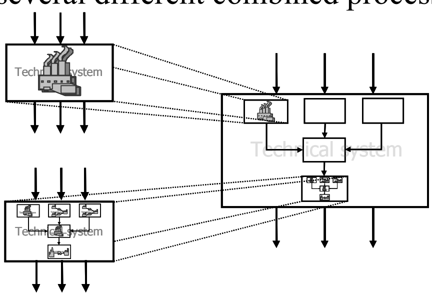

Figure 6: Process that consists of a combination of individually documented processes.

5 Documenting LCI data according to the CPM documentation criteria and the ISO/TS 14048 data documentation format

In order for LCI-data to be assessed with regard to the quantitative and qualitative dimensions of data quality described above, the LCI-data i.e. the model of the technical system need to be sufficiently documented. Documentation of the model is facilitated by a common understanding and agreement of what aspects that are considered relevant to document. The CPM data documentation criteria provides a common agreement of which information in ISO/TS 14048 that should be documented. Thus the CPM data documentation criteria together with the ISO/TS 14048 data documentation format can be regarded as a guideline for quality LCI data documentation. By sharing a common language and a common view of quality, data may easily be communicated between two parties. In this way, all relevant information to enable an assessment of the data is communicated together with the data.

The CPM documentation criteria together with ISO/TS 14048 can be used as a report template when describing any model of a technical system, both for LCI-data and for the study report. Data describing any type of technical system can be documented, e.g. individual processes, cradle-to-gate production systems for specific materials and plants, as well as models of technical systems that contains subsystems i.e. models of technical systems that are composed of models of technical subsystems.

Figure 7 illustrates in which part of the ISO/TS 14048 data documentation format that the different information according to the CPM data documentation criteria is documented.

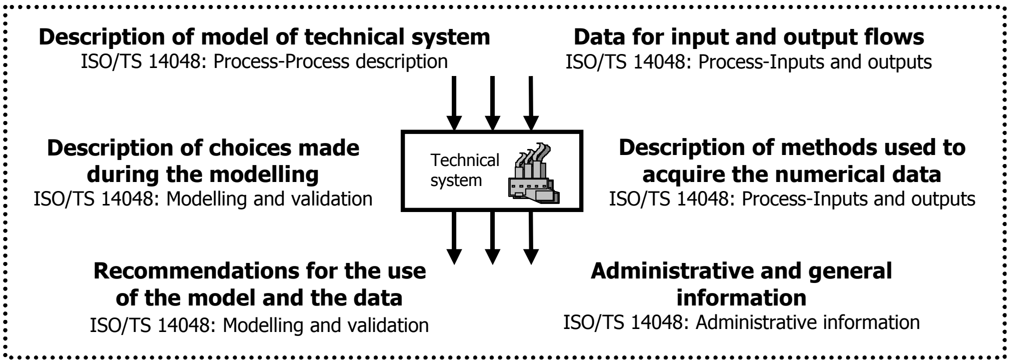

Figure 7. The CPM data documentation criteria and the ISO/TS 14048 data documentation format.

Documentation according to the CPM data documentation criteria using the ISO/TS 14048 is described in detail below. For the interpretation of the description the following is stressed:

- *Order of the information*
  The division into three different parts and the order of the information is based on the structure of ISO/TS 14048 and is aimed to facilitate interpretation. Data documented according to the CPM documentation criteria using the ISO/TS 14048 format do not, however, need to be presented in this order, e.g. when publishing data or making reports, as long as the fields are specified in accordance with the ISO/TS 14048 format.

- *Subheadings*
  In the presentation of the documentation, subheadings have been introduced based on

the CPM data documentation criteria (see figure 7), that is not part of the ISO/TS 14048 data documentation format. The subheadings have been introduced to facilitate the interpretation and to distinguish between different types of information.

- *Nomenclatures*
  For some information, there are nomenclatures that should be used. A nomenclature is a set of specifications or rules to name and classify data in a consistent and unique way. Common nomenclatures facilitate communication and interpretation of the data. All nomenclatures that are recommended to use in the documentation are found in Appendix 1.

- *Additional or more detailed information in ISO/TS 14048 compared to the CPM data documentation criteria*
  The focus of this guide is data documentation according to the CPM data documentation criteria. However, in ISO/TS 14048 there are some additional or more detailed information that may be documented, that are not part of the original meaning of the CPM data documentation criteria. Such information is presented under the headlines "Additional information or specification not included in the CPM data documentation criteria" for each section. This additional information are not explicitly included in the original criteria, but may be used when relevant. The additional information will further specify and improve the reviewability of the process.

5.1 Process

Process holds data and documentation that describe both the qualitative and quantitative properties of the modelled process. This includes documentation of the technical system and its quantitative parameters, together with a description of the relevant circumstances for which the model is valid. The documentation of Process consists of a *Process description* and *Inputs and outputs*.

5.1.1 Process description

5.1.1.1 Description of model of technical system

The description of the process provides a description of the function and the scope of the technical system, i.e. what is included in the system with regard to included activities or processes, equipment and technology, and which quantitative reference that have been chosen. Equipment that has a large influence on the inputs and outputs to the process should be stated especially, for instance cleaning equipment, details regarding technical performance (e.g. degree of efficiency) and the state of the technology (e.g. best available or average technology etc.).

The model of the technical system (the process) is according to the CPM data documentation criteria described through a *Name,* one or several *Classes,* a *Quantitative reference,* a short specification of the *Technical scope*, together with a detailed description of the *Technology*, the *Valid time span*, and the *Valid geography*.

Name

Descriptive and most commonly known name of the process. The name should give a first indication of which technical system that is described.

Class

Class supplies a categorisation of the process, for example according to sector. The class is described by:

- *Name*: The appropriate name in the class that specifies the process according to a class-nomenclature.
- *Reference to nomenclature:* Specification of the class-nomenclature from which the Name is chosen.

According to the CPM data documentation criteria, the sector to which the process belongs should be specified, e.g. manufacturing, agriculture, air transport, etc. There are several statistical classification systems that may be used to specify the sector, for example the EU statistical classification or ISIC (international standard industrial classification of all economic activities). Within CPM, a simplified version of the ISIC classification was developed for the Sector nomenclature (see appendix 1). It is recommended to use either the CPM simplification or the EU or ISIC nomenclature.

Note: A class makes it easy to search and identify the data. Compared to a name of the process, the class according to a nomenclature gives an unambiguous structure.

Example:

- *Name:* Manufacturing – machinery and equipment
- *Reference to nomenclature:* CPM sector nomenclature published in CPM report 1997:6

Quantitative reference

Specification of the quantitative reference for the process. A quantitative reference is the reference to which the amounts of the inputs and outputs are related, e.g. the functional unit or reference flow. The quantitative reference is described by:

- *Type:* The type of quantitative reference, e.g. functional unit, reference flow, etc. The type is chosen from a nomenclature (see appendix 1).
- *Name:* The name of the quantitative reference
- *Amount:* The amount of the quantitative reference
- *Unit:* The unit of the quantitative reference

Example:

- *Type:* Functional unit
- *Name:* Polyethylene
- *Amount:* 1
- *Unit:* kg

Technical scope

A short description of the scope of the process. The scope may range from an individual process, to more composite systems such as a cradle to gate system for a specific product.

The specification is done by a nomenclature, that have been developed within CPM and that is also used in the ISO/TS 14048 document. The nomenclature has been specified in accordance with the different types of scopes that are studied in LCA; i.e.

Unit operation, Gate to gate, Cradle to gate, Gate to cradle or Cradle to grave (see appendix 1).

Technology

Technology contains a description of the technical system. The description is made by a short description in *Short technology descriptor* and in detail in *Technical content and functionality*. The description of the system can also be supplemented with a graphical picture *Technology picture*. For processes described as a combination of separately documented unit processes, the internal structure is documented in *Process contents*.

The description of the technical system should provide the user with an understanding of the process and how the input flows are related to output flows.

Short technology descriptor

Short description of the included technology. This may be used as an abstract that supplements the detailed description in *Technical content and functionality*.

Technical content and functionality

Detailed description of the model of the technical system, with regard to included process steps and activities, etc. The description should provide an understanding on how reported inputs are transformed into the reported outputs.

All process steps that are included in the system should be described, e.g. administration, internal recycling loops, preparation, sewage treatment, scrubber technology etc. Activities within the system that has a large influence on the reported inputs and outputs should especially be stated, since the description should enable an identification of technology that may have a large influence on e.g. emissions, energy consumption etc.

Please note that the description of the model of the technical system only concerns information regarding what is included within the system. Related information regarding e.g. technical subsystems that have been excluded should be described in *Modelling and validation*. Example of such information is information on transports to and from a studied technical system that are not included within the system, but may still be valuable for the data user.

Also, other information that is not directly relevant in the description of the system should be avoided, such as e.g. details about how the product or service delivered by the system is used when it leaves the studied technical system. Such information may however be important for the data user, and should be stated in *Modelling and validation*.

Technology picture

Graphic representation of the technology e.g. a graphical flowchart of the process. The purpose of the picture is to illustrate the technical system and supplement the description of technology in *Technical content and functionality.*

Process contents

Process contents is used only for processes that consists of a combination of individually documented processes (please see figure 6). The process contents describes which documented processes that are included in the process and how the processes are linked together in e.g. a flow chart. This allows for fully transparent documentation of e.g. LCI product systems. The process contents is described in terms of:

- *Included processes:* References to the documentation each process that is included.
- *Intermediate product flows:* References to the inputs and outputs that link the included processes together. The referencing is done two by two by for each link by specifying the source and the destination process and the inputs or outputs in the two processes that are linked together. This is documented by:
  - *Source process:* Reference to the process that is the source of the input or output.
  - *Input and output source:* Reference to the specific input or output in the source process.
  - *Input and output destination:* Reference to the specific input and output in the destination process that is linked together with the input or output source.
  - *Destination process:* Reference to the process which is the destination of the input or output

Note: When using specifically designed software, the process contents is often only presented to the user as a graphical flow chart. However, the process contents can also be used for paper-based data handling. Please see CPM report 2001:8 [12], for an example on how such a composite system is documented in ISO/TS 14048.

Valid time span

Description of the time span during which the documented process and data may be valid.

The valid time span is generally identical to the time of the data collection. Examples of limitations in time for the validity of the data may be future known technology shifts, planned measurements improvements, major changes in society or specific seasons. The range of the valid time span for the process and the data may be described through:

- *Start date:* The start date of the valid time span, specified as XXYY-MM-DD
- *End date:* The end date of the valid time span, specified as XXYY-MM-DD
- *Time-span description:* A description of the valid time span.

Please note that the specification of a start and end date should always be supplemented by a description, to facilitate the interpretation of the stated time-span. If it is difficult to specify a start and/or an end date, it is sufficient to supply a general description of the valid time-span.
Please also note that the valid time span is not the time when the data was published. The time of publication is stated in *Date completed* (see Modelling and validation below)

Example:

- *Start date:* 2002-01-01
- *End date:* 2005-01-01
- *Time-span description:* The process data is valid only for three years, due to that a major process change is planned for 2005.

Valid geography

Description of the geographical area or location for which the documented process is valid. The valid geography is generally the area or location of the data collection. The valid geography is described through:

- *Area name:* One or several name of the area or location. The area is specified by a nomenclature.
- *Area description:* Description of the area or location, for example through the geographical extension or geographical limitations of the studied process or system
- *Sites:* Address or addresses to the included production sites.
- *GIS (Geographical Information System):* One or several references to the location or area in a GIS system.

Example:

- *Area name:* Europe
- *Area description:* Probably most producers in European Community countries are represented in the forming of data. No specific sites are revealed.
- *Sites:* -
- *GIS:* -

5.1.1.2 Additional information or specification not included in the CPM data documentation criteria

In addition to the information specified by the CPM data documentation criteria, the following additional information or specification of the process description may be documented in ISO/TS 14048: *Aggregation type*, *Operating conditions*, and *Data acquisition*.

Aggregation type

The type of aggregation that has been performed on the process. There are two main types of aggregation; horizontal that represents averages of several processes providing the same function, and vertical that represents the sum of several interconnected processes.

The aim with documenting the aggregation type is to be able to distinguish between e.g. average values for a business sector i.e. mean values of several data sets for same process (horizontal aggregation) and e.g. a LCI system composed of non-aggregated systems (vertical aggregation). If none of the aggregation types apply, this should be specified.

When specifying the aggregation type, the following exclusive nomenclature must be used according to ISO/TS 14048: Non-aggregated, Horizontally aggregated, Vertically aggregated, Both horizontally and vertically aggregated, and Unknown. (See Appendix 1)

Technology

In addition to the documentation about the technology described above, there is also a possibility to describe the *operating conditions* and to specify a formal *mathematical model* for the process.

Operating conditions

Description of different relevant operating conditions for the process, that may have an influence on entire sets of measurements or individual measurements. For example, operating conditions can be relations between inputs and outputs.

Example:

"Operating conditions were normal for all of the included processes, except process X where only 70% of the normal operating conditions where utilised."

Mathematical model

Mathematical model can be used for a mathematically formal description of the underlying physical relationships between the inputs and outputs of the process. This can be used for storage and communication of information that describes possible allocation factors, or dynamic operating conditions. The mathematical model is documented by:

- *Formulae:* One or several mathematical formulae that is used in the model. The formulae are specified in accordance with mathematical syntax.
- *Name of variable:* One or several names of defined variables that is used in the formulae.
- *Value of variable:* Values of the defined variables.

Data acquisition

Data acquisition is used to describe the data collection and treatment at the process level. This is done through a description of the *sampling procedure* that has been used for selecting included processes, and which *sampling sites* and the *number of sites* that have been included. Also the *sample volume* of the included sites may be documented, both in terms of *absolute* volume i.e. the total production volume of the included sites, as well as the *relative* share of the production volume in relation to the total production volume for e.g. a specified region.

Thus, data acquisition is documented by:

- *Sampling procedure:* Description of the procedure that has been used for selecting the included processes from the available population for which the process is valid. For example, only a number of representative sites have been selected to represent an average for a specific production and region.
- *Sampling sites:* Address(es) to the site(s) that have been included.
- *Number of sites:* The number of included sites.
- *Sample volume*
    - *Absolute:* The total production volume for the included sites.
    - *Relative:* The relative share of the production volume for the included sites in relation to the total production volume of the population for which the process is valid.

5.1.2 Inputs and outputs

5.1.2.1 Data for input and output flows

The inputs and outputs of the system that are considered environmentally relevant are quantified in relation to the chosen quantitative reference, e.g. the functional unit. Depending on how the flows are considered they may be grouped into different categories such as e.g. natural resources, refined resources, emissions, products, co-products, etc. Also, information about the origin and destination of the flows are important to allow for impact assessment to be made, since a flow may have very different impact on the environment depending on the nature of the emitting or receiving body.

Thus, each input or output that enters or leaves the process should be specified by the *identification number*, the *direction* and the *group*, the substance *name*, and the *amount* per quantitative reference. The origin or the destination of each flow is specified by the *receiving environment*, which can be specified in detail through a *receiving environment specification*, and the *geographical location*.

Please note that the specification of the origin or the destination of the input or output concerns the origin at the point where the input enters the studied system or the destination at the point where the output leaves the system. The information can be used for local considerations in impact assessment.

To facilitate documentation and interpretation, there are nomenclatures that should be used when documenting the inputs and outputs.

Identification number

Specific number identifying the input or output.

Direction

The direction of the input or output, i.e. input to or output from the process. There is an exclusive nomenclature that shall be used according to ISO/TS 14048: Inputs, Outputs and Non-flow related aspects (see appendix 1).

Group

The group to which the input or output belongs. There is a nomenclature developed within CPM for the specification of group that should be used (see appendix 1). It is important to keep in mind that the group and the direction are generally connected. According to the CPM nomenclature groups for inputs are: natural resource and refined resource, and groups of outputs are: product, co-product, emission, and residue.

Receiving environment

The receiving environment for the input or output. This information is important to be able to perform impact assessment in an LCA study.

For inputs and outputs where the origin or the destination is another technical system, the receiving environment is Technosphere, e.g. a refined resource that is used in the process. For inputs or outputs where the origin or destination is the environmental system, the receiving environment is described by the type of environment, for example an emission that is let out to water, air or ground, or a natural resource that is extracted from the ground.

A nomenclature for receiving environment has been developed within CPM, which has also been included as an exclusive mandatory nomenclature in the ISO/TS 14048 document (see appendix 1). According to this nomenclature the receiving environment is specified by Technosphere, Air, Water or Ground.

Receiving environment specification

Further detailed specification of the receiving environment. This supplements the specification in *receiving environment*, and allows for more specific impact assessment. There is a nomenclature developed within CPM that has also been included in the ISO/TS 14048 document (see appendix 1). For example the receiving environment specification may be Agricultural air, Ground water, Forestral ground, etc.

Geographical location

Specification of the geographical location where the process and the inputs and outputs occur. The description is useful when performing impact assessment since the environment has different sensitivity to different combinations and amounts of inputs and outputs at different geographical locations. The specification may be done by a nomenclature, in accordance with convention of naming of regions and countries.

Name

Specification of the name of the substance entering or leaving the process. The substance needs to be unambiguously named. This is crucial in order for the name to be correctly interpreted by the data users. The name can be specified by *Name text*, *Reference to nomenclature*, and *Specification of name.*

Name text

The name of the substance. It is recommended to name the substance in accordance with a specified nomenclature, and specify the nomenclature that is used in *Reference to nomenclature*.

Reference to nomenclature

A reference to the nomenclature from which the name of the substance is chosen e.g. CAS-numbers, CPM-report 2001:2. Within CPM a nomenclature for naming of resources and emissions has been developed [13], and it is recommended to use this nomenclature for such substances.

Note: When documenting a specific process, different nomenclatures may be used for naming different inputs and outputs. It is generally difficult to find a nomenclature that includes names of all substances that is used in a specific process. Such common nomenclatures can only be achieved within specific contexts, such as within a company or an industrial sector.

Specification of name

Further specification of the name, to further facilitate the interpretation of the name of the substance. For example, substances may be known under synonym names, e.g. the trade name and the chemical formula, and a specification of the synonyms simplify interpretation of the substance.

Amount

The amount of the input or output, in relation to the quantitative reference e.g. the functional unit. The amount can be documented in terms of statistical properties, i.e. the name of the distribution function, names of parameters of the distribution function and quantitative values on each parameter and the unit of the amount. Thus, the amount is expressed by a *name,* and one or several *parameters* together with a *unit*.

Note: The handling of amounts in ISO/TS 14048 is more detailed and flexible than the original CPM data documentation criteria. In the original criteria there was a possibility to supply a quantity, a maximum and a minimum as well as a standard deviation. However, there was no structured way to specify what kind of amount that was supplied. Therefore, in this report the flexibility in the ISO/TS 14048 has been utilised.

Name

Name of the distribution function that is used to describe the amount. The name may be specified by a nomenclature (see appendix 1). Examples of names are Non-statistical single, Non-statistical range, Non-statistical distribution, and Normal distribution. Non-statistical refers to that the amount is not statistically acquired and treated.

Note: The amount according to the original CPM data documentation criteria corresponds to Non-statistical distribution.

Parameter

One or several parameters for the amount, where the actual value are specified. The set of parameters are specified by the distribution function.

Each parameter is expressed in terms of a *Name* and a *Value*

- *Name* The name of the parameter, e.g. Quantity, QuantityMin, QuantityMax. The name may be specified by a nomenclature (see appendix 1)
- *Value* The value of the parameter. Please note that the unit for the parameters are supplied in *Unit* (below).

For the distribution functions mentioned above, the following parameters should be used:

Name of distribution function	*Parameter – Name*
Non-statistical single	Quantity
Non-statistical range	QuantityMin QuantityMax
Non-statistical distribution	Quantity QuantityMin QuantityMax
Normal distribution	Expectation Standard deviation

Unit

The unit for the amount, documented by:

- *Symbol or name* The unit or symbol for the given amount. SI-units are recommended.
- *Explanation* Explanation and/or reference of the symbol or name. When SI-units are not used, it is important that the unit or symbol is explained, in order for it to be correctly interpreted.

Example of documentation of Amount:

- *Name:* Non-statistical range
- *Parameter*
    - *Name:* QuantityMax
    - *Value:* 55
    - *Name:* QuantityMin
    - *Value:* 20
- *Unit*
    - *Symbol or name:* kg
    - *Explanation:* SI-unit

Property

Information about properties of the inputs and outputs, such as density, temperature, pressure and price. Inputs and outputs may have many different properties that are relevant when performing an LCA study. Some of these properties are not specific for the substance, but can be dependent on the conditions that prevail at e.g. a plant. For example temperature and pressure may be relevant properties for an input or output flow. Properties are documented by:

- *Name:* The name of the property, e.g. density, temperature, etc.
- *Amount:* The amount of the property, for the specific input or output.
- *Unit:* The unit for the amount.

Example:

- *Name:* Temperature
- *Amount:* 273
- *Unit:* K

Table 1: Example of table of quantitative information.

Direction	Group	Receiving environment	Receiving environment specification	Geographical location	Name	Amount
Input	Refined resource	Technosphere		Sweden	**Name text** Oil **Specification of name** The type of oil is not known.	**Name** Non-statistical single **Parameter** *Name* Quantity *Value* 11.2 **Unit** *Symbol or Name* kg
Output	Emission	Air	Urban air	Sweden	**Name text:** CH4 **Reference to nomenclature** CPM report 2000:2:	**Name** Non-statistical range **Parameter:** *Name* QuantityMin *Value* 14 *Name* QuantityMax *Value* 22 **Unit** *Symbol or Name* kg
Output	Product	Technosphere		Sweden	**Name text:** Polyethylene	**Name** Non-statistical single **Parameter** *Name* Quantity *Value* 14 **Unit** *Symbol or Name* kg

5.1.2.2 Description of methods used to acquire numerical data

The quantitative data for the input and output flows of a process has generally been acquired using several different methods, e.g. different measurement techniques, theoretical models, estimations etc. In general a combination of several different methods is used, for example, a measured value may be used together with certain assumptions to calculate the value for a specific flow. In some cases, data describing a similar technical system may have been used to represent inputs and outputs the studied technical system

The methods used to acquire the quantitative information of inputs and outputs are described in *Documentation.* The description is made in terms of the type of *data collection* that has been performed, the *collection date*, a detailed description of the *data treatment* that has been performed, together with a *reference to data sources* that were used.

Documentation may be given for a specific individual input or output and/or for a set of inputs and outputs. This is useful when the same methods and assumptions have been used to collect data for more than one input or output.

Data collection

A short specification or indication of the methods that have been used to collect the data.

The specification may be done through a nomenclature. A nomenclature for different types of methods has been developed within CPM (see appendix 1). This nomenclature is aimed to cover the most commonly used methods to collect data, for example Derived from continuous measurements, Modelled from data describing a similar system; and Derived, unspecified. New types may be added to this nomenclature, but the "predefined" types should be used as far as possible. For example, "Derived, unspecified" can be used when the data was derived using data from different literature sources and the numerical basis for the data was not specified in the source that was used.

Collection date

The date or the time period during which the data and the basis for the data were collected.

For example, the basis for the data may be measurements performed during a specific time period, such as a month or a year, and the value that is presented is an average of the measurements. The time period that should be specified is then from the time of the first measurements that are included within the average to the time of the averaging.

The following data format should be used: CCYYMMDD/CCYYMMDD.
If only the year is known, write: CCYY0101
If only the year and month is known, write: CCYYMM01.

Data treatment

Description of the methods, sources and assumptions used to generate the amounts that are presented for inputs and outputs. The description should include a clear account of the methods that have been used and the assumptions and calculations that have been performed to obtain the numerical values that are presented. Ideally, the description should enable a check of the calculations and other data processing that have been performed from the acquisition of the value from the original source.

Literature, personal contacts and other sources that have been used during data acquisition should be referenced in Data treatment and then specified in Reference to data source below.

If a non-statistical range is given in amount for the input or output, i.e. a minimum and maximum value, the basis for the values should be described. This is extremely important in order for the data user to be able to interpret the data. For instance, a minimum value may be an extreme value, or a calculated minimum value.

Example 1:
The data that are presented are calculated as an average based on information from two component manufacturers. The information from the manufacturers was acquired using a LCI data questionnaire, see reference.

Example 2:
The general description and data for the plant is taken from the environmental report of 2001 for company X. Information about the scrap delivered to X from XX is achieved from interviews with process manager at X and XX. To represent the amount per functional unit, the total amounts for each input and output in 2001 are divided with the total amount of received waste, which was 300 500 ton in 2001.

Reference to data source
References to data sources that have been used in the data collection and data processing, and that is referred to in Data treatment. Examples of data sources may be different types of literature, personal contacts, databases etc.

5.1.2.3 Additional information or specification not included in the CPM data documentation criteria

In addition to the information about inputs and outputs according to the CPM data documentation criteria, the following information may be given for individual inputs or outputs in ISO/TS 14048.

Environment condition

Qualitative description of the conditions of the environment to facilitate impact assessment. The environment conditions supplements the indication of the environment that is supplied in *Receiving environment* and *Receiving environmental specification*.

The environmental condition allows for a more detailed description of the specific conditions that prevail in the environment from which an input is extracted or to which an output is let out. This detailed description allows for more specific and local impact assessment to be made.

Example: For the receiving environment: “Ground”, the environmental condition could be: “The area is very sensitive for sulphur dioxide”.

Internal location

Information about how an input is used within the process or from where an output originates within the process.

Example:
Ammonia is used for reduction of NOx in the flue gas.

Related external system

Information of related external technical systems of an input or output, to e.g. identify upstream and downstream processes not included in the described process. For example, the name and location of a supplier of raw material, transportation modes that is used in the transport of a material, or the type of plant receiving the wastewater can be given.

The related external systems can be described by:

- *Origin or destination:* the delivering or receiving processes for intermediate product flows e.g. geographical information about the destination for an output.
- *Transport type:* Name of the transport supplier or the transportation mode
- *Information reference:* References to contact persons and relevant documents where information on the described related external systems may be found

Example:

- *Identification number:* 1
- *Name – Name text:* Ammonia
- *Related external system*
    - *Origin or destination:* Ammonia producer in southern Finland
    - *Transport type:* Truck, long distance
    - *Information reference:* Company internal report

5.2 Modelling and validation

Modelling and validation describes the prerequisites for the modelling of a process as well as the validation of the resulting model, recommendations of how the data should be used and a data quality statement. The prerequisites includes documentation of the choices that have been made during the modelling of a process, e.g. which principles that are used and what assumptions and exclusions to that are made, as well as documentation of the purpose for the data. This documentation is crucial for a data user when interpreting the general quality and relevance of the data.

Please note that information about the properties of the process itself is not described here.

5.2.1 Description of choices made during the modelling of the process and the objective for the choices

The objective or the purpose for the data collection, and the intended application of the process and the data generally has a large influence the result. The scope of the system and the choice of functional unit and system boundaries are all based on the purpose. Therefore, both the purpose and the choices that have been made in the modelling to fulfil the purpose with regard to system boundaries should be carefully described. Also the sources of information should be documented.

Intended application

Description of the intended application for the process. The intended application for the process generally determines the level of detail and quality ambition that is used in the modelling. Therefore the description is important for users to understand the documented process as a whole.

The intended application is generally documented through a description of the purpose or objective for the modelling, data collection and documentation of the process.

Information sources

Specification on the sources that have been used in the modelling of the process, e.g. different technical handbooks, personal contacts at production sites, etc. If the complete process is documented and published in a different format, this reference should especially be given, for example if a literature reference has been used as the only source in the documentation of the process.

This allows the user of data to get an overview of the sources and also check the original sources if desired. An unlimited number of information sources e.g. literature, personal communication, databases etc can be given.

Note: According to the CPM data documentation criteria the original source for the documentation and data should be specified.

Modelling choices

Modelling choices describes the different choices that have been made in the modelling of the studied system, such as system boundaries in terms of excluded elementary flows, intermediate product flows and processes, as well as allocations and process expansions. The description of modelling choices supplements the technical description of the process in process description.

The description of system boundaries is made by describing the criteria that has been used for the choice and the motives for the choice. This provides an understanding for how the model was designed and why a specific scope has been chosen. A system boundary is generally defined by what is communicated between the system and its surroundings, i.e. in LCA by emissions and waste and the resources extracted from the environmental system, and material and energy from other technical systems.

The modelling choices are documented by description of the *Criteria for excluding elementary flows*, the *Criteria for excluding intermediate product flows*, the *Criteria for externalising processes*, the *Allocations performed* and the *Process expansion*. The description of Modelling choices supplements the description of the process in section Process description in ISO/TS 14048.

Criteria for excluding elementary flows

Description of criteria that have been used when choosing which elementary flows to include or exclude. Elementary flows are defined as input or output flows to a process that originates in or ends up in the environmental system, such as a natural resource extracted from the ground or an emission let out in water or air. The description of the criteria should both include a specification of the criteria and a description of the motive for the choice.

This description is important for data users to interpret the reported inputs and outputs correctly, and to identify the reason for any missing inputs and outputs (data gaps). For example, if known flows for the process have intentionally been excluded even though they may have an environmental impact.

Example: The choice of parameters that are reported for emissions to air is based on legislature for the studied process. Some emissions from the process that may have a potential impact on the environment may therefore have been excluded due to that they are not included in the legislature.

Criteria for excluding intermediate product flows

Description of the criteria that have been used in the selection of intermediate product flows i.e. inputs or outputs that comes from or leaves to another technical system. The reasons why a certain input or output have been excluded should also be described e.g. if data is missing. This information is important to be able to identify and interpret data gaps in the process etc.

Example: Only raw material inputs larger than 2 kg per kg product is included. Thus minor flows have been excluded.

Criteria for externalising processes

Description of the criteria that has been used to exclude technical subsystems. The description can be made through a specification of which subsystems that have been excluded, together with a description of the reasons why the subsystems have been excluded, e.g. due to lack of data.

Example: All internal transports have been excluded from the process, due to lack of information.

Allocations performed

Description of allocations that have been performed in modelling of the process to obtain the numerical data that are documented. The description can be made by specifying the co-products that have been allocated together with an explanation of how the allocation has been performed. Allocations is thus documented by:

- *Allocated co-products:* The co-products that have been removed through the allocation
- *Allocation explanation:* Description of the allocation, including choice and justification of allocation method, procedure and information that have been used in the allocation.

If no allocations have been made for the process, this should be explicitly stated, e.g. with the text “Not applicable”. This facilitates the interpretation of the data for the user.

Process expansion

Description of process expansions performed, with regard to which processes that have been included together with an explanation for the expansion. Process expansions are often made in order to model the full effects of change or to avoid allocations. This information can be described by:

- *Process included in expansion:* Specification of the processes that have been included as a result of the process expansion
- *Process expansion explanation:* Description of the reason, motives and details for the system expansion.

Note that the subsystems included as a result of the system expansion are also described the process description, e.g. in Technology and Process contents.

If no system expansions have been done for the documented process this should be explicitly stated, e.g. with the text “Not applicable”.

5.2.2 Recommendations for the use of process and the data

The description of the process, the methods that have been used in the data collection and the choices that have been made in the modelling (supplied in the previous sections) constitute a good basis to assess the reliability and the relevance of the presented process and data. However, there may be certain aspects that the data user should be especially aware of, regarding for instance limitations for the applicability of the data or special circumstances when the data should not be used.

Also, if the expected data user has little or no prior experience of the technical system and the business that is described, some further information may be needed in order for the data user to handle the data correctly. This may for example concern the representativeness of a plant or manufacturing process compared to other similar plants or processes regarding the technology used etc. Therefore, some recommendations or guidelines and other relevant information should be given.

Such information may be documented in *Data quality statement*, *Validation* and *Other information*

Data quality statement

Description of known quality strengths and weaknesses in the documented process and data. The description can e.g. be made through a general description of the quality of the numerical basis for the data, or quality deficiencies in the overall documentation of a process, regarding how representative the process data is.

If a quality assessment has been made by the data generator of how uniform the study methodology is applied to the various components of the study, the result from the assessment should be documented.

Validation

Detailed description of any validation that has been performed on the documented process. This is made by a description of the *method* that was applied and the *procedure* that was used in the validation, the *result* of the validation together with a specification of the *validator,* i.e. the person or persons who performed the validation.

Important note: According to the original CPM data documentation criteria it is only required to document the reviewer, i.e. the validator of the data. However, since many different types of review may have been performed on the data it is important for the interpretation to have a description of how the review has been performed.

Thus, validation is documented by:

- *Method:* Short description of the type of method that have been applied in the validation, e.g. proof-reading of data entries, mass balance, SPINE@CPM data documentation review
- *Procedure:* Description of the aspect of data quality that have been examined, e.g. mass balance of all inputs and outputs or mass balance of all incoming raw materials and outgoing product and waste etc.
- *Result:* Description of the result from the validation. If errors, missing data or other deficiencies were found during the validation but no corrections have been made, this should be especially documented.
- *Validator:* The person performing the validation. The name, competence, organisation and address of this person should be given.

Note: All data sets published in CPM's LCI database have been reviewed with regard to documentation according to the CPM's data documentation criteria [14].

Other information

Other relevant information about the process and the data that is not included in other data documentation.

Information on how to use the process and the data should especially be considered and documented, e.g. known limitations, the assumed area of application regarding geographical, technology or other trade specific applicability, etc. Also, other general cautions and recommendations may be given regarding how the data can be used.

5.2.3 Additional information or specification not included in the CPM data documentation criteria

In addition to the documentation of modelling and validation according to the CPM data documentation criteria, ISO/TS 14048 also allows documentation about the *modelling principles*.

Modelling principles

Modelling principles include general principles that have been used in the modelling of the process. Modelling principles is documented by:

- *Data selection principle:* The principle that have been used when selecting which data to include in the process. For example the principle that have been applied for choice of data sources to use for different parts of the process.
- *Adaptation principles:* The principles that have been used to remodel the collected data into a unit process suited for LCI.
- *Modelling constants:* The assumptions that have been held constant throughout the modelling of the process. One or several modelling constants may be documented. The modelling constants are described through:
  - *Name:* The name of the modelling constant
  - *Value:* The value of the modelling constant

5.3 Administrative information

Identification number

A unique identification number for the process, that is specified by the registration authority. The identification number is used to identify the process.

Registration authority

The organisation responsible for the documented process. For example, for data sets published in CPM's LCI database CPM is the registration authority.

Version number

Version number for the documented process. The version number can be used to find the latest version of the documentation of a process.

Data commissioner

The person(s) or organisation responsible for the commission of the data collection or updating of the data. The data commissioner is specified by name, mailing address, phone number, fax number and email address.

Data generator

The person(s) or organisation responsible for the modelling of the process, including interpretation, compilation or updating of the data. The data generator is specified by name, mailing address, phone number, fax number and email address.

Data documentor

The person responsible for the documentation of the data in the ISO/TS 14048 data documentation format. The data documentor is specified by name, mailing address, phone number, fax number and email address.

Data completed

The date when the study or data for the process were completed and reported. The date should be specified as YYYY-MM-DD
Note: Date completed does not correspond to the time period during which the process was acquired. This time-period may be documented in Process description – Valid time span.

Publication

Reference to a literature where the original copy of the documentation of the process can be found.
Note: The literature reference on which the data documentation is based is specified in *Information sources* (see modelling and validation), if the complete process has been published elsewhere in a different format.

Copyright

The holder of copyright for the documented process.

Access restrictions

Short description of how the document may be distributed in terms of conditions and agreements e.g. details on secrecy agreements or restrictions regarding the data.

6 Working practically with documentation

6.1 Documentation during an LCA project

This section describes how to practically work with data documentation during an LCA project. During an LCA project, there is a lot to gain by working consistently with documentation of the data and the study from the beginning of the project. The work may be divided into four steps (see figure 8). In each step, the result is documented according to the CPM data documentation criteria, using the ISO/TS 14048 data documentation format. Below is a description of each step.

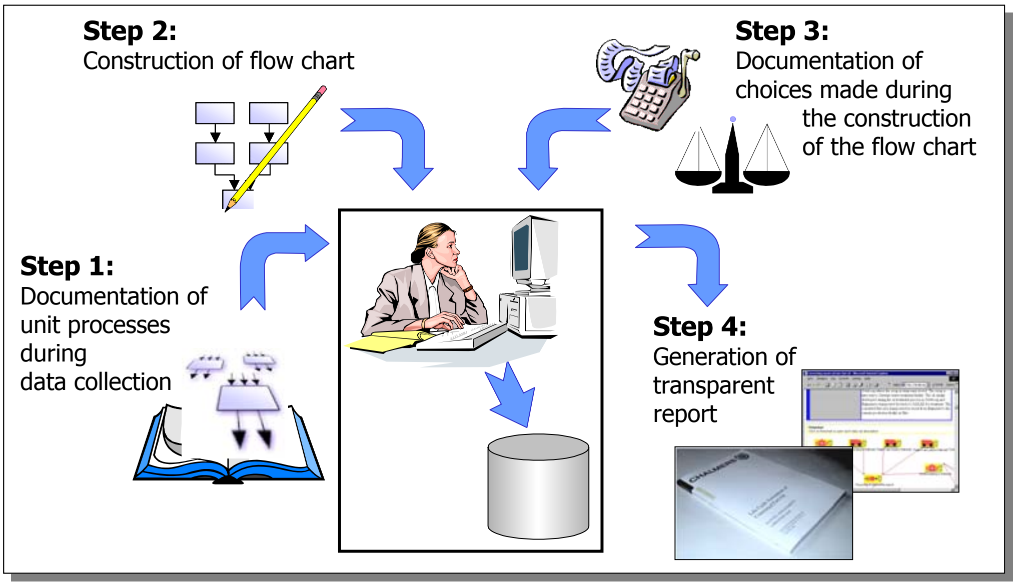

Figure 8. Working with documentation during an LCA project [15]

Step 1. Documentation of unit processes during data collection
Each unit process is consistently documented during the data collection. Documentation of each collected unit process:

- Provides consistent knowledge of each subsystem that is included within the studied system
- Facilitates data quality assessment
- Supports validity checks of data

In this step the CPM documentation criteria serves as a checklist to ensure that all relevant information is acquired of each unit process that included in the study. The knowledge of the data is generally most extensive at the time of the data acquisition. If that knowledge is not documented there is a risk that it will be lost, and it may be difficult or impossible to recreate the knowledge later in the project. For example, the data is often specifically interpreted for the actual application. This specific interpretation should be documented, since a different data user may interpret the data differently. The different aspects of data quality may easily be assessed, to ensure that data quality requirements established in the goal and scope is fulfilled. The documentation allows for different types of review and validity checks to be performed on the data. This is a requirement according to ISO 14041:1998(E) [11].

In section 6.2 a description is given of aspects to consider when working with documentation of different data sources.

It should be stressed that the time that is spent on documentation is generally repaid by the advantage of having a well-documented basis for the study during the interpretation, in the reporting and review of the study.

Also, the data can be easily reused in subsequent studies and by other users. The documentation of data will thus facilitate efficient shared use of data and databases, since all relevant information of the technical system and the data is readily available and easily interpretable.

Step 2. Construction of flow chart
The documented unit processes are used in the construction of the flow chart, i.e. in the construction of the product system in the LCA.

During this step the documentation of each unit process helps to e.g. avoid double counting and makes it possible to identify and understand reasons for data gaps. This requires a thorough knowledge of the content and the scope of each subsystem that is included in the study, which may be achieved if each unit process is clearly defined and explicitly described.

Step 3. Documentation of choices made during the construction of the flow chart
The choices made during the construction of the flow chart are documented, e.g. the goal and the scope of the study, the criteria that has been used in the modelling, the choice of allocation method, etc.

The documentation of the flow chart, together with the documentation of each unit process facilitates interpretation of the result. Every part of the studied system can be easily checked to understand the reasons for the result. Consequently, the risk for erroneous conclusions to be drawn from the result will be reduced. The result from the interpretation should also be documented.

Step 4. Generation of transparent report
By working consistently with documentation throughout the LCA project, the study report can be easily generated, since both the flow chart and the choices made in the modelling of the flow chart, as well as the included subsystems are consistently documented. This inherently implies a transparent report of the study. Thus, it is possible to automatically generate a study report, consisting of a description on how the modelling of the composite technical system was performed and a description of each of the included models of technical subsystems.

The report can be efficiently reviewed, through the structured format for reporting, where all relevant information is transparently described. Thus, if the reporting of the study and the data is done according to the CPM data documentation criteria, the time needed for review will decrease, since the information of the project is easily accessible and interpretable. This may in the long term decrease the cost to review LCA-studies. This is for example vital to allow for review of an LCA-study to be used a basis for type III ecolabelling.

Note: The ability of the ISO/TS 14048-format to store composite system means that a study performed using ISO/TS 14048 and the CPM documentation criteria could be reported in the database using e.g. a special browser. There is however at present no software tools that supports this type of reporting.

6.2 Documentation of data from different data sources

This section describes to work with different sources, including secondary sources which are often used when documenting a LCI data set for LCA use. Furthermore aggregated systems and remodelling of a modelled system is discussed as well as data gaps since missing information is a common problem when working with all types of data.

The documentation of LCI-data according to the CPM documentation criteria constitutes a report describing the technical system that is studied and the choices made in the data acquisition. This should enable an assessment and analysis of the data and of all aspects of data quality by the data user, by the receiver of the result and by reviewers. For example, the documentation should enable an assessment of similarities and dissimilarities between different data sets describing similar technical systems. A difference in a specific emission for two similar technical systems may for instance originate in minor differences in the technology used.

Ideally, the documentation of data should be completed by the person or persons that are originally acquiring the data. The documentation will in such case only involve a report of the data acquisition procedure. However, in any LCA project generally several different sources of data are used. Often the data is not sufficiently documented in the original source or the documentation is difficult to interpret. Regardless of the source, however, the data should be handled adequately.

Secondary sources

When using data from secondary sources such as different types of written reports, the main part of the work with data involves interpretation and analysis of the material. This is generally a time consuming task, and in order to avoid duplication of efforts it is important that the work with the interpretation is documented. Otherwise the next data user may have to reinterpret the material, before it may be used.

In many cases, the material is extensively interpreted, beyond what is explicitly described in the original source, and it is important that this is documented in order for the acquired knowledge not to be lost. For example, the person performing the documentation may have been in touch with the person responsible for the original material in order to clarify some issues. The person interpreting the material may also in some cases be able to supplement the information in the original source regarding knowledge of the business in which the technical system operates.

It should also be remembered that any information regarding inconsistencies in the original material and comments by the person that has done the interpretation of the material is also valuable for a data user, and should therefore be documented. It should however be clearly stated in the documentation that this type of information regards views of the person responsible for the documentation.

Obviously, there will always be a risk when working with different types of written reports that the original source may be misinterpreted, through misunderstandings, wrongful translation of technical terms, misinterpretation of nomenclature etc. Hence, whenever possible, it is strongly recommended that the person(s) responsible for the original data acquisition should do the documentation or at least review the documentation.

Remodelling
Sometimes models of technical systems are remodelled to transform the data into a form that is suited for LCA or to better suit the immediate purpose for which it will be used. For example, data from environmental reports describing an industrial plant may be remodelled into data describing a specific product produced within the plant.

It is then vital that the practitioner thoroughly documents the work and explicitly explains the choices and assumptions that have been made in the remodelling. Both to ensure the trust of the original data supplier, that the supplied data has been handled correctly and to ensure the trust of the commissioner or other parties interested in the result.

Today, it is not uncommon in LCA that practitioners remodels data without explanations or with only implied references. The remodelling may be based on a thorough analysis and interpretation of the original material, but if that is not explicitly described it is impossible to assess the result. Consequently, if the remodelling are not explained, the data is useless.

Aggregated systems
Aggregated data on large aggregated composite systems are generally difficult to document without loss of vital information. Such systems should preferably be divided into the subsystems of which is consists, thus allowing separate documentation of each individual subsystem. The advantage of this approach is that the composite system will be fully transparent. This enhances the flexibility. Parts of an aggregated system may be updated when needed. For instance a cradle to gate system for some material can be updated regularly. The system boundaries chosen for the complete aggregate system may also not be applicable in other studies, but parts of the system may be applicable and reused in other studies.

However, if it is not feasible or possible to disaggregate the system; the technical system, the purpose of the study, the system boundaries, use of allocation methods etc. need to be carefully described in order to avoid misinterpretation of data. The person responsible for the documentation should be especially observant on issues that have a large influence on the result. For instance, if the purpose of the study was to compare different alternatives, several systems may have been excluded that were similar in the compared alternatives. This may lead to large errors if any of the compared alternatives are used to represent a “real” cradle to gate system.

Also, when describing large aggregate systems it is important to clearly state whether or not “general” systems (such as electricity production or transports), or “cradle to gate” systems (such as production systems of materials) are included in the system. Also, what is included within these types of systems should be described.

Missing information
In some cases it may be difficult to acquire all information that is required by the CPM documentation criteria. Some of the information may be missing or lost in the original material, and it is not feasible (due to e.g. economical reasons) or possible (due to e.g. the fact that the information simply is not available) to obtain the information.

The fact that the information is missing is however important information for the data user. It should therefore be explicitly stated in the documentation that it has not been possible to obtain the information, and if possible the reason to why it was not possible. Otherwise, other users may think that the information was available, but have been overlooked by the person responsible for the documentation. The data user may then make new attempts to obtain the information and fail by the same reason.

7 What is sufficient data documentation?

Data sufficiently documented according to the CPM documentation criteria should ideally not need further research for the data user to be able to interpret and correctly use the data. In practice the general ambition for documentation may vary depending on for what the data will be used and within which contextual environment the data will be communicated. The concept of sufficient documentation is thus very much dependant on the application and the receiver of the information.

Data that are only to be communicated within a specific context, e.g. internally within an organisation, generally requires a less detailed description, than if the same data will be communicated externally e.g. between a customer and supplier. Within an organisation the users may be assumed to share a common terminology and much information is implicit and more or less general knowledge within the company regarding technology, processes etc. Consequently, such details do not require an explanation within the organisation.

However, when the data is transferred to a different contextual environment the terminology and implicit knowledge needs to be explained, in order for the receiver of the information to be able to correctly interpret and use the information. The receiver of the information can not be expected to hold the knowledge that is internal within the company. A general recommendation is therefore that when data is to be communicated externally, a more detailed description may be needed, in order for the data to be directly useful for the receiver of data.

Also, documentation of the data constitutes an investment, and depending on how valuable the data is considered, the ambition for the documentation will most likely vary. For example, if it is known that a data set will only be used in a specific application and not communicated, a less detailed description may be sufficient. However, if the data will be reused in many applications and by several users (e.g. be included in a company internal database) a more detailed description is necessary to avoid further costs for data.

It may often be difficult to know at the time of data documentation, how the data will be communicated and for what the data will be used, other than the intended application for which it was acquired. The person responsible for the documentation should therefore always aim to provide the prospective data user with all relevant information available at the time of the documentation, thus giving the best possible starting point.

8 References

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Appendix 1
Nomenclatures

Below are the different nomenclatures that are recommended to be used in the documentation.

Nomenclatures in: Process – Process description

Class – Name

Nomenclature developed within CPM and published in CPM-report 1997:6, Pålsson A-C. "Handbok vid arbete med datakvalitet och SPINE". The nomenclature is based on the ISIC nomenclature.

Biological
- Forestry
- Agriculture
- Fishing

Mining and quarrying
- Coal and lignite mining
- Crude oil and natural gas extraction
- Metal and mineral mining
- Other mining

Construction

Manufacturing
- Materials and components
- Machinery and equipment
- Consumer goods

Energyware
- Fuel
- Grid electricity and district heat

Transport
- Land transport
- Air transport
- Water transport

Commercial, residential and institutional

Waste handling and processing

Quantitative reference - Type

Nomenclature from ISO/TS 14048.

Functional unit
Incoming product flow
Outgoing product flow
Reference flow of process
Production period
Other flow
Other parameter

Technical scope

Nomenclature developed within CPM and published in CPM-report 1997:6, Pålsson A-C. "Handbok vid arbete med datakvalitet och SPINE". Also included in ISO/TS 14048.

Technical scope	*Explanation*
Unit operation	A technical system where e.g. a certain process is studied with regard to inputs and outputs. Different types of unit operations, such as single processes as combustion,

	welding, etc
Gate to gate	A technical system where all activities occur in one place. The processes that manufacture or take care of flows into and out from the system are not included. A "Gate to gate" system may consist of several "Unit operation" systems.
Cradle to gate	A technical system where all flows into the system comes from the environmental system.
Gate to cradle	A technical system where all flows out from the system reach the environmental system.
Cradle to grave	A technical system that comprise a full life cycle, where flows for e.g. a certain product have been traced from the cradle to the grave.

Aggregation type

Nomenclature from ISO/TS 14048. The nomenclature is exclusive, i.e. mandatory to use to be in accordance with ISO/TS 14048.

Non-aggregated
Horizontally aggregated
Vertically aggregated
Both horizontally and vertically aggregated
Unknown

<u>Nomenclatures in: Process - Inputs and outputs</u>

Direction

Nomenclature from ISO/TS 14048. The nomenclature is exclusive, i.e. mandatory to use in order to be in accordance with ISO/TS 14048

Inputs
Outputs
Non-flow related aspects

Group

Nomenclature developed within CPM and published in CPM-report 2000:2 Erixon M. (editor)"Facilitating Data Exchange between LCA Software involving the Data Documentation System SPINE".

Group	*Explanation*
Natural resource	Inputs of natural resources e.g. iron ore, bauxite, sea water, rock salt or crude oil.
Refined resource	Inputs of resources (raw material, energy etc) that have been processed in some way e.g. inputs of wood logs, steel, nitric acid, electricity or fuel oil.

Product	The product of the studied system, which ends up somewhere else in the technosphere.
Co-product	An output of the studied system to technosphere, which has an economical value.
Emission	Unintended output from the studied system to the environmental system.
Residue	Used for outputs that is without economic value and that is not air or waterborne e.g. the waste in a landfill site remaining at the end of the time period investigated or the residue that is collected for recycling.

Receiving environment

Nomenclature from ISO/TS 14048. The nomenclature is exclusive, i.e. mandatory to use to in order to be in accordance with ISO/TS 14048.

Air
Water
Ground
Technosphere

Receiving environment specification

Nomenclature developed within CPM and published in CPM-report 1997:6, Pålsson A-C. "Handbok vid arbete med datakvalitet och SPINE". Also included in ISO/TS 14048.

Agricultural air
Forestral air
High altitudes (>1000 m)
Indoor air
Rural air
Urban air

Creek
Fossil water
Ground water
Lake
Marsh
Ocean
Pond
Rapid
River
Surface water
Swamp
Waterfall

Agricultural ground
Forestral ground
Grassland ground
Impediment ground
Industrial ground
Landfill ground
Rural ground
Urban ground

Name – Name text

For naming of emissions and resources it is recommended to use the nomenclature developed within CPM and published in CPM-report 2000:2 Erixon M. et al. ”Facilitating Data Exchange between LCA Software involving the Data Documentation System SPINE”. Due to that the nomenclature in this report is quite extensive it is not presented here.

When naming other substances it is recommended to use a well-defined nomenclature and specify the nomenclature in Reference to nomenclature.

Amount

The following naming of Name and Parameter – Name are suggested. The non-statistical types are based on the CPM data documentation criteria.

Name	*Parameter – Name*
Non-statistical single	Quantity
Non-statistical range	QuantityMin QuantityMax
Non-statistical distribution	Quantity QuantityMin QuantityMax
Normal distribution	Expectation Standard deviation

Note: Non-statistical refers to that the amount is not statistically acquired and treated.

Documentation – Data collection

Nomenclature developed within CPM and published in CPM-report 1997:6, Pålsson A-C. ”Handbok vid arbete med datakvalitet och SPINE”.

Data collection	*Explanation*
Derived, statistics	Result from calculation that are solely based on statistically acquired data, and that has been processed with statistical methods.
Derived, mixed	Result from calculation that are based on several different datatypes, and where none of the initial values are of the type 'Unspecified'
Derived, unspecified	Result from calculation that are based on several different types of methods, and where one or more of the initial values are of the type 'Unspecified' or 'Derived, unspecified'.
Modeled data	Data that are based, entirely or for the most part, on theoretical modelling

Estimated from similarity	Data that has been estimated with data from a similar process.
Economical information	Data that is based on economical information such as purchasing or sales statistics.
Monitored data, continuous	Data based on continuous monitoring
Monitored data, discrete	Data based on discrete monitoring
Random samples	Data based on random samples
Single sample	Data based on a single sample.
Unspecified	The basis for the data is not specified
Unspecified, expert outspoke	The data is based on a statement made by an expert in the field.
Unspecified, guesstimate	The data is based on an estimation.
Unspecified, panel judgement	The data is based on a judgement made by a panel.
Legislated limit	Limit that has been prescribed by law, on e.g. a national level.
Corporate limit	Limit set for or by a specific company, e.g. according to an environmental management system

Appendix 2
Example of LCI-data documented according to ISO/TS 14048

The following example of a documented process has been published in the CPM report 2001:8, "First examples of practical application of ISO/TS 14048 data documentation format". In section Inputs and outputs, some inputs and outputs have been excluded in this example. To view the full example as well as other examples, please read the CPM report.

Data documentation of process

Process

Process description

Name

Production of Wine Ethanol Fuel (ETAMAX D), including grape cultivation and wine production

Class

Name
2429 Manufacture of other chemical products n.e.c.

Reference to nomenclature
International Standard Industrial Classification of all economic activities, ISIC rev 3. Statistical Papers, Series M, No 4, Rev 3, United Nations, New York 1990 ST/ESA/STAT/SER.M/4/REV.3

Quantitative reference

Type	Functional unit
Name	Wine ethanol fuel
Unit	kg
Amount	1

Technical scope

Cradle to gate

Aggregation type

Vertically aggregated

Technology

Short technology descriptor
Production of wine ethanol fuel from grapes, including production of additives.

Technical content and functionality
ETAMAX D is the term used for pure ethanol fuel used for buses in Sweden in 1998.The fuel consists of (in percentage by weight):

95 % Ethanol made from European wine surplus (90,2 %)
Beraid 3540 (ignition improver) (7%)

Methyl tert-butyl ether (denaturation agent) (2%)
Iso-butanol (denaturation agent) (0,5%)
Morpholine (corrosion inhibitor) (125 ppm)

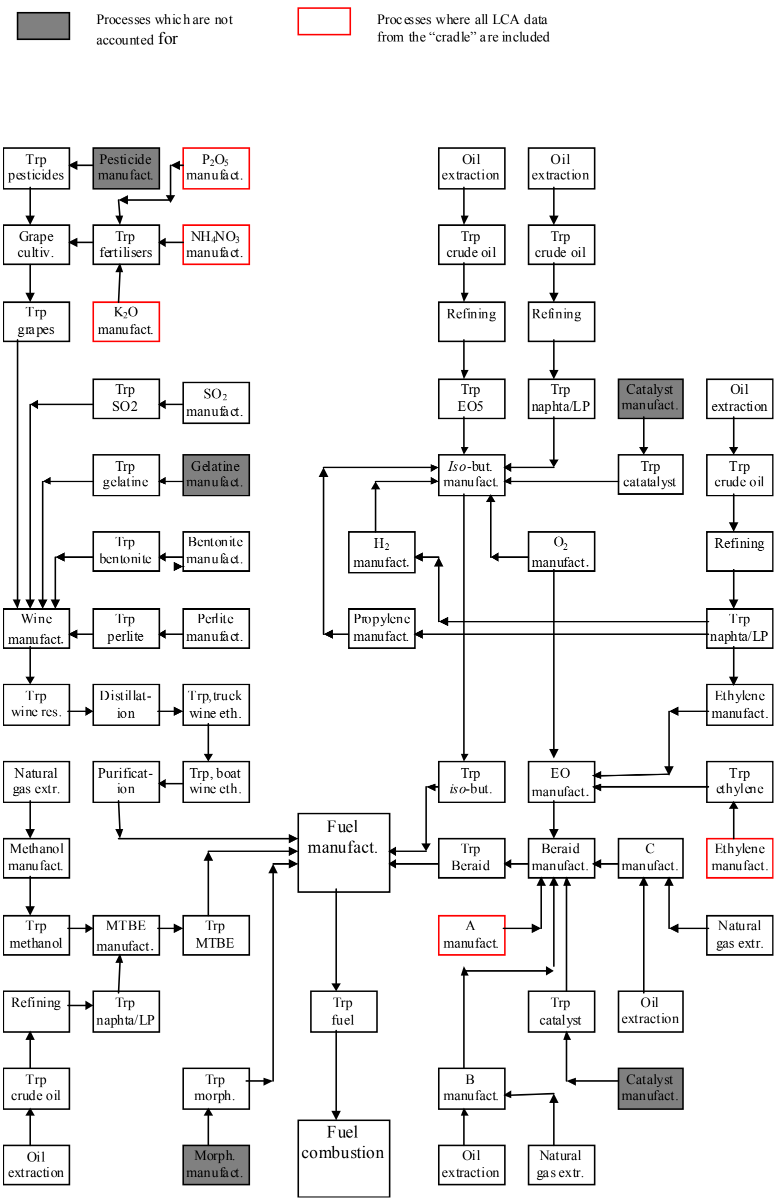
Grape cultivation, wine manufacturing and distillation of wine to ethanol take place in Italy. The raw ethanol from the distillation is shipped to Sweden where it is distilled further to reduce its aldehyde and sulphur content. When the concentration of ethanol has reached 95%, the fuel is mixed with the additives.

Emissions and energy demands for the following processes are included:
-Harvesting and spreading of fertilisers during the grape cultivation (the grapes are cultivated in northern Italy and most of the harvesting is done by hand, the fertilizers are spread with different types of agricultural machines).
-Production of fertilisers (the fertilisers are produced in Italy)
-Wine production (only electricity is used for the process which includes all the steps from grinding to barrel packing)
-Production of help chemicals for wine production (the chemicals are produced in Italy)
-Distillation (the wine is distilled in a one column distillation plant, which requires steam and electricity, partly produced from biogas from the grape shales and branches)
-Purification (the raw ethanol is distilled to a higher alcohol concentration, steam and electricity is required for the process)
-Production of fuel additives
-Combustion of fuel in bus engine (the fuel is combusted in a Scania bus engine, specially developed for ethanol fuel)
-Transports (50% filling coefficient)

All energy sources are traced back to the extraction of energy raw material. For the processes in Sweden, the petrochemical raw material extraction is assumed to take place in Norway. For raw materials connected to energy use in other countries, a world average is used.

The electricity profile is based on the electricity profile for each country respectively. The electricity raw materials are traced back to the extraction in the same way as energy raw material not used for electricity production.

Technology picture



Valid time span

Start date 1998

End date 1998

Time span description

All data are for the wine ethanol fuel situation of 1998. Some data were extracted in 1997, but most of them in 1998. Exceptions are energy data which date back to 1993 (energy raw material extraction) and 1995 (electricity profiles).

Valid geography

Area Name SE IT

Area description

The study is based on production and consumption of ETAMAX D in Sweden. The ethanol is produced in Italy. All additives are produced in Sweden, except for morpholine, which is not accounted for.

Inputs and ***outputs***

Direction	Group	Receiving environment	Geographical location	Name	Amount	Documentation
Input	Refined resource	Ground	Italy	Grapes	**Name** Absolute **Unit:** *Symbol or Name* kg **Parameter:** *Name* Absolute *Value* 11.2	**Data collection** Derived, unspecified **Collection date** 19930101/19980101 **Data treatment** LCI data are taken from the literature reference. The calculations were carried out by an LCA software tool. **Reference to data source** XXXX
Output	Emission	Air	Global	CO_2	**Name** Absolute **Unit** *Symbol or Name* kg **Parameter** *Name* Absolute *Value* 1.87	**Data collection** Derived, unspecified **Collection date** 19930101/19980101 **Data treatment** LCI data are taken from the literature reference. The calculations were carried out by an LCA software tool. **Reference to data source** XXXX

(This is only a small part of the inputs and outputs for the given process)

Modelling and validation

Intended application

The purpose was to study the production of wine ethanol fuel for buses in order to track down where the largest environmental charges could be found. Since the ethanol and the ignition improver are the major components of the fuel, it was of interest to focus on their environmental impact. The commissioner of the study (Company) might have a possibility to affect the production of the ignition improver.

The more detailed purpose was;
-To identify the environmental impacts of using ethanol fuel for buses, and compare the results to already existing LCA:s on other fuels. The report displays a comparison of wine ethanol fuel to diesel, natural gas and ethanol from wheat and wood.
- To track down the steps in the life-cycle with the largest environmental impacts
- To identify the contribution of the ignition improver to the total environmental impacts
- To use the results of the study as an indication to where to find improvement possibilities.

The intended user of the result is Company XX

Information sources

- Data has been collected from specific suppliers and sites mainly in Italy and Sweden.

- All production data have been obtained from technicians or sales managers of the different companies involved.

Modelling principles

Data selection principle

Site-specific data is preferred but if that is not available literature data or modeled data is used if considered necessary.

Modelling choices

Criteria for excluding elementary flows

The fact that emissions on different geographical places can have different effects on the environment has not been accounted for.
Only CO2 emissions with fossil origin are accounted for.
The influence on ground and water is only dealt with in steps where data could be obtained, and are therefore not comprehensive. Only the emissions to air are complete, why these data are the only ones presented.

Criteria for externalising processes

The following processes have not been included in the study:
- Production of machines, industrial plants and infrastructure
- Production of pesticides and the emissions from pesticides from the grape cultivation
- Production and emissions from morpholine (fuel additive)
- Production and emissions of chemicals used for the distillation process

Allocations performed

Allocation explanation

Allocation is made on a mass basis, where allocation has been applied, i.e. on fertiliser production and cracker product production. The basis for allocation was chosen because it was considered equal in relevance to other possible bases (for example energy basis), but easier to apply.

Data quality statement

In order to receive reliable data for wine ethanol, several distilleries, wine producers and grape cultivators were visited on the sites of production. Data for the grape cultivation have the highest uncertainties due to the fact that weather conditions and cultivation areas (flat or hilly cultivation) will strongly affect the fe rtiliser and fuel use.

Many data originates from reports to authorities and environmental reports. An exception is the production of Beraid 3540. During the production of this additive, measurements were carried out on site. Discussions with technicians at Company XX have been carried out to a greater extent than for other companies involved.
Data for electricity, where the electricity have been bought from the state net, is based on the electricity profile for the country in question (profile from 1995). The energy raw materials for electricity production are traced back to the extraction in the same way as for fuels which are not used for electricity production. For petrochemical raw materials used in Sweden, the raw material extraction is assumed to take place in Norway. For petrochemical raw materials used in other parts of the world, a world average is used.

Data for transportation are average data for long distance transports in Sweden, applicable for trucks produced 1995 or later. Since most raw materials are bulk chemicals, quite new catalyst equipped vehicles and empty returns are assumed. For transportations in Italy, older trucks without catalysts are assumed. For the boat transport of raw ethanol from Italy to Sweden, the data were collected from the particular shipping company.

Validation

Method Review of thesis

Procedure

The report on the study of wine ethanol fuel is the result of a Master of Science thesis carried out in co-operation with Company XX and University YY. XXXX at University YY, who is mentioned as reviewer of the study, was the examiner of The final thesis.

Other information

The data from the study are applicable for the fuel ETAMAX D, if all the ethanol in the fuel is produced from surplus wine from Italy. It is possible to add emission data from a specific bus driven on ETAMAX D in the purpose of studying the environmental impact from that particular bus.

It is also possible to compare the wine ethanol fuel to other fuels. If this is done, the boundaries and allocation methods of the compared studies must be the same as for the wine ethanol fuel study. If the boundaries and allocation differ for different studies, these studies can not be considered comparable.

It was shown that one of the largest single environmental impacts of the life-cycle of wine ethanol fuel was the transport of the raw ethanol from Italy to Sweden. Choosing a different transport, for example a boat with cleaning devices for exhaust gas, would strongly affect the result. The high fuel consumption during the grape cultivation is also an important contributing factor for the result, and it must be recognised that grape cultivation probably is carried out in different ways in different parts of the world.

There are other fuels where wine ethanol is a component, but ETAMAX D is the only pure ethanol fuel in Sweden today (1998). The ethanol in ETAMAX D does not necessarily have to come from wine, though this is the origin of ethanol used in bus fuel at present time.

Administrative information

Identification number

CPM_ISO/TS14048_WorkExamples_93

Registration authority

CPM (Center for Environmental Assessment of Product and Material Systems), Chalmers University of Technology, Göteborg, Sweden

Version number

1

Data commissioner

Company XX

Data generator

XXXXXXXXXXX

Data documentor

XXXXXXXXXXX

Date completed

1999-01-20

Publication

XXXXXXXXXXX

Access restrictions

Public

Appendix 3
Short guide for LCI data documentation according to the CPM data documentation criteria and ISO/TS 14048 format

Process

Process description

Description of model of technical system

Name

Descriptive and most commonly known name of the process. The name should give a first indication of which technical system that is described.

Class

Categorisation of the process, for example according to sector. The class is described by:

- *Name*: The appropriate name in the class that specifies the process according to a class-nomenclature. See appendix 1.
- *Reference to nomenclature:* Specification of the class-nomenclature from which the Name is chosen.

Quantitative reference

Specification of the quantitative reference for the process. A quantitative reference is the reference to which the amounts of the inputs and outputs are related, e.g. the functional unit or reference flow. The quantitative reference is described by:

- *Type:* The type of quantitative reference, e.g. functional unit, reference flow, etc. The type is chosen from a nomenclature, see appendix 1.
- *Name:* The name of the quantitative reference
- *Amount:* The amount of the quantitative reference
- *Unit:* The unit of the quantitative reference

Technical scope

A short description of the scope of the process. The scope may range from an individual process, to more composite systems such as a cradle to gate system for a specific product. The specification is done by a nomenclature, see appendix 1.

Technology

Short technology descriptor

Short description of the included technology. This may be used as an abstract that supplements the detailed description in *Technical content and functionality*.

Technical content and functionality

Detailed description of the model of the technical system, with regard to included process steps and activities, etc. The description should provide an understanding on how reported inputs are transformed into the reported outputs.

Technology picture

Graphic representation of the technology e.g. a graphical flowchart of the process. The purpose of the picture is to illustrate the technical system and supplement the description of technology in *Technical content and functionality.*

Process contents

Process contents is used only for processes that consists of a combination of individually documented processes. The process contents is described in terms of:

- *Included processes:* References to the documentation each process that is included.
- *Intermediate product flows:* References to the inputs and outputs that link the included processes together. The referencing is done two by two by for each link by specifying the source and the destination process and the inputs or outputs in the two processes that are linked together. This is documented by:
    - *Source process:* Reference to the process that is the source of the input or output.
    - *Input and output source:* Reference to the specific input or output in the source process.
    - *Input and output destination:* Reference to the specific input and output in the destination process that is linked together with the input or output source.
    - *Destination process:* Reference to the process which is the destination of the input or output

Valid time span

Description of the time span during which the documented process and data may be valid. The range of the valid time span for the process and the data may be described through:

- *Start date:* The start date of the valid time span, specified as XXYY-MM-DD
- *End date:* The end date of the valid time span, specified as XXYY-MM-DD
- *Time-span description:* A description of the valid time span.

Valid geography

Description of the geographical area or location for which the documented process is valid. The valid geography is described through:

- *Area name:* One or several name of the area or location, specified by a nomenclature.
- *Area description:* Description of the area or location, for example through the geographical extension or geographical limitations of the studied process or system
- *Sites:* Address or addresses to the included production sites.
- *GIS (Geographical Information System):* One or several references to the location or area in a GIS system.

Additional information or specification not included in the CPM data documentation criteria

Aggregation type

The type of aggregation that has been performed on the process, specified by a nomenclature (see appendix 1)

Technology

Operating conditions

Description of different relevant operating conditions for the process, that may have an influence on entire sets of measurements or individual measurements. For example, operating conditions can be relations between inputs and outputs.

Mathematical model

Mathematical model can be used for a mathematically formal description of the underlying physical relationships between the inputs and outputs of the process. The mathematical model is documented by:

- *Formulae:* One or several mathematical formulae that is used in the model. The formulae are specified in accordance with mathematical syntax.
- *Name of variable:* One or several names of defined variables that is used in the formulae.
- *Value of variable:* Values of the defined variables.

Data acquisition

Data acquisition is used to describe the data collection and treatment at the process level. The data acquisition is documented by:

- *Sampling procedure:* Description of the procedure that has been used for selecting the included processes from the available population for which the process is valid.
- *Sampling sites:* Address(es) to the site(s) that have been included.
- *Number of sites:* The number of included sites.
- *Sample volume*
    - *Absolute:* The total production volume for the included sites.
    - *Relative:* The relative share of the production volume for the included sites in relation to the total production volume of the population for which the process is valid.

Inputs and outputs

Data for input and output flows

Identification number

Specific number identifying the input or output.

Direction

The direction of the input or output, i.e. input to or output from the process. There is an exclusive nomenclature that shall be used according to ISO/TS 14048: Inputs, Outputs and Non-flow related aspects.

Group

The group to which the input or output belongs, specified by a nomenclature (see appendix 1).

Receiving environment

The receiving environment for the input or output. This information is important to be able to perform impact assessment in an LCA study. The receiving environment is specified by a nomenclature (see appendix 1).

Receiving environment specification

Further detailed specification of the receiving environment. This supplements the specification in *receiving environment*, and allows for more specific impact assessment. The information is specified by a nomenclature (see appendix 1).

Geographical location

Specification of the geographical location where the process and the inputs and outputs occur, by a nomenclature (see appendix 1).

Name

Name text

The name of the substance entering or leaving the process.. It is recommended to name the substance in accordance with a specified nomenclature, and specify the nomenclature that is used in *Reference to nomenclature*.

Reference to nomenclature

A reference to the nomenclature from which the name of the substance is chosen e.g. CAS-numbers, CPM-report 2001:2.

Specification of name

Further specification of the name, to further facilitate the interpretation of the name of the substance.

Amount

The amount of the input or output, in relation to the quantitative reference e.g. the functional unit.

Name

Name of the distribution function that is used to describe the amount. See appendix 1 for a nomenclature.

Parameter

One or several parameters for the amount, where the actual value are specified. The set of parameters are specified by the distribution function.

Each parameter is expressed in terms of a *Name* and a *Value*

- *Name* The name of the parameter, e.g. Quantity, QuantityMin, QuantityMax. See appendix 1 for a nomenclature.
- *Value* The value of the parameter. Please note that the unit for the parameters are supplied in *Unit* (below).

Unit

The unit for the amount, documented by:

- *Symbol or name* The unit or symbol for the given amount. SI-units are recommended.

- *Explanation* Explanation and/or reference of the symbol or name. When SI-units are not used, it is important that the unit or symbol is explained, in order for it to be correctly interpreted.

Property

Information about properties of the inputs and outputs, such as density, temperature, pressure and price. Properties are documented by:

- *Name:* The name of the property, e.g. density, temperature, etc.
- *Amount:* The amount of the property, for the specific input or output.
- *Unit:* The unit for the amount.

Description of methods used to acquire numerical data

Documentation of the methods that have been used for data collection and data treatment. The documentation may be given for a specific individual input or output and/or for a set of inputs and outputs. This is useful when the same methods and assumptions have been used to collect data for more than one input or output.

Data collection

A short specification or indication of the methods that have been used to collect the data. The specification may be done through a nomenclature (see appendix 1).

Collection date

The date or the time period during which the data and the basis for the data were collected.
The following data format should be used: CCYYMMDD/CCYYMMDD.
If only the year is known, write: CCYY0101
If only the year and month is known, write: CCYYMM01.

Data treatment

Description of the methods, sources and assumptions used to generate the amounts that are presented for inputs and outputs. The description should include a clear account of the methods that have been used and the assumptions and calculations that have been performed to obtain the numerical values that are presented.

Reference to data source

References to data sources that have been used in the data collection and data processing, and that is referred to in Data treatment.

Additional information or specification not included in the CPM data documentation criteria

In addition to the information about inputs and outputs according to the CPM data documentation criteria, the following information may be given for individual inputs or outputs in ISO/TS 14048.

Environment condition

Qualitative description of the conditions of the environment to facilitate impact assessment. The environment conditions supplements the indication of the environment that is supplied in *Receiving environment* and *Receiving environmental specification*. This detailed description allows for more specific and local impact assessment to be made.

Internal location

Information about how an input is used within the process or from where an output originates within the process.

Related external system

Information of related external technical systems of an input or output, to e.g. identify upstream and downstream processes not included in the described process.

The related external systems can be described by:

- *Origin or destination:* the delivering or receiving processes for intermediate product flows e.g. geographical information about the destination for an output.
- *Transport type:* Name of the transport supplier or the transportation mode
- *Information reference:* References to contact persons and relevant documents where information on the described related external systems may be found

Modelling and validation

Modelling and validation describes the prerequisites for the modelling of a process as well as the validation of the resulting model and recommendations and a data quality statement.

Description of choices made during the modelling of the process and the objective for the choices

Intended application

Description of the intended application for the process regarding e.g. geographical, technology or other trade specific applicability. The intended application for the process generally determines the level of detail and quality ambition that is used in the modelling. Thus, the description is important for users to understand the documented process as a whole.

The intended application is generally documented through a description of the purpose or objective for the modelling, data collection and documentation of the process.

Information sources

Specification on the information sources that have been used in the modelling of the process, e.g. different technical handbooks, personal contacts at production sites, etc. If the complete process is documented and published in a different format, this reference should especially be given, for example if a literature reference has been used as the only source in the documentation of the process. An unlimited number of information sources e.g. literature, personal communication, databases etc can be given.

Modelling choices

Criteria for excluding elementary flows

Description of the criteria that have been used when choosing which elementary flows to include or exclude. Elementary flows are defined as input or output flows to a process that originates in or ends up in the environmental system, such as a natural resource extracted from the ground or an emission let out in water or air. The description of the criteria should both include a specification of the criteria and a description of the motive for the choice.

Criteria for excluding intermediate product flows
Description of the criteria that have been used in the selection of intermediate product flows i.e. inputs or outputs that comes from or leaves to another technical system. The reasons why a certain input or output have been excluded should also be described e.g. if data is missing.

Criteria for externalising processes
Description of the criteria that has been used to exclude technical subsystems. The description can be made through a specification of which subsystems that have been excluded, together with a description of the reasons why the subsystems have been excluded, e.g. due to lack of data.

Allocations performed
Description of allocations that have been performed in modelling of the process to obtain the numerical data that are documented. Allocations is documented by:

- *Allocated co-products:* The co-products that have been removed through the allocation
- *Allocation explanation:* Description of the allocation, including choice and justification of allocation method, procedure and information that have been used in the allocation.

Process expansion
Description of process expansions performed, with regard to which processes that have been included together with an explanation for the expansion. Process expansions are described by:

- *Process included in expansion:* Specification of the processes that have been included as a result of the process expansion
- *Process expansion explanation:* Description of the reason, motives and details for the system expansion.

The subsystems included as a result of the system expansion are also described the process description, e.g. in Technology and Process contents.

Recommendations for the use of process and the data

Data quality statement

Description of known quality strengths and weaknesses in the documented process and data. The description can e.g. be made through a general description of the quality of the numerical basis for the data, or quality deficiencies in the overall documentation of a process, regarding how representative the process data is.

A quality analysis made by the data generator of how uniform the study methodology is applied to the various components of the study, is considered.

Validation

Detailed description of any validation that has been performed on the documented process. Validation is documented by:

- *Method:* Short description of the type of method that have been applied in the validation.
- *Procedure:* Description of the aspect of data quality that have been examined.
- *Result:* Description of the result from the validation. If errors, missing data or other deficiencies were found during the validation but no corrections have been made, this should be especially documented.
- *Validator:* The person performing the validation. The name, competence, organisation and address of this person should be given.

Other information

Other relevant information about the process and the data that is not included in other data documentation. For example information about how to use the process, known limitations and assumed area of application of the described process regarding e.g. geographical, technology or other trade specific applicability. Also, other general cautions and recommendations may be given regarding how the process and the data can be used.

Additional information or specification not included in the CPM data documentation criteria

In addition to the documentation of modelling and validation according to the CPM data documentation criteria, ISO/TS 14048 also allows documentation about the *modelling principles*.

Modelling principles

Modelling principles include general principles that have been used in the modelling of the process. Modelling principles is documented by:

- *Data selection principle:* The principle that have been used when selecting which data to include in the process.
- *Adaptation principles:* The principles that have been used to remodel the collected data into a unit process suited for LCI.
- *Modelling constants:* The assumptions that have been held constant throughout the modelling of the process. One or several modelling constants may be documented. The modelling constants are described through:
    - *Name:* The name of the modelling constant
    - *Value:* The value of the modelling constant

Administrative information

Identification number

A unique identification number for the process, that is specified by the registration authority. The identification number is used to identify the process.

Registration authority

The organisation responsible for the documented process. For example, for data sets published in CPM's LCI database CPM is the registration authority.

Version number

Version number for the documented process. The version number can be used to find the latest version of the documentation of a process.

Data commissioner

The person(s) or organisation responsible for the commission of the data collection or updating of the data. The data commissioner is specified by name, mailing address, phone number, fax number and email address.

Data generator

The person(s) or organisation responsible for the modelling of the process, including interpretation, compilation or updating of the data. The data generator is specified by name, mailing address, phone number, fax number and email address.

Data documentor

The person responsible for the documentation of the data in the ISO/TS 14048 data documentation format. The data documentor is specified by name, mailing address, phone number, fax number and email address.

Data completed

The date when the study or data for the process were completed and reported. The date should be specified as YYYY-MM-DD

Publication

Reference to a literature where the original copy of the documentation of the process can be found.

Note: The literature reference on which the data documentation is based is specified in *Information sources* (see modelling and validation), if the complete process has been published elsewhere in a different format.

Copyright

The holder of copyright for the documented process.

Access restrictions

Short description of how the document may be distributed in terms of conditions and agreements e.g. details on secrecy agreements or restrictions regarding the data.