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Methodology for handling forest industry environmental data

Method report

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IMI - Industrial Environmental Informatics
for
CPM - Centre for Environmental Assessment of Product and Material Systems
CHALMERS UNIVERSITY OF TECHNOLOGY
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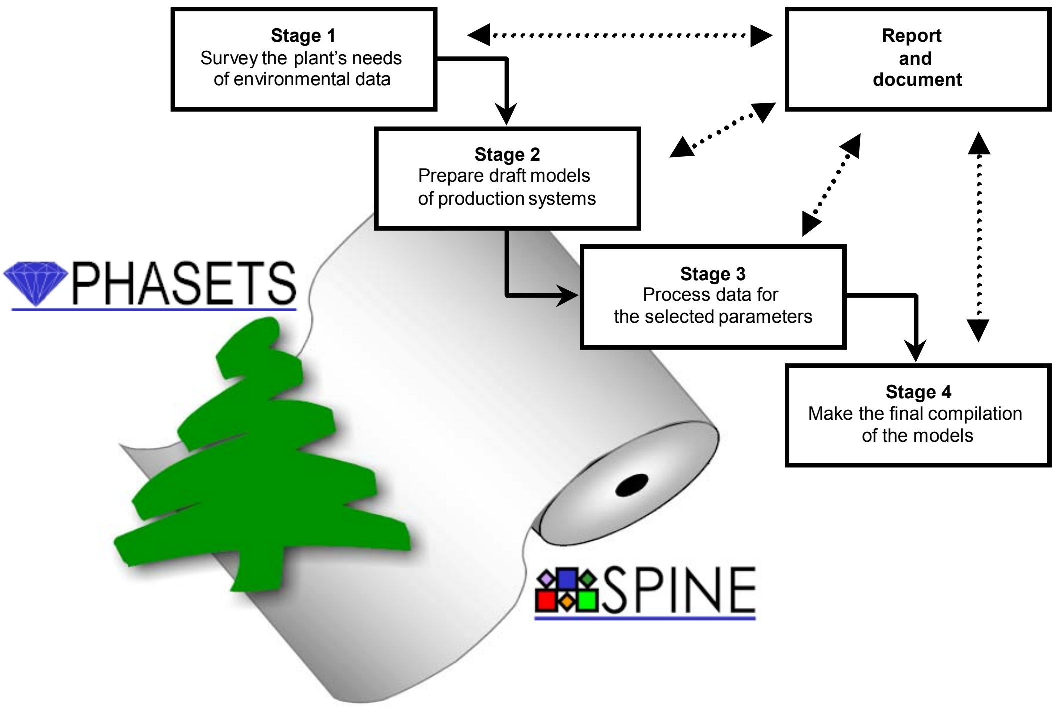


Prepared in collaboration between
the Swedish forestry industry and Chalmers University of Technology

SSVL CPM CHALMERS

Foreword

This method report has been developed in the project " Methodology for handling forest industry environmental data", which was performed during the years 2000 to 2002. The project was financed by the Swedish forest industry through the Swedish Forest Industries Water and Air Pollution Research Foundation (SSVL). The participating companies financed their participation through their own internal funding and through in kind resources within CPM. The project was managed by CPM (Center for Environmental Assessment of Product and Material Systems) at Chalmers University of Technology in Gothenburg, Sweden.

The following material is available from the project:

- Pålsson A-C, et al. "*Methodology for handling forest industry environmental data – Method report"*, CPM-report 2005:1 (both Swedish and English version is available)
- Pålsson A-C, et al. *"Methodology for handling forest industry environmental data – Manual",* CPM-report 2005:2 (both Swedish and English version is available)
- Pålsson A-C, et al. *"An industry common methodology for environmental data management"*, Presented at SPCI 2002, 7th International Conference on New Available Technologies, June 4-6, 2002, Stockholm

The following persons participated in the project:

Project group

- Agneta Enqvist, Duni
- Görgen Loviken, SCA Graphic Sundsvall
- Per Jonsson, Kappa Kraftliner
- Gunnar Karlsson, Duni
- Åsa Möller, M-real
- Ann Britt Nilseng, Korsnäs
- Cennert Nilsson, M-real
- Lars Olsson, Kappa Kraftliner
- Ann-Christin Pålsson, CPM, (Project manager)
- Ellen Riise, SCA Hygiene Products
- Johan Skäringer, Korsnäs
- Helen Sundvall, M-real
- Ola Svending, Stora Enso

Reference group

- Torbjörn Brattberg, Vallviks Bruk
- Jan Bresky, Stora Enso
- Raul Carlson, CPM
- Christer Engman, Iggesund Paperboard
- Åke Gustafson, SCA Graphic Sundsvall
- Ingrid Haglind, Skogsindustrierna (during the project runtime at AssiDomän)
- Roland Löfblad, Södra Cell
- Elisabet Olofsson, SCA Hygiene Products

Content

Introduction

The methodology described in this report has been developed in project collaboration between CPM[1] and SSVL[2]. This project has primarily been carried out by practical work at production plants, where the methodology has been tested and adapted to the specific needs and requirements of the industry.

This method report describes the basis and the theoretical foundation for the methodology. The practical procedure when implementing the methodology is described in "Methodology for the forest industry's handling of environmental data - Manual". This method report and the manual are also available in Swedish.

The following companies and company groups have participated in the development:

Assi Domän	M-real
Duni	SCA
Holmen	Stora Enso
Kappa	Södra
Korsnäs	Rottneros

The following production plants have participated with practical tests in the development of the methodology:

Assi Domän Kraftliner	Duni Kisa
SCA Ortviken	Korsnäs
Stora Enso Skoghall	M-real Husum

[1] CPM – Center for Environmental Assessment of Product and Material Systems is an industry-based competence center at Chalmers University of Technology in Göteborg, Sweden (http://www.cpm.chalmers.se).
[2] SSVL - The Forest Industry's Water and Air Pollution Research Foundation

Purpose

The purpose of the methodology for forest industry's handling of environmental data is to:

- **allow for the compilation of a common database for the industry**
  The data for the database is acquired at participating plants with a common and comparable way of working.

- **quality assure environmental data management**
  Documented routines for processing, compiling and reporting of environmental data are incorporated into management systems (ISO 9001, ISO 14001 etc.) and are adapted to the unique prerequisites at each plant.

- **simplify and co-ordinate the production plants' compilation of environmental data for different needs**
  Structured environmental data management provides simpler handling, where e.g. data for life cycle assessment, environmental labelling and environmental reporting can be co-ordinated.

- **facilitate communication of environmental information to customers and other stakeholders**
  Environmental data for different stakeholders are easily available and well-founded.

- **set an industry standard for handling of environmental data**
  A common methodology supplies a common language and way of working within the forest industry.

Some possibilities with an industry common methodology

Efficient, assured and accessible environmental information and data for process as well as product

The demands for efficient, assured and accessible environmental information are increasing with increasing environmental awareness of the market. The industry and individual production plants need to be able to meet and respond to the demands with reliable environmental information and data that holds for a critical review.

Simplified internal compilation and reporting for the system (product, process, administration)

The industry's and the plant's stakeholders requires information describing environmental impact for the production of products, for the processes used in the production and for other administration. In order to satisfy the stakeholder’s different requirements on information and data, a simple and flexible way to internally compile and report environmental data is needed.

Unambigous and easily accessible information for customers/users and in time consumers

The customers are asking for specific information about the paper that they buy. In order to give reliable and relevant information about each of the products that are manufactured, the plant need to be able to acquire and document environmental data in a good manner.

With increasing competition on the market, it will also be necessary to be able to describe differences between main products in more respects than price and strength. It is increasingly other values that will be important in the competition between products on the market when price and quality are comparable for several producers. Well-documented methods to acquire such 'added benefits' are then required, which can be applied in the industry and which results in comparable and reliable data.

Environmental product declarations may in the future be as necessary as quality declarations or product specifications. This requires a well-documented manner to acquire data that are accepted in the industry.

Unambiguous and easily accessible information for authorities (national and EU) for current and future needs.

The development within EU (IPP[3], IPPC[4] etc.) is pointed towards, if slowly, product-based thinking and framework. This will put requirements on the reduction of environmental impact of production and use of products. It will be necessary to 'correctly' allocate environmental impact between different products from one production plant.

In accordance with the requirement from EU, the environmental protection agencies may require that resource use and emissions are reported per product. There must then be a procedure for acquiring data that are common and accepted by those concerned.

Advantage towards other industries

It gives a strength against competing materials if all companies within the pulp- and paper industry has a common methodology to describe environmental impact, that is transparent and fulfils standardised demands. The Swedish pulp and paper industry should be able to speak with one voice in these issues. This requires an agreement within the industry of a way of working that is scientifically accepted and credible.

[3] IPP – Integrated Product Policy
[4] IPPC – Integrated Pollution Prevention and Control

What kind of information is handled within the methodology?

Compilations of environmental data - models of technical systems

In order to respond to different stakeholders' questions, most production plants needs to acquire and compile different types of environmental data to describe the environmental impact of the activities. The environmental data that are requested concern e.g. use of raw materials, emissions to air and water, generated waste and produced products. Different stakeholders have however varying requirements on what should be included in the compilation and how the data should be acquired. The compilations may for example concern individual process steps, departments, production lines or the entire plant.

The different compilations that need to be handled do however have one thing in common; they describe defined parts of the plant. A compilation of environmental data for a well-defined part of a technical system is in this context referred to as *a model of a technical system* (see figure 1).

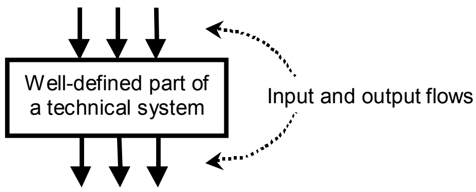


Figure 1. Model of a technical system

A model of a technical system can be *simple* or *composite* (see figure 2). The difference between these is that a composite model is constructed of several simple models.

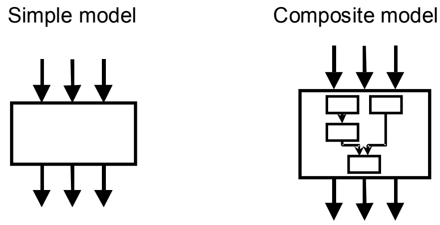


Figure 2. Simple and composite models of a technical system

Designing a model of a technical system

A model of a technical system is in general designed for a specific purpose and area of application, which guides the choices when designing the model. The choices regard:

- system content, boundaries and level of detail, i.e. processes that shall be included in the model or can be left out, e.g. internal transports etc.
- which parameters[5] that shall be reported

[5] Input and output flows to the plant that may case environmental impact. Also called indicators.

- what time span the model shall describe
- allocation models[6] that shall be used
- specific requirements on acquisition and processing of data for the parameters that shall be reported.

During the design, requirements on quality and level of detail in the model are balanced to costs and area of application. The model should not be more detailed than what can be motivated economically and with respect to defined needs. It is generally practical to work with the models step-by-step, by making a first draft, test whether it works and refine and adjust when needed.

Models of technical systems for different applications

Models of technical systems are used within a number of different applications in industrial environmental management. The models that needs to be handled at a plant can in general be divided into two different types:

- *activity- and process related models* which describes environmental impact for an activity or a process.
- *product related models* which describes environmental impact for the production of a selected product or product group.

Depending on in which application it is used, the model has different content and system boundaries. Below a brief description is given of applications within which models are used, and how these models generally are defined.

Activity- and process related models

Below some examples are given of applications where models describing environmental impact for an activity or a process are used.

Environmental management system

To measure environmental impact of the activity and set environmental goals, models describing for example organisational units (departments) or production steps are used. The models are generally designed during the environmental investigation, where the activity's input and output flows are surveyed, and is subsequently used to follow-up the defined goals. In these models the parameters that have been identified as environmental aspects for the activity are included.

[6] Allocation means partitioning the input or output flows of a unit process to the product system under study (defined as in ISO 140406). Environmental impact sometimes has to be allocated between different processes or products. For example, it may be necessary to do an allocation if a measuring system only measures the total flow of steam which is then used in several processes, or where one process produces several products. Please also see "Methodology for handling forest industry environmental data - Manual ".

Environmental reporting

In environmental reporting, models describing the entire activity is used and communicated. The model includes the parameters that are relevant for the activity and that are required by customers and other stakeholders.

Environmental reporting to authorities

In environmental reporting to authorities, models describing the plant according to the control programme are used. These models generally only include the part of the plant and the parameters that are specified in the control programme.

Process optimisation

In process optimisation, models of individual process steps or production lines are used to optimise and steer processes, e.g. with respect to a specific parameter.

Product related models

Below some examples are given of applications where models describing environmental impact of the production of a specified product are used.

Life cycle assessment (LCA)

In life cycle assessment a model is created which describes the environmental impact of a product or a service during its entire life cycle, from extraction of natural resources, through all processing stages, use and final waste management. The model is created by building a composite system as a flow chart, where the included components describes the processes and transports that are included in the production and handling of the studied product or service.

Eco-labelling

Models used in different types of eco-labelling are specified by the body responsible for the eco-label. In a certified environmental product declaration (EPD) according to the Swedish system, for example, the model describe a life cycle assessment of the product, conducted according to the requirements and product specific requirements that applies for EPD[7].

Product development

In product development, models of production systems are used to describe expected changes in environmental impact due to changes in e.g. composition of the product etc.

[7] More information about EPD is available from the Swedish Environmental Management Council: http://www.miljostyrning.se

Fundamental structures used in the methodology

The forest industry's methodology for environmental data handling structures the work with designing, compiling, documenting and reporting different types of models of technical systems. The methodology is based on two fundamental structures:

- PHASETS: the framework for the way of working when handling environmental information and data for a model of a technical system.
- SPINE: the format that is used for documentation of models of technical systems.

These structures will be described in the following chapters.

PHASETS – Phases in the design of a model of a technical system

The fundamental framework for the forest industry's methodology for environmental data handling is the PHASETS structure (PHASEs in the design of a model of a Technical System). PHASETS structures environmental data handling for different purposes and has been especially designed to be the basis in an efficient and quality assured enviromental 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.

The structure has been developed at CPM, independent of a specific industry sector, based on experiences from the development and maintenance of the Swedish national LCA database. The structure is comprehensively decribed in a scientific article[8].

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. (see figure 3).

[8] Carlson R., Pålsson A-C. *Industrial environmental information management for technical systems.* Journal of Cleaner Production, 9 (2001) 429-435.

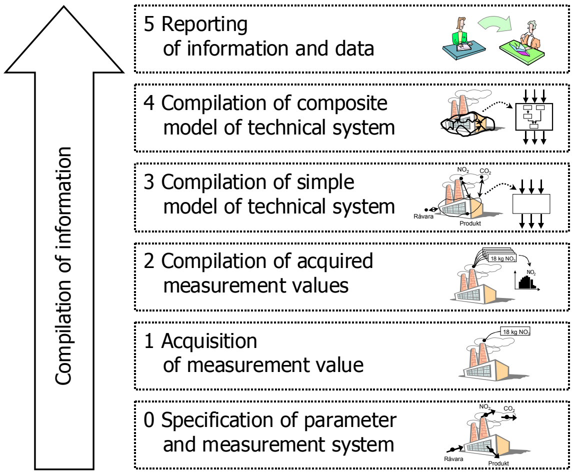


Figure 3. The PHASETS structure

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 (see figure 3):

Phase 0. *Specification of parameter and measurement system.*
Supplies the fundamental interpretation of the measured parameter.

Phase 1. *Acquisition of measurement value.*
Registering individual measured values for the measured parameter.

Phase 2. *Compilation of acquired measurement values.*
Compilation of the acquired measured values into e.g. different types of mean values for a specified interval.

Phase 3. *Compilation of a simple model.*
Design of a simple model of a technical system using the information for individual parameters that were acquired in the previous phases.

Phase 4. *Compilation of a composite model.*
Design of a composite model using compiled simple models.

Phase 5. *Reporting of information and data.*
Reporting of information and data between the different phases of PHASETS and externally.

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. A description of communication paths for environmental information within a company, based on PHASETS, has been performed within a thesis work performed at Stora Enso[9].

[9] Annika Taprantzi "A Systematic Approach for Acquiring Industrial Data and Information for Industrial Applications", Master of Science thesis at Miljö- och vattenteknik, Uppsala Tekniska Högskola, UPTEC W 01 002

Below a decription of each phase in PHASETS is given; the tasks that are performed and the results that are reported.

Please note: The description of the phases is given in the order that information and data is reported through different work tasks, to the compilation of final report (see the overwiev in figure 4). The description therefore starts in phase 0 and continues up to phase 5. When PHASES is introduced however, it is practical to start in phase 5 to develop a specification of the information that is needed for the report and then work downwards in the structure to phase 0. See the chapter 'Introducing the methodology in production plants' for a description of the procedure when working with the methodology.

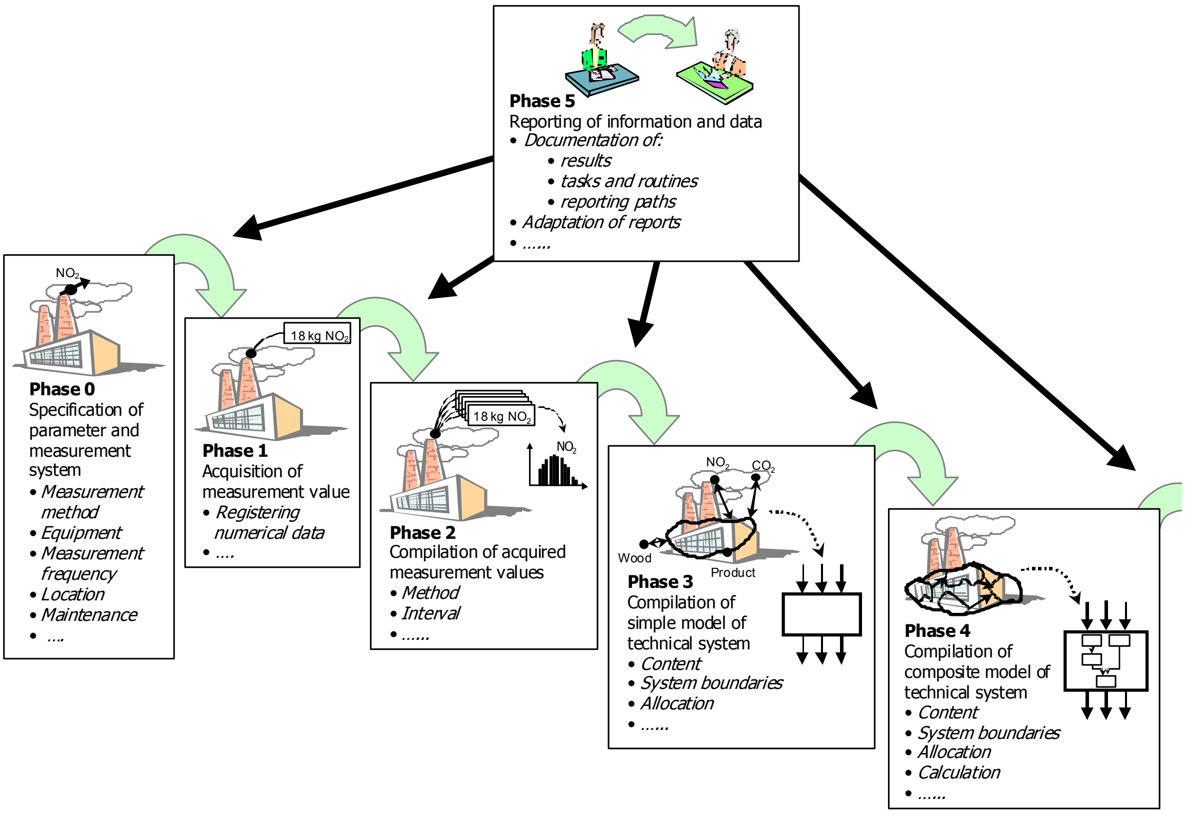
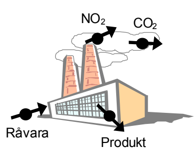


Figure 4. Overview of tasks and information handled within the phases of PHASETS

Phase 0
Specification of parameter and measurement system



In phase 0, parameters and their associated measurement systems are specified. A well-specified interpretation of the measured parameter is a prerequisite to be able to compile and process relevant information for the parameter. This interpretation is achieved with a well-specified measurement system, which may be physical measurements, calculation models and different types of estimations.

In order for a measurement system to be well-specified the following should be known:

- *Method of measurement;* specification of the method with which the parameter is measured
- *Equipment*; specification of the equipment, with which the parameter is measured, and its performance, sensitivity, and conditions for measurement.
- *Measurement frequency*; the frequency with which measured values is registered in the measurement system, e.g. once per minute, once per month, once per year
- *Location*; the location of the measurement system in the technical system
- *Maintenance*: routines for calibration etc., and follow-up of the routines

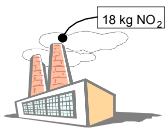
Measurements for different parameters are generally conducted with different measurement frequency and for different purposes. There may sometimes also be dependencies between different parameters that must be considered. These aspects need to be handled when measurement values for several different parameters are compiled to describe a defined technical system (which is done in phase 3 in PHASETS).

Reporting of results

In order to assure a correct interpretation of parameter and measurement system, the following should be reported to the subsequent phases:

- Routines and specifications for registering measurement values, specified by the measurement system
- Limitation in the measurement system
- Dependencies between parameters
- Follow-up of the routines for maintenance and calibration; any divergences that had an influence on the parameter

Phase 1
Acquisition of measurement value

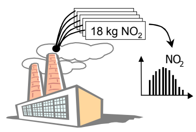


When a measurement system is established, measurement values may be acquired. In phase 1, the registering of numerical data for the specified parameter is made.

Reporting of results

In order to be able to interpret and analyse the measurement values that are acquired, any discrepancies from the routines and other cirumstances that had an influence on the result needs to be documented and reported to subsequent phases together with the measured value.

Phase 2
Compilation of acquired measurement values



In phase 2 the acquired measurement values is compiled to describe trends, mean values, total amount etc. for a specified interval.

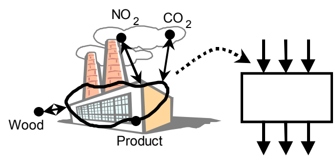
The compilation of measurement values is made with a specified method, which generally is specified by the measurement system, for a specified interval. For example the interval may be a time period during which the measured values were acquired, or for which the compilation is valid (for example estimation of a yearly average based on an individual sample).

During the compilation, the set of measurement values is analysed. The procedure during this analysis are generally determined by the method for the compilation; for example how extreme values should be handled, and how measurement values should be sorted, and what assumptions and simplifications that may be done. For this analysis, certain cirumstances about the acquisition of the set of measured values need to be known. An interpretation of the result can also be made.

Reporting of results

- Compiled set of measurement values
- The interval for which the compilation is valid
- Interpretation of the result; for example discrepanicies during the studied interval and other relevant information for how the information should be used

Phase 3
Compilation of a simple model of a technical system



In phase 3, a compilation of a simple model of a technical system is made by means of the information for selected parameters that were acquired in the previous phases. The design and compilation specifies the model's:

- Purpose and area of application
- System content and system boundaries, i.e. which processes etc are included in the model and which are excluded
- Input and output flows (i.e. what parameters are reported)
- Methods used in the acquisition and processing of data for input and output flows, through references to earlier phases in PHASETS (i.e. phase 0 to phase 2).
- Allocations or other assumptions that are applied to transfer environmental data acquired in phase 0 to phase 2 in PHASETS, to flows describing the model

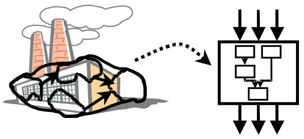
Sea also the chapter 'Design of a model of a technical system'.

In the design of simple models of technical systems that shall be used for the construction of a composite model, the requirements that are specified for the composite model needs to be followed (see also 'Phase 4 Compilation of a composite model of a technical system')

Reporting of results

See the chapter 'SPINE - Documentation of models of technical systems' for a description of documentation and reporting.

Phase 4
Compilation of a composite model of a technical system



In phase 4, a composite model of a technical system is compiled by means of information acquired in previous phases. The compilation includes the specification of the model's (c.f. phase 3):

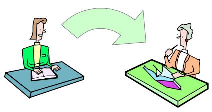
- Purpose and area of application
- System content and system boundaries, i.e. which models shall be included in the composite model, and which can be excluded. Requirements of design and content of the models to be included in the composite model are defined here.
- Allocation
- Calculation of input and output flows, i.e. how the calculations for the composite model shall be performed. Input and output flows for a composite model are calculated by means of data for input and output flows for the included models

See also the chapter 'Design of a model of a technical system'.

Reporting of results

See the chapter 'SPINE - Documentation of models of technical systems' for a description of documentation and reporting.

Phase 5
Reporting of information and data



Phase 5 handles reporting of information and data between the phases of PHASETS and externally.

During reporting the sender should make sure that information and data can be interpreted, and correctly used by the receiver. Generally the information is reported between different organisational units and between personnel with different areas of expertise, experience, competence, etc. In order for the receiver to correctly use the information he or she might need further background information that bridges such differences in competence areas. This is generally information that is not necessary when the information is only handled within the specific phase of PHASETS. For the reporting to be efficient the information content of the report should be discussed and agreed upon by the sender and the receiver.

It should also be recognised that within each phase of PHASETS, information and data is handled that are only used for internally for quality assurance and follow-up of the work. In the normal case only a part of this is reported to subsequent phases, i.e. the parts that are relevant for the information to be used correctly in the subsequent phases. The amount of information that are reported are decided in consultation between sender and receiver.

SPINE - Documentation of models of technical systems

What is SPINE?

When documenting the models that are compiled the SPINE[10] format should be used. SPINE is specifically designed for documentation, reporting, storage and communication of models of technical systems. The format specifies *what* infomation is relevant to document and *how* it should be documented. This facilitates both the work with documentation and with interpretation of the documentation.

The documetation in SPINE can be performed with SPINE based software or with Word- or Excel templates. Which alternative that is chosen depends on what is practical based on the specific cirumstances.

SPINE is used in the national LCA database SPINE@CPM, and a number of companies within different industries are using SPINE for company internal LCA- and environmental databases. The format was the starting point for the international standardisation of a data documentation format ISO/TS 14048 (see also the chapter 'International standardisation of data documentation'). The format is also recommended as a reporting format in the Swedish EPD system (Environmental Product Declaration), third party certified ennvironmental product declarations.

[10] SPINE - Sustainable Product Information Network for the Environment. See also: http://www.globalspine.com

Documentation in SPINE

The documentation of models of technical systems in SPINE is divided into five parts, within which the work with acquisition and compilation of the model is described (see figure 5 below). This description is based on the CPM documentation criteria[11], that specify what information in SPINE that should be documented in order for it to be reviewable and reuseable in new applications.

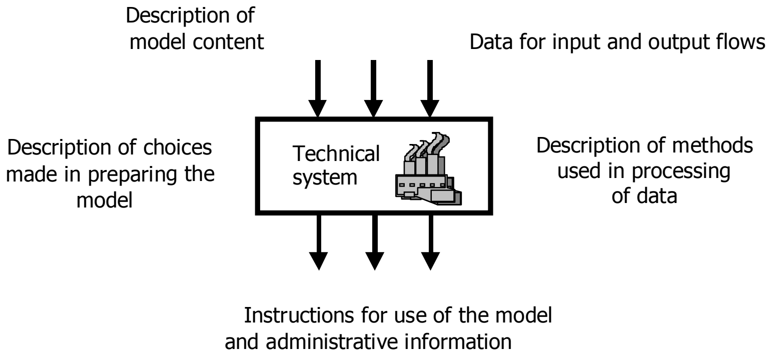


Figure 5 Documentation of models of technical systems in SPINE

The documentation consists of:

- *Description of model content*
  Description of the processes, equipment, etc. which are included in the model.
- *Description of choices made in preparing the model*
  Description of purpose and area of application, the delimitations that were made during the design of the model and any allocations that have been performed.
- *Data for input and output flows*
  Environmental data for the parameters that have been selected for the model.
- *Description of methods used in processing of data*
  Description of the methods, assumptions and processing that have been done to acquire the data presented for the model.
- *Instructions for use of the model and administrative information*
  Overall description of area of application or limitations in useability, as well as an assessment of data quality. Administrative information describing how the model may be distributed.

SPINE can be used for documentation of both simple and composite systems. See 'Methodology for handling forest industry environmental data - Manual' for a further specification of how information is documented in the SPINE-format.

[11] The CPM documentation criteria was developed 1996 in a project collaboration with representatives from companies within different industries, and were published 1997 in CPM-report 1997:1 "Krav på datakvalitet CPMs databas" (in Swedish)

SPINE and PHASETS

PHASETS structures the work when compiling a model of a technical system but gives no guidance as to how the information should be documented. SPINE supplements PHASETS by structuring the documentation of the information that is acquired.

SPINE is mainly used for documeting the result from work in phase 3 and phase 4 of PHASETS, i.e. the two phases that describes the design of a model of a technical system.

Below an overview is given of which phase in PHASETS is documented in the different parts of SPINE

SPINE	**PHASETS**
Description of model content	Phase 3 and Phase 4
Description of choices made in preparing the model	Phase 3 and Phase 4
Data for input and output flows	Phase 0 to Phase 4
Description of methods used in processing of data	Phase 0 to Phase 4
Instructions for use of the model and administrative information	Phase 5

General recommendations for the documentation

The documentation is used for reporting to different stakeholders, when updating and changing the model and for follow-up. This puts requirements on the documentation:

- The description of *model content* and the *choices made in the preparation* should be sufficiently detailed for those who are working with and using the model to determine exactly what has been included in it and what has been excluded.
- The documentation of *data for input and output flows* and *methods used in the processing of data* should make it possible to trace all handling and processing of the presented data, all the way down to the measurement system. This is important in order to be able to verify, update the model and to follow-up the work.
- The documentation of *instructions for the use of the model and administrative information* should provide users with an understanding of areas of application and limitations, and unambigous knowledge regarding how the information may be distributed.

It should hovewer be recognized that the reporting may need to be adapted depending on what the documentation will be used for. It is then crucial to consider what is known about the reciever. If for example the model shall be communicated to a customer, only selected parts of the complete documentation are included in the reporting.

International standardisation of data documentation

A technical specification[12] for data documentation within ISO was finalised in July 2001; ISO/TS 14048 Environmental management – Life cycle assessment - Data documentation format. The standardisation work was initiated by Sweden, based on results from the establishment of the Swedish national database at CPM. The Swedish experiences from the work with SPINE have been included in the standardisation work, and the fundamental ideas regarding documentation in the technical specification are to a large extent based on the Swedish experiences. The SPINE and the ISO/TS 14048 formats are fully compatible, and similar. By using SPINE for documentation, the changeover to ISO 14048 is simplified.

Since this technical specification is the first within ISO 14000 series[13] regarding documentation, it is anticipated that it will have an influence on the documentation within environmental management systems, eco-labelling etc.

Quality assurance of environmental data handling

Quality assurance of environmental data can only be achieved by a quality assured handling of data. Quality assurance of the handling is achieved by documentation of the routines for the tasks that is performed, how they are maintained, and how the results are reported between different functions (c.f. principles within quality systems such as TQM[14], ISO 9001). This requires explicit roles and responsibilities in the handling of environmental data.

The documentation enables:

- Follow-up, management and control of the environmental information quality
- Use of the information in new applications
- Traceability and personnel independent handling
- Verification and review

With the PHASETS structure, quality management can be distributed through the entire chain of environmental data handling. The quality of the result from each phase depends on how well the tasks within the phase have been performed, how well tasks in the previous phases have been performed and, how well the reporting between the phases works. *Each phase and the reporting between the phases are thus equally important for the quality of the final result.* Thus, when using PHASETS for quality assurance, the quality within each phase may be handled separately, independent of previous and subsequent phases, as well

[12] A Technical Specification (TS) has a three-year revision period, compared to a International Standard that has a five-year revision period. Both are however normative documents.
[13] ISO 14000-series – International standards for environmental management
[14] TQM – Total Quality Management

as the quality of the transfer of information and data between phases may be handled separately. This is the fundamental idea for quality assurance in the forestry industry's methodology for handling of environmental data.

Introducing the methodoloy in production plants

Procedure when introducing the methodology

The forestry industry's methodology for environmental data handling is implemented at production plants in four stages. In each stage, specific tasks and information in acquisition, processing, compilation and reporting of environmental data for the plant is handled. The work procedure is described in detail in "Metodology for handling forest industry environmental data - Manual". The work procedure and the manual has been developed and tested by practical work at production plants.

The foundation for the work procedure is the PHASETS structure. For the practical work, the different phases of PHASETS has been grouped into four stages (please refer to figure 6). In the implementation, the work begins at the top phase to then go further down in the structure. In each stage, requirements are specified on the work that needs to be performed in the subsequent stages. This facilitiates the work and makes it efficient.

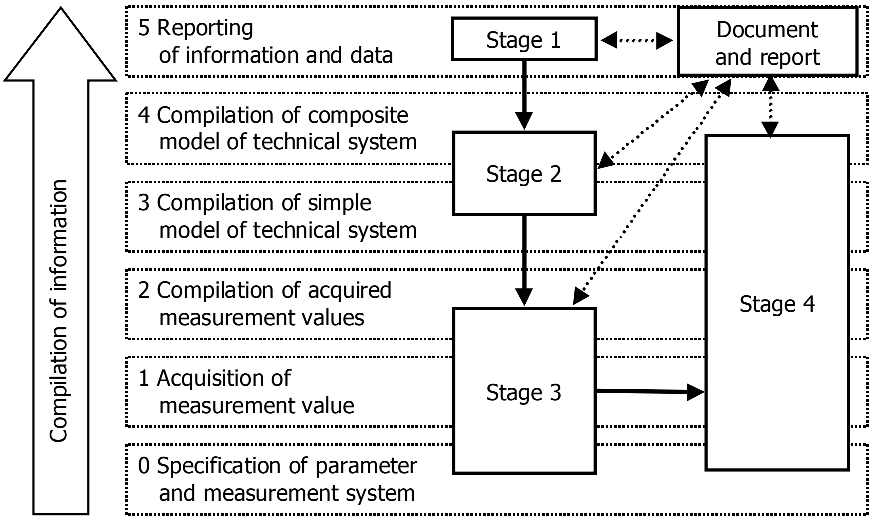


Figure 6. The work procedure for implementation of the methodology, and which phases of the PHASETS structure that are handled in each stage of the implementation.

In **stage 1** the plant's needs for environmental data is surveyed. During this work the stakeholders that request environmental data are identified, as well as their requirements on the data. The survey is used to determine which models that need to be handled, and to prioritise and control the further work. This stage corresponds to phase 5 in the PHASETS structure (please refer to figure 6).

In **stage 2** the first draft models of production systems are prepared, that describes the production of the products or product groups that were selected, based on the survey of environmental data needs. The production systems may be prepared as simple or composite systems. In this work the parameters that shall be reported for the systems are also selected. This stage corresponds to phase 3 and phase 4 in the PHASETS structure (please refer to figure 6).

In **stage 3** data are processed for the parameters that were selected for the draft models. Allocation issues for the draft models are also investigated. This stage corresponds to phase 0 to phase 2 in the PHASETS structure (please refer to figure 6).

In **stage 4** the final compilation of the models is made, based on the information that have been acquired and prepared in the previous stages of implementation. This stage corresponds to phase 0 to phase 4 in the PHASETS structure (please refer to figure 6).

In each stage, the tasks, reporting paths and routines that are identified and designed for the work, and the results that are achived shall be **documented and reported**. The documentation guarantees quality assurance of the environmental data handling. Reporting and documentation corresponds to phase 5 in the PHASETS structure (please refer to figure 6). The models that are prepared and compiled should be documented in the SPINE format (please refer to chapter 'SPINE - Documentation of models of technical systems').

Integrating the methodology in management systems

The aim with the methodology is that it should be easy to integrate into any existing management system. The fundamental idea is that the methodology should structure and co-ordinate existing data handling at the plants, and make the information easily accessible for new applications.

When introducing the methodology one should therefore base the work on what is already done, investigate what works and what may be improved, and design routines for tasks and handling which are missing or do not work sufficiently. Established management systems, such as ISO 14001, EMAS and ISO 9001, should be utilised. Also, in order for the methodology to be integrated, any new routines that are needed to work according to the methodology should be inserted in the management systems. New or altered routines should only be designed when necessary for the information to be handled and used more efficiently and effectively.

The share of information that is already handled at the plant probably varies in the different stages of implementation of the methodology. The part that handles information where well-established routines probably are available within existing systems are acqusition and processing of data, which is handled in stage 3 of the implementation. For the stage that deals with the preparation of models of technical systems (stage 2), it is however possible that established routines are missing in the existing systems, and that new operative routines may need to be introduced.

Co-ordination of models used at a production plant

Common models

Different models may be required for different applications, due to that it generally is difficult to design models that may fulfil all different stakeholders and information needs. For exemple, the model that is used in communication with customers may not be useable in communication with authorities, since these stakeholders have different requirements on the information.

However, by identifying common parts between the different compilations of environmental data that needs to be handled at the plant, the work can be made more efficient. For example, product and process related models could be co-ordinated by building the production system as a composite model. Be defining the included process components generally, these may be used to construct different types of composite models that describe the activites at the plant in different manners.

Processing of environmental data

In the ideal case, the acquisition and processing of data for individual parameters are common for all different types of models that need to be handled, and the information that is prepared can easily be used to make different types of compilations for the activies at the plant. In reality though, the processing of data is often made to be used in a specific application, which is not necessarily generally useable for all different types of models. This specifically concerns the compilation of acquired measurement values into different types of mean values. This needs to be considered and analysed in order to as far as possible co-ordinate the handling.

Chosing level of ambition when introducing and using the methodology

The level of ambition when introducing and using the methodology is selected based on the plant's own needs and requirements. For example, one may choose to use the methodology to structure all aspects of environmental data handling at the plant, or to use it to specifically structure product related environmental data, or to only use it to acquire the basis for the compilation of an industru common database. The level of detail on the models that are defined may vary from a very detailed composite model, to a simple model ('black box').

During the implementation, an overview and review of the plant's handling of environmental information and data may be performed. The implementation may also be used as a test of routines for environmental data handling within environmental management and quality systems. This may for example be used to identify possibilities for improvements in the environmental data handling, and the quality of environmental information and data.

The full potential concerning co-ordination, efficiency and quality is achieved when the methodology is used to structure all aspects of environmental data handling at the plant. The methodology may then function as an integrated support for the plant's environmental work.