Centre for
Environmental Assessment
of Product and Material Systems

Project report

Establishment of CPM's LCA database

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CPM report 1998:3

SPINE

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Summary

The goal of this CPM project was to make LCA data accessible for LCA analysis. The overall requirement was to establish a national quality reviewed LCA database. The project has been successful in reaching the goal and in fulfilling the requirements.

Some deviations have been made, however, in regards of unspoken quantitative expectations on the project. It was found to be more difficult than expected to find quality reviewable data. Existing data were found to be insufficiently documented in order for it to be quality reviewed. Therefore the goal of the project converged from just making LCA data accessible to making *sufficiently documented* LCA data accessible.

The project has directed much work on the issue of *sufficient documentation*, work suggested to be brought in to an ISO working group. If this suggestion is accepted, today's outcome from the CPM investments will be brought many steps further towards making *sufficiently documented* LCA data accessible for LCA analysis, and for all other users of environmental data on technological activities.

/Raul Carlson, 25 November 1998

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How to read this report

This report consists of two separate parts: A project summary and an appendix describing the result of the project from different viewpoints.

The project was subdivided into two phases and 10 different subprojects. Phase one consisted of 6 subprojects and ran between august of 1996 and January of 1997. Phase two ran between April and December of 1997 and consisted of 4 subprojects.

The project summary shortly describes the entire project and subprojects during phase one and phase two.

Since the result of the project is a system of technical parts, organizational parts, data contents and other results on different administrational systems levels, it was considered to have been difficult for any reader of the report to extract these results from the results of the subprojects. Therefore, in the appendix the results are interpreted from the viewpoint of different stakeholders.

The summaries of each subproject begin with a reference to the interpreted chapters in the appendix where a more thorough explanation may be found.

/Raul Carlson, 25 November 1998

Project members

Name	*Organization*
Alena Ashkin	ABB
Alexandra Karlsson	SAAB
Anders Andrea	Ericsson
Ann-Christin Pålsson	Chalmers University of Technology
Bengt Steen	Chalmers University of Technology
Caroline Setterwall	Vattenfall
Elisabeth Bergnor Gidnert	STFI
Ellen Riise	SCA
Göran Brohammer	SCA
Göran Löfgren	Nordic Port
Göran Mälhammar	Ericsson
Göran Swan	STORA
Helena Greijer	ABB
Jan Bresky	STORA
Jens Malmodin	Ericsson
Jens Wiksell	Volvo
Johan Felix	ABB
Jörgen Wennsten	Volvo
Laila Iren Helgesen	Norsk Hydro
Lars Lenell	Ericsson
Lennart Bäcklin	Perstorp
Lennart Karlson	ABB
Luis Blanco	Volvo
Maria Munter	Vattenfall
Mikael Ekdahl	Perstorp
Mikael Severinsson	Perstorp
Ola Svending	STORA
Peter Arvidsson	Akzo Nobel
Pär Johansson	SAAB
Raul Carlson	Chalmers University of Technology
Sophie Louis	Volvo
Susan Iliefsky	SCA
Ulf Boman	Vattenfall
Ulrika Ågren	STORA

The database project

Results

- 174 well-documented data sets [Appendix XI]
- Data review and data documentation [Appendix II & Appendix III]
- A technical system which supports data administration and review [Appendix IX]
- Protected internet publication of data [Appendix IX]
- Initiated project for finding methods for data documentation at production sites [Appendix VI]
- A description of the role for the CPM data administration within Sweden. [Appendix I]
- Formulated a draft LCA data questionnaire, referred to as a form and a draft method for how this can be used. Further development is needed. [Appendix VIII]
- Has strongly participated in the proposal for a new work item to the ISO 14040 series, concerning standardization of LCA data documentation format. [Appendix VII]
- A number of reports describing different aspects of LCA data handling and the CPM data administration. [Appendix IV, Appendix V, Appendix X]

Summary

In the beginning of the database project some participants expected that at the end of the project there would be ‘thousands of quality reviewed data sets’ in the database. This expectation was largely based on the false idea that as long as LCA data were SPINE formatted it could also be quality reviewed.

However, SPINE users had not been able to sufficiently document their data, due to lack of methodology and due to shortcomings in commercial SPINE software. And therefore, all data that had been SPINE formatted before the start of the project were rejected for publication in the common CPM database. And so, *all* data sets published at the end of the project, nearly 200, has been SPINE formatted and documented within the project.

Sufficient documentation of data is important for being able to perform statistical quality assessments of the data, when data of such quality occurs, and for data users to appraise the *relevance* of a data set.

The general lack of documented LCA data and the lack of documentation methods were identified as the most crucial obstacles for building an LCA database and, in the long run, for enabling general access to high quality LCA data. Therefore much effort has been laid on developing practical and useful methods for data documentation, together with methods for data review.

The CPM data documentation criteria (originally called data ‘quality criteria’) were formulated with the ambition to develop good methods for data documentation, methods that could be used by anyone working with LCA data.

As these methods has been developed and tried out, it has also been apparent that they are well functioning, and that they can instantly be integrated with the regular LCA work within any institute or corporation.

In short, the methodology recommends that the same person being responsible for the creation, reformatting or other data manipulation should supply the data with sufficient documentation and that this documentation should be stored in the database together with the data and published or reported together with the data. If the documentation needs to be added to the data set afterwards, by someone else, the documentation will be prone to misinterpretation and errors, and will inevitably become much more expensive. The methodology is developed to avoid such dysfunctional data and data documentation.

The SPINE database format fully supports the same efficient way of working with LCA data and data documentation as the CPM data documentation methodology recommends.

Generally, commercial and other publicly available databases are insufficiently documented.

Nevertheless, for making sufficiently documented LCA data accessible in the long run, it is not enough to have methods for *re*formatting LCA reports and other secondary sources for environmental data. Instead, data needs to be documented as they are measured or otherwise originally created.

It was for this reason that the subproject '*Emission Possible*' was initiated. The ambition within this subproject is to find and develop methods for data documentation, data handling and organizational integration of data handling procedures at production sites. Such methods will support not only the improvement of the access and quality of data for LCA, but it will also become an important tool for the environmental management systems, for eco labeling type III and for lean LCA methods like the EPS system.

As a result from the discussions held at the initiating meeting for Emission Possible, CPM together with SMS (Svensk Material- och Mekanstandard) brought a proposal for a new work item to the ISO 14040 series. The proposal concerns standardization of LCA data documentation format.

The voting, whether this proposal will lead to a new workgroup or not, is not yet finished as this report is written.

An international standard for an LCA data documentation format will be extremely useful for all kinds of environmental data handling. Integrated with the environmental management systems and assimilated with, for example, the governmental reporting format, product communication formats, eco labeling and LCA, it has the power of simplifying and reducing the costs for all kinds of environmental control activities within the industry and the society in whole.

Regardless of the outcome from the ISO voting, the efforts made within the database project will have made a great leap forward in making sufficiently documented LCA data accessible to the LCA community. In the nearest future these results needs to be taught, used, and integrated with the common LCA work.

All participants who shared their competence and experiences with each other during the project are well worth great thanks.

/Raul Carlson, 25 November 1998

The subprojects

Database project's phase one

Project leader: Raul Carlson, CPM, Chalmers University of Technology

Summary of phase one

Phase one was the most intensive part of the project, with many meetings, often two or even three meetings a week. The participants started out from very different viewpoints, backgrounds and organization, and ended up with having a common view of the problems, a common language for dealing with the problems and with having a more *realistic* view of how to create a common LCA database.

During this phase of the project it became evident that the problems with the technical solutions for the CPM database were quite small, while the organizational difficulties often seemed almost immense. CPM was a new organization, and the different parties had not found their roles within the network. And yet did not the administrational unit of CPM work satisfactory. In spite of the difficulties associated with these distractions, much common work was made and many important agreements were formulated.

Some issues were identified to be unexpectedly difficult, such as secrecy barriers regarding data and agreements on common and feasible nomenclatures, while other supposedly more difficult issues were solved quite smoothly. For example, the invaluable data documentation criteria (originally called quality criteria) were formulated with practically total agreement in all details.

Short reports on the subprojects

Assessment of forms and policies for data acquistion and database input
Original Swedish name: "Datainmatning"

Project leader: Lennart Karlson, ABB Corporate Research
Formulation of the subproject's consequential results can also be seen in Appendix, under:
- Appendix V. Data acquisition at SPINE@CPM
- Appendix XI. List of activities in the SPINE@CPM database 980216

Summary

Many different approaches for acquiring data were tested and tried. Most of which were found impossible to realize:

- The proposal for a transferal of large amounts of data from large databases into SPINE format was elected negative. The reason was that none of the publicly available databases are quality reviewed, and most data in these databases are not prioritized data. Instead, these large databases are considered accessible as they are. No common efforts should be made at this time, to translate them into SPINE format.
- It was suggested that data from all publicly available LCA reports should be reformatted into SPINE. However, there were no available resources for doing this work. The person at CPM/Chalmers responsible for LCA data acquisition was also responsible for method development and data review. Some reports, however, were reformatted into SPINE in this way.
- All available data from the different LCA departments within the CPM companies should leave their data to CPM. However, either due to lack of documentation of these data or due data secrecy, data could not be handed over to CPM.

The result of the subproject was a number of transport data, originally reported by A-M Tillman at Technical Environmental Planning, and data from an LCA-report published by Vattenfall in 1996.

However, the most important result from the subproject definitely was the understanding of the different difficulties associated with acquiring data to a common database. Much of the unrealistic expectations from the beginning of the project were replaced by realism.

Short notes on the project

- A handful of data was acquired.
- Most of the companies' data were rejected, largely due to lack of data documentation methodology and insufficient software.
- Data secrecy is a crucial dilemma.

Formulation of basic definition of CPM data quality requirements
Original Swedish name: "Datakvalitet"

Project leader: Peter Arvidsson, Akzo Nobel Surface Chemistry
Formulation of the subproject's consequential results can also be seen in Appendix, under:
- Appendix III. Data methodology report
- Appendix II. Data review at SPINE@CPM
- Appendix VI. What's in 'Emission Possible'
- Appendix I. The role for SPINE@CPM in a SPINE network
- Appendix VII. Standardization of LCA Data Documentation Format

Summary

The formulated data documentation criteria (in the original report these were referred to as data quality criteria) are in agreement with SPINE. This was not unexpected, but it verifies both the design of SPINE, as well as the documentation criteria themselves. During the project, the criteria were also compared with the data quality requirements of a draft of the ISO 14001 standard, and it was found that they were in good agreement also with this standard.

Short notes on the project

- The documentation criteria were considered an provisional. Testing should be made in order to find weaknesses and improvements.
- Data quality is not about 'good' or 'bad', since there is yet no data, which may be statistically assessed. Instead, the quality requirements focused on sufficient documentation, in order to enable assessment of relevancy.
- In means of data acquisition: Software must be redesigned to support the documentation criteria.
- It was found necessary to formulate a quality organization, in order to secure any defined data quality level.

Foundation of basic CPM data nomenclatures
Original Swedish name: "Hierarkier och nomenklaturer"

Project leader: Göran Swan, STORA Corporate Research
Formulation of the subproject's consequential results can also be seen in Appendix, under:
- Appendix III. Data methodology report
- Appendix I. The role for SPINE@CPM in a SPINE network
- Appendix IX. Technical Administration of SPINE@CPM

Summary

During the project, the different nomenclatures of SPINE were investigated and their meanings were discussed. A number of feasible base-structures for the nomenclatures were formulated. They were published in the data documentation manual and were integrated with the software SPINE@CPM Data Tool developed within the project.

Short notes on the project

- The formulated nomenclatures were considered temporary, since testing were expected to rise demand on improvements.
- Concerning data acquisition: Software needed to support work with the nomenclatures. SPINE@CPM Data Tool does, but there is no such commercial software.
- It is close to impossible to find substance nomenclatures that will suit all different sectors and industrial branches.

Installation of a SPINE database system
Original Swedish name: "Teknisk databasmiljö"

Project leader: Raul Carlson, Chalmers Tekniska Högskola
Formulation of the subproject's consequential results can also be seen in Appendix, under:
- Appendix IX. Technical Administration of SPINE@CPM

Summary

There were two objectives for this subproject. The first was to solve all technical difficulties associated with establishing the database, and the other was to spread the knowledge and understanding of SPINE to the different information systems departments of the CPM member companies. The first aim of the project has been fulfilled, while the second has been largely a failure. Some companies were interested in the beginning, but found it difficult to identify a role. Probably this was due to that LCA still has not been fully integrated within the CPM companies at an operational level.

Short notes on the project

- Data is published via Internet.
- A protected (reference-) database is installed at an external systems administrator.
- It has been necessary to develop software both for understandable communication of the results, and because commercial alternatives would have been more expensive

Assessment of basic requirements on the CPM database maintenance and organization
Original Swedish name: "Databasorganisation"

Project leader: Raul Carlson, Chalmers Tekniska Högskola
Formulation of the subproject's consequential results can also be seen in Appendix, under:
Appendix I. The role for SPINE@CPM in a SPINE network
- Appendix II. Data review at SPINE@CPM

Summary

The awareness of the need of a database organization was generally low: At the end of phase one the technical administration worked well, while there still was low data inflow and there still were no methodology for data review.

Due to the overall organizational weaknesses of the CPM administration and organization during phase one of the project, it was at this time necessary to stress the importance of integrating the database organization with a well functioning CPM organization. However, when this is written, at the end of the databases phase two, the organizational problems have been taken care of, and we are about to formulate a well functioning both organization and role within the surrounding organizations.

Short notes on the project

- The most important parts of the database organization have been identified.
- The organization was further developed during phase two of the database project.

Assessment and formulation of basic data communication approach, choice of protocol and ambitions of standardization
Original Swedish name: "Datakommunikation"

Project leader: Luis Blanco, Volvo Data
Formulation of the subproject's consequential results can also be seen in Appendix, under:
- Appendix VII. Standardization of LCA Data Documentation Format
- Appendix IX. Technical Administration of SPINE@CPM

Summary

The objective of the subproject was to agree upon a common approach for how to exchange data between different SPINE databases. This is important, since data should not need to be reinserted manually if it has already been inserted into one SPINE database. The solution to this problem is not trivial, and it is also important that a solution becomes standardized, so that LCA data communication functions.

At the time for the project the software company Nordic Port had developed a software for this purpose, but the aim within the project was to both chose whether this solution could be a CPM standard, and to find a direction for a standardized redevelopment of that solution.

It was decided that the Nordic Port solution could do temporarily, but that there was a real need for a standardized approach. Data communication experts from Volvo were invited to inform about the two standards EDIFACT and STEP, and the decision within the subproject was that STEP was the communication standard most likely to fit the needs of LCA data communication.

Short notes on the project

- It was decided that the most suitable standard for LCA data communication is STEP (ISO 10303).
- Temporarily most suitable solution was found to be the Nordic Port data communication solution. However, Nordic Port has never been able to release that software. During phase two of the database project, the SPINE@CPM data administration has been forced to develop their own solution for how to communicate LCA data between SPINE databases. [4]

Database project's phase two

Project leader: Raul Carlson, CPM, Chalmers University of Technology

Summary of phase two

Phase two of the database project was not as intensive as phase one. Most agreements had been made, and the project was at the stage of practical implementation.

Data acquisition could be tried out practically, by the help of the documentation criteria [10], the documentation manual [11] and by the use of the SPINE@CPM data Tool [Appendix IX]. In addition to this, Ann-Christin Pålsson has been out visiting the LCA practitioners within the CPM companies, to give practical education and advice on how to work with documentation of LCA data [Appendix IV].

Much effort has been made to improve the entire database organization: Technical equipment has been improved, such as the database publication, the data insertion and review software, and the tools for moving data between databases.

Also, since the lack of sufficiently documented data was identified as a crucial obstacle during phase one of the project, different approaches for how to change this in the long run has been tried out. Best known is the initiation of the project 'Emission Possible', where the ambition is to find methods for data documentation at production sites. But other efforts has been made as well: Governmental environmental reports and LCA reports has been reformatted and the reformation has been qualitatively analyzed, data review methodology has been formulated and tested, and the CPM data acquisition has been involved with data acquisition projects within the Swedish transport sector. In general, the overall status of the difficulties and possibilities associated with LCA data acquisition has been thoroughly examined and the results from the CPM project has started to be tested and communicated outside of the CPM sphere.

The official SPINE web site, which has evolved as a further development of the project's web site [http://deville.tep.chalmers.se], is frequently visited from all over the world, and questions are often directed to the SPINE@CPM data administration. However, the most internationally interesting activity during the project's phase two, is the CPM/SMS joint proposal for a new work item to the ISO/TC 207/SC 5, concerning the standardization of an LCA data documentation format.

Short reports on the subprojects

Industrial data acquisition
Original Swedish name: "48 enhetsprocesser"

Project leader: Lennart Karlson, ABB Corporate Research
Formulation of the subproject's consequential results can also be seen in Appendix, under:

- Appendix V. Data acquisition at SPINE@CPM
- Appendix XI. List of activities in the SPINE@CPM database 980216

Summary
The subproject has been successful in means of its quantitative result.

The objective of the project was that the CPM companies should deliver a specific number of data sets to the common CPM database. Each data set should be documented in agreement with the data documentation criteria, as formulated during phase one of the database project.

Unfortunately, at the time of the deadline of the project, in December 1997, there were only a few data sets handed over for CPM data review. At the time for this report to be written, however, most companies have handed over their data in due with their commitments.

Short notes on the project

- It has been obvious that for anyone to be able to document data in accordance with the documentation criteria, they first need education.
- The organizational relations between CPM and the LCA departments at the companies are unclear. This is expressed in terms of prioritization; many of the persons responsible for the data insertion within the companies has told the CPM data administration that they have not had time for the work, until after project deadline.

Establishing foundation of a national LCA-data system
Original Swedish name: "Verksamhetsutveckling"

Project leader: Raul Carlson, CPM Chalmers University of Technology
Formulation of the subproject's consequential results can also be seen in Appendix, under:
- Appendix I. The role for SPINE@CPM in a SPINE network
- Appendix IV. Education
- Appendix VI. What's in 'Emission Possible'

Summary
During phase one of the database project, all resources were used for solving detailed technical and methodological questions. There was no room for integration and contemplation, in the form of organizational development, education and establishment of relations between the CPM data administration and other institutes. Due to the fact that there was a lack of documented data, it was also considered important to start new ways to change this situation in the long run.

The three areas to give special interest therefore was chosen to be:

- Systems development, which should seek forms for to improve and secure data supply in a long run.
  The result from this area, was the initiation of the project 'Emission Possible', and the development of the organization and role for the CPM data administration, both described in the Appendix of this report [Appendix I] [Appendix VI].

- Supervised LCA-data insertion, aimed at giving a truly practical education on data documentation.
  The result from this area is described in Appendix IV.
- Education and educational material, which should develop educational material and give education on the results of the project.
  The result from this area is a set of educational material that has been used during 'Supervised LCA-data insertion' [Appendix IV][Appendix IX].

Short notes on the project

- Emission Possible requires much project administration, more than it has been given. If the project shall lead to useful results, this needs be changed. A new project meeting is planned, in order for the project to straighten up.
- Education has shown to be both important and productive. The discussions and practical experiences from the 'Supervised LCA-data insertion'-sessions are important.
- The educational material are good, but may be improved and increased in volume, as new experiences are made.

International workshop on data compatibility and communication
Original Swedish name: "Internationell LCA-datakompatibilitet-workshop"

Project leader: Jörgen Wennsten, AB Volvo, Teknisk Utveckling
Formulation of the subproject's consequential results can also be seen in Appendix, under:
- Appendix VII. Standardization of LCA Data Documentation Format

Summary

Practically, this subproject failed. The intention was to invite to a small workshop to inform about the Swedish work with SPINE, within CPM as well as outside. However, the first date that was set for the workshop happened to be exactly the same date as for a SPOLD meeting, on a similar theme. Therefore that date was cancelled. Later, when a new date was set up, the information reached the invited persons too late, so that most of them didn't have time to come. Therefore, also that workshop was cancelled.

All in all, the outcome of the project was a well planned agenda, which instead was used for to inform a number of invited Swedish parties about the CPM/SMS proposal for a new work item concerning the standardization of an LCA data documentation format. Another valuable outcome was that the invitation reached out internationally and informed about the database work within CPM, and about the official SPINE Internet site.

Short notes on the project

- The difficulties with succeeding with the subproject was partly due to the subproject leader's difficulties with prioritizing the project leadership to other duties within his company. This of course falls back on the database project leader who should have been aware and reacted.

Design of a simplified LCA data form for industrial LCA data exchange
Original Swedish name: "Leverantördata-formulär"

Project leader: Göran Brohammer, SCA Mölnlycke
Formulation of the subproject's consequential results can also be seen in Appendix, under:
- Appendix VIII. LCI data questionnaire

Summary

The objective of the subproject was to design a simple, common questionnaire, a data form, for exchange of LCA data between product supplier and customer. This was accomplished, but the most valuable outcome of the project is not the form in itself, but the discussions held during the one-day mini-workshop for designing the form.

In order to receive any data from a supplier there first must have been some sort of a personal contact with the supplier, on the LCA data issue. Otherwise it will be difficult to know anything about the quality of the data filled in to the form by the supplier.

Another obstacle about acquiring data from suppliers is that there today is a suspicious attitude towards giving away information about the environmental performance of production, both because this information could be used for bad publicity and because it might fall into the hands of competitors. To bypass this obstacle, it may be important to formulate a business relationship on how LCA data should be handled by the two parties.

The third important note made during the day was that the suppliers should be incorporated with the LCA work to which they supplied data, through the form. At least they should be informed of the results of any LCA study in which their plant is involved.

Short notes on the project

- Due to the fact that most companies have designed their own forms for acquiring data from their suppliers, it can be expected to be difficult to start using a common form for this purpose. Unfortunately this may lead to increased difficulties with receiving and interpreting data from suppliers. A common form is important in order to simplify data acquisition.

Future work; Continuation of the project results

Emission Possible, part II

Emission Possible as initiated within the database project will be finally reported at the end of April 1998. The experiences from the first part of the project will then be used to formulate a more detailed agenda for a continuation of the project.

Quality program for data documentation and data handling

In spite of the fact that the data documentation criteria were formulated in total agreement within the quality subproject, they still are a dilemma to many data users and suppliers. Most existing data does not conform to the criteria and it will require a large investment in order to change this fact; adding documentation to data requires much manual resources that is needed for the practical life cycle assessments within institutes and corporations.

Therefore it has been suggested to formulate a quality program for data handling and documentation. The intention is to find a way to commonly increase the data documentation quality from today's levels up to levels where data can actually be statistically assessed.

The idea is that such a quality program should be formulated to include all kinds of data acquisition and data communication situations. On a yearly basis the documentation criteria should be increased for each type of data acquisition and the whole program should be administrated from the CPM data administrational unit.

International engagements

For the SPINE efforts to give full payback, it is necessary that the SPINE format becomes internationally accepted and used. An internationally common format for all kinds of LCA data handling situations would lead to better economical efficiency for all kinds of industrial or societal environmental control.

The CPM/SMS proposal for a new work item concerning the standardization of an LCA data documentation format, suggested CPM to hold the secretariat for this workgroup.

If the voting result is 'Yes' to this suggestion, this will imply a stable international role for CPM and the Swedish efforts on SPINE. If another outcome will result from the voting, SPINE and CPM should seek other ways to 'market' the results and ambitions.

Data communication

In spite of the efforts made, there still is no general way for automatically communicating LCA data between different installations of SPINE databases. In short words; data communication cannot be made totally general, without an almost unnatural interference of a human analyst. There are many details that cannot be handled satisfactory by computer software.

However, if agreements are made, concerning nomenclatures and other details, data communication can be made quite general within organizations.

It may be possible to create one large such organization of a number of software vendors, data suppliers and data users, so that they together agree on some key nomenclatures etceteras.

It is suggested to create an open project where many different parties participate, to agree on every detail that must be considered in order to enable general LCA data communication.

Other aspects of data communication are the transferal of data from publicly available databases into SPINE format. Any such transfer must be preceded by an analysis of the format of the database. If there are such publicly available databases that may be of interest for the CPM group, certain small projects could be put together for the analysis, and the transfer could be left to software developers or other commercial parties.

Secrecy, openness and economy

Much discussion has been held on the secrecy and openness problems of data. Data can not be published via the common public database because they are secret, and data must be made public in order to build a database. This dilemma must be consistently solved.

It has been declared that average values of different kinds could be more easily to publish than site specific data. But the averages need to be calculated from site-specific data. Therefore the degree of secrecy must be assessed so that it may be possible to find out whether it is possible to create publicly available data from e.g. secret data.

Openness also concerns economical issues. In order to distinguish between secret data and expensive data, all data needs to be related to a prize. Inaccessibility is then a matter of available resources.

It is necessary to formulate economical data handling and to develop a data market. Within this market it is important that the monetary flow is opposite directed to the data flow, and that each individual who can claim a cost for data, also can claim an economical compensation. The development of this market is a great challenge to the CPM data administration. See also Appendix I, section Data acquisition and commitments.

Prioritization and data acquisition

It is important that the CPM stakeholders are involved with the prioritization of the growth of the database. Within their different organizations they should seek to acquire data that could be of general interest, and to publish this data to the CPM group.

It is also recommended that the stakeholders care to find a skillful insight into the SPINE model and the CPM data documentation criteria, so that the prioritization that will not be fulfilled within the companies can be unambiguously formulated towards others CPM parties. Otherwise it is most likely that prioritization will not be understood and consequently not followed.

It is recommended that the CPM group meets frequently, in order to assess the contents of the database, their common needs and their common internal projects. It is most likely that much of the contents has not been understood until it is discussed, and it is also likely that some data that

is to be acquired by some CPM party is currently being acquired within a project at another CPM party. Such common acquisitions could then be coordinated, in order to reduce the overall costs for LCA data. Of course also, such meetings could be held in order to identify urgently needed data sets, in order to direct extra focus towards these.

Another task that can preferably be made together within CPM, is data modeling. There are many parts of life cycles where it today is extremely difficult to acquire any site specific or even average data. This is true for the electronic industry, for example. Publicly available data on such production generally lacks documentation, which enables it to be assessed by data users. The result then is that also the LCA studies performed from such data will lack transparency.

Therefore, it can instead be recommended that data on these parts of the life cycles are modeled, and that the models, with assumptions and estimations, are thoroughly documented together with the data and with the LCA studies. Since such modeling needs different kinds of knowledge, it is suggested that the CPM companies together coordinates modeling projects to create such data sets.

See also Appendix I, section Data acquisition and commitments.

Workbench; software and the LCA analyst's super library

There are no software based on SPINE, which satisfies the generality requirements of the LCA research. The currently available software EcoLab and EPS has been developed for industrial use, and not for societal analysis and for analysis of systems scenarios including, for example, different kinds of material recycling. There is also a need within the LCA research to have software tools, which can be used for modeling non-linear behavior of technical systems. Such general software has not yet been found. For these reasons discussion has been held on the subject of developing LCA software for research use.

The general long-term aim is to integrate such software into a workbench, which will hold SPINE accessible, as well as all kinds of other information sources, to support the BAP [Best Available Practice for LCA] ambition of CPM.

Probably this system will not only be a concern for CPM, but also for other environmental research centers within the Chalmers university. The need is identified but the plans has not yet been taken far.

Data administration

The database project results in many different parts, which needs to be administrated and nursed, in order to function and develop properly. The nomenclatures, for example, will need to be looked over every now and then, in order for them to grow into a meaningful tool rather than a wild bush of different names. Also, as time goes the data sets in the database will need to be updated, due to new and more actual knowledge.

If these aspects of the database are not taken into account, and if they are forgotten due to high costs, for example, the quality and the value of the database will soon decline.

Another important aspect of the data administration is the technical administration: during the project many solutions has been tried evaluated. The solutions selected has been selected because they were either economically preferable or because they were simple enough for the time. As the database grows, and as the investments in form of inserted data grows in economical value, these solutions may be insufficient. Therefore the database should be handed over to a stable technical administration as soon as possible.

Further development of SPINE

Due to complexities, in order to perform any kind of assessment of environmental consequences from activities in the technical system both the social weightings and the environmental cause effect chains must be regarded.

However, during the database project the focus has been directed towards the SPINE ability to handle LCI data, i.e. data about technical systems, such as production processes, partial life cycles and production plants. But SPINE was designed also to store information about the impact assessment stage of LCA, such as information about social systems' weighting of different environmental changes and information on models of cause effect chains in the environmental systems.

To efficiently take full advantage of the SPINE capabilities, it is important to also start filling these other parts of SPINE with information.

In parallel with the database project, these other parts of SPINE has been remodeled, and will soon be definite enough to fully support any weighting model and any modeling of environmental cause effect chains. It is recommended that resources be freed in order to acquire data to fill also these parts of SPINE.

However, it should be thoroughly reconsidered to whom this responsibility is given, so that both the competence and the working capabilities are sure to match the ambition of the work. For example, there are no resources available or planned for, for to develop a software tool for this part of SPINE.

Project budget

{Contact the authors for a budget report of the project.}

Reports and publications from the project

1. Bengtsson M., Carlson R. Molander S. and Steen B. *Handling GIS Information in Life Cycle Assessment Using a Relational Database*, submitted to Journal of Hazardous Materials, presented at RISK 97, 21-24 Oktober 1997

2. Björklund T. *Utvärdering av metadatainmatning för 17 byggnadsrelaterade produktionsprocesser i en SPINE-databas*, CPM internal report, 1997

3. Carlson R., *LCA-data i gemensam pott*, ByggForskning 6/96 sid 30-31, 1996

4. Carlson R., *Databasprojekt resp.Tvåårig projektplan: Etablering av CPM:s LCA-databas*, CPM internal reports, 1996

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6. Carlson R., *12 Vanliga Frågor med Svar om CPM:s LCA-Databas*, CPM-rapport 3:1997

7. Carlson R., *Strategin kring arbetet med CPM:s LCA-Databas*, CPM-rapport 4:1997

8. Erixon M., Ågren S., *Miljörapporter som underlag till livscykelanalys*, CPM-rapport 5:1997

9. Erixon M., Ågren S. *Utvärdering av inmatning i SPINE av information från miljörapporter*, CPM internal report, 1997

10. *Krav på datakvalitet CPM:s databas 1997*, CPM-rapport 1:1997

11. Pålsson A-C, *Handbok vid arbete med datakvalitet och SPINE*, CPM-rapport 6:1997

Appendix

Index of Appendix

How to use this Appendix

Much of the contents in this appendix will be used as separate information and educational material for the SPINE@CPM organization. The separate reports are formulated for different purposes, explaining different aspects of the SPINE@CPM roles, functions and tools.

The appendix parts are aimed towards 4 different groups:

- Environmental strategic planners
- LCA practitioners and analysts
- Manager or co-workers with environmental responsibilities
- Computer technicians and administrators

Below is a list indicating which groups may find most value from each specific appendix. Each appendix also begins with a list of assumed '*Target groups*'. It should be stressed, however, that this division is not definite and each reader should try to find which parts gives answers to his or her questions.

Appendix I. The role for SPINE@CPM in a SPINE network

- Environmental strategic planners
- Manager or co-workers with environmental responsibilities

Appendix II. Data review at SPINE@CPM data administration

- LCA practitioners and analysts
- Manager or co-workers with environmental responsibilities

Appendix III. Data methodology report

- LCA practitioners and analysts

Appendix IV. Education

- LCA practitioners and analysts
- Manager or co-workers with environmental responsibilities

Appendix V. Data acquisition at SPINE@CPM data administration

- LCA practitioners and analysts
- Manager or co-workers with environmental responsibilities

Appendix VI. What's in 'Emission Possible'

- Environmental strategic planners
- Manager or co-workers with environmental responsibilities

Appendix VII. Standardization of LCA Data Documentation Format

- Environmental strategic planners

- Computer technicians and administrators

Appendix VIII. LCI data questionnaire

- LCA practitioners and analysts
- Manager or co-workers with environmental responsibilities

Appendix IX. Technical Administration of SPINE@CPM

- LCA practitioners and analysts
- Computer technicians and administrators

Appendix X. Requirements on a SPINE database, for making it SPINE@CPM Data Tool compatible

- Computer technicians and administrators

Appendix XI. List of activities in the SPINE@CPM database 1998-02-16

- LCA practitioners and analysts

Appendix XII. An example of a sufficiently documented data set

- LCA practitioners and analysts
- Manager or co-workers with environmental responsibilities

Appendix I. The role for SPINE@CPM in a SPINE network

Target groups

- Environmental strategic planners
- Manager or co-workers with environmental responsibilities

Introduction

For making the CPM LCA database successful, efficient and sustainable, it has to be maintained within a stable organizational structure. This structure concerns both the organization within CPM, as well as CPM's role as a database holder within the national and international society.

We want the database to grow, and we want it's content to map, or mirror, the world around us as correctly as possible, so that we can be confident with the decisions we base from analyses of the data from the database. These goals are competing, since today it is difficult to find large amounts of well-documented data.

Due to an increased interest in LCA data, not only for performing LCAs in a traditional sense, but also for eco labeling, it has become realistic not only to influence, but also for CPM to *lead* a change regarding the LCA data supply.

This change will be made by standardizing the LCA data format, by finding solutions for companies to integrate the data acquisition for the environmental management systems and environmental reporting with data handling for LCA, and by educating and supporting companies and institutes in correct data handling. This will increase data supply and data quality in the long run. The entire society will benefit from this, since more and better information is necessary for guiding us as we try to decrease the negative changes we do to the environment.

This report describes the CPM data management's role in this change, our aims with working with data handling, quality reviews and education. It also describes our economical standpoint in regards of data access to the CPM database, as well as our role as a national authority in regards of LCA data and database solutions.

Data administration at CPM; SPINE@CPM

During phase 1 of the database project we sketched an organizational structure for the CPM data administration, as shown in figure 1. In this sketch the organization is structured in terms of functions:

1) *Data acquisition*,
2) *Data review*,
3) *Data publishing* and
4) *Technical administration*.

Each of which is crucial for the CPM database to work as intended.

During the project we also learned that we needed two additional functions

- *Research and redevelopment*, which is a function shared between the CPM data administration and the CPM research environment, and
- *Education, standardization and requirements*, which is the relation between the entire organizational environment of the data administration and the data administration itself.

Research and redevelopment are important aspects of the CPM data administration: Due to new research results and due to implementation of new ideas, the detailed requirements on the data administration will continuously alter. Also, since the data administration is developed at and as the frontline of product ecology research, there will for a long time be a discrepancy between the knowledge and the requirements *within* the data administrational unit and outside. This discrepancy may be reduced by education and by other harmonizing actions and moves, such as standardization etc. Such actions are important in order for the data administration to conform to both the product ecological methodology and to any user of the database.

This report will describe the present and suggested contents of the functions *Data acquisition*, *Data review and Data publishing*. The fourth function, *Technical administration*, is described in a separate report: *Technical Administration of SPINE@CPM*.

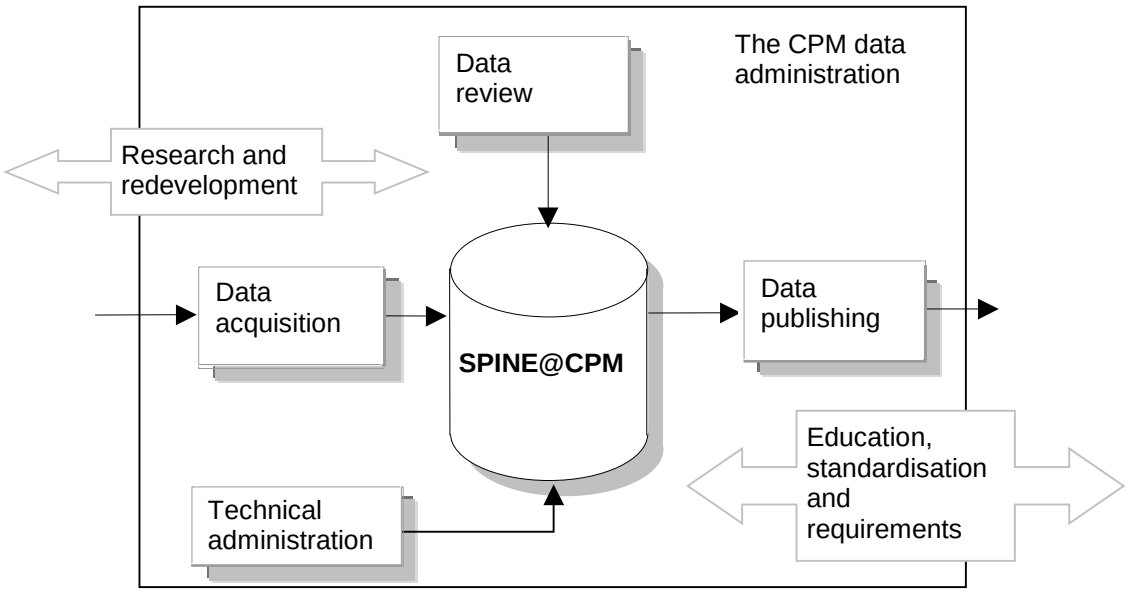


Figure 1. Administrational structure of the CPM data and database: SPINE@CPM

Note: All different solutions presented in this report take into account economical limitations, as well as the limitations in knowledge and even *competence*, as we experience them today.

Data acquisition and commitments

Experiences

During the project, we ran two different sub-projects aimed at acquiring data from different sources into the database. But the experience from these projects shows that this way of working is not efficient. This was due to

- the difficulty with coordinating data acquisition for many different companies and
- the difficulties with the motivation for acquiring data for its own purpose.

Commitments

Instead, in order to take better care of actually acquired data, we recommend two types of s*tatements of data acquisition commitments*:

1. All CPM projects that includes any acquisition of LCA data should be committed to write down a data plan, including the project's ambitions regarding openness and security, its data quality goals, etc. (This could possibly be a first step towards reviewed LCAs)
2. All CPM member organizations should be committed to write a CPM data declaration regarding their ambition to support the common database with data. (In this sense, the data review of the common database could be used also for partial LCA-review.)

It is suggested that the formulation of these statements of commitments should be general enough to be applicable to *any* project including this type of data acquisition.

See also: Appendix V. Data acquisition at SPINE@CPM

Note: Chalmers/CPM does not have the ambition to review not open data or reports.

How to deliver data

Due to small resources at Chalmers/CPM, data should be inserted into a SPINE database or into SPINE format by data deliverer, unless otherwise clearly stated.

On database completeness

CPM will not have the ambition to hold all existing data but will rather help industries and institutes with managing their SPINE databases and with publishing their data.

Procedures for quality review

Data quality

There are three aspects of data quality:

1) Knowledge of *what* data describes (data documentation)
2) Knowledge of the degree of *correctness* of the data (statistics)
3) The *relevance* of the data, for a specific purpose

There is not yet any applicable approach on how to review data in regards of its correctness. Also, the relevance for data cannot be decided until in a specific case, when the data is to be used in a study.

Data review

Due to the situation in the field of data quality, any data will be reviewed only in regards of the *data documentation*, in comparison with the CPM data documentation requirements.
We expect these requirements to change as we redevelop our first approach during the CPM phase 2.

See also: Appendix II. Data review at SPINE@CPM

Aid for fulfilling data requirements

Nomenclature:
For simplification of work and for harmonization of naming conventions, the database project held one subproject for finding nomenclatures for *Substances, Sectors, Process Types, Environment* and *Geography*.

See also: [1] Handbok vid arbete med datakvalitet och SPINE

Data documentation criteria:
For the reason that the database at CPM should be *'quality reviewed'*, the database held one sub-project aimed at *defining* 'quality' for the CPM database. The result was presented in a technical report, showing how to interpret the fields in SPINE, and also listing which SPINE-fields are mandatory and which are voluntary when documenting LCA data for the CPM database.

See also: [2] Krav på datakvalitet CPM:s databas 1997

Handbook for working with data quality:
The quality criteria report was not written as a manual for LCA data handlers. Therefore, in addition to the technical report, a handbook was written, on how to work with data documentation in line with the CPM documentation requirements.

See also: [1] Handbok vid arbete med datakvalitet och SPINE

SPINE web site tutorial:
Due to the importance of reaching out beyond the CPM sphere, an official SPINE@CPM web site has been set up. This site presents SPINE in methodological terms, as well as in terms of computer techniques. There also is a *complete tutorial* for how to document LCI data in accordance with the CPM data documentation criteria.

See also: Internet address: http://deville.tep.chalmers.se

SPINE@CPM Data Tool:
At the time when we should start to document data in line with the CPM criteria, there were no software tools available for this purpose. Therefore we started developing *SPINE@CPM Data*

Tool, an LCI data documentation software. *SPINE@CPM Data Tool* is a full LCI data management tool, including data insertion and update, data communication and data reporting. However, due to prioritization the tool is limited to simple data sets and does not handle aggregated data sets.

See also: Appendix IX. Technical Administration of SPINE@CPM

Support:
It is possible to call the CPM data administration. Courses can also be held, both individual and for groups.

Data publishing and economical compensation

How to access data

Data in the common CPM database will be accessible for all CPM members. They can be viewed and browsed via the SPINE@CPM web-site or through a MS Access database file. In the future, when the database contains more and more data, these database files will not contain all data at SPINE@CPM. (See more about MS Access-files in the separate report *Technical Administration of SPINE@CPM*.)

Access restriction

The board of CPM has clearly formulated an ambition that the database should have *some* restrictions on access. There are two reasons for this:

- The parties investing in the build up of the database wants to avoid a situation where external parties 'drains' the CPM database at no cost.
- CPM wants to establish an understanding towards data users in order to further spread the knowledge and the consensus found *within* CPM.

Economical compensation for database access

There still has been taken no decisions regarding how to formulate the economical compensation for data access. We could suggest, however, three forms of minimum economical compensation (all three considered equal in regards of economical value):

1. For external party, one year of access SKr 300.000.
2. For CPM member (as part of the CPM membership cost): 5 data reviewed data sets.
3. For semi-external party: economical weighting may be made, for formulating an economical value of the relational goodwill between CPM and the semi-external. The value of the goodwill may discount from the SKr 300.000.

Note: At the time when this report is being written, the CPM board has decided that the project leader of the database project, Raul Carlson, and the chairman of the CPM board, Sven-Olof Ryding, shall find a way for to commercialize the CPM database. This work has not yet started.

The role for CPM in a SPINE network

Education and a Common Understanding

During phase 2 of the database project, in 1997, many LCA practitioners received individual education on data handling. This education has been performed at site, i.e., at each individual's working place within their companies [Appendix IV]. Of course this is a too costly routine to be continued within the normal CPM database management.

Instead we will develop courses in LCA data handling, which will normally be held at Chalmers. Since the experiences from the individual education sessions shows that the knowledge in LCA methodology needs to be improved or refreshed, we will seek to form these courses so that they also includes moments teaching this methodology.

In addition to this, we aim at authoring course material and handbooks on SPINE data handling.

Techniques and technology

Database maintenance and data handling has a close relationship with computing and database software, a relation that has implications in both directions: software design and solutions affects the way data is handled, and the needs and routines for data handling defines requirements on the software.

As the methodology for data documentation, handling, publication and communication has evolved within the database project at CPM, we also have found the need for being flexible in choice of software solutions. Therefore we have developed our own software. We refer to these solutions as SPINE@CPM. SPINE@CPM consists of software for data documentation, reporting and 'in-house' data communication together with a web-solution for database publication [Appendix IX].

We intend to make these solutions available, as a package solution for research institutes' Internet and companies' Intranet solutions. By this, we aim at harmonizing the LCA data use within the society within which CPM works.

It has been discussed that CPM will hand away the technical development and maintenance of all technical solutions and software tools to commercial companies, as soon as they are enough developed to meet our demands.

The choice on this issue will be based on available resources other technically related plans within the CPM BAP (Best Available Practice for LCA) ambitions. [See also the report from the database project: 'Future work; Continuation of the project results']

References

1. Pålsson A-C, Handbok vid arbete med datakvalitet och SPINE, CPM-rapport 6:1997
2. Krav på datakvalitet CPM:s databas 1997, CPM-rapport 1:1997

Appendix II. Data review at SPINE@CPM data administration

Target groups

- LCA practitioners and analysts
- Manager or co-workers with environmental responsibilities

Introduction

To ensure that data published in the SPINE@CPM database comply with the documentation requirements decided within the CPM group [1], data submitted to SPINE@CPM will be reviewed before the data is published.

See also: Appendix XII, An example of a sufficiently documented data set

Different aspects of data review

Data documented according to the documentation requirements may be reviewed in different ways:

- Agreement of the information with the original source
- Completeness of the documentation
- Conformance to the documentation format
- Text handling

Agreement of the information with the original source

In most cases the person(s) responsible for the documentation has compiled, revised, interpreted and analysed the information from the original source of the data. This involves a risk for misinterpretation or distortion of the original source. The documentation reflects the views of the person responsible for the documentation, and not that of the original source.

Completeness of the information

The documentation requirements implies that data published at SPINE@CPM should be sufficiently documented and should ideally not require further research for the data user to be able to assess the relevance of the data for a given application.

Conformance to the documentation format

The point in having a common documentation format is that the required information should be easily found. If the information is complete but do not comply with the format, the information may be difficult to obtain without having to read through the full documentation of data.

Text handling

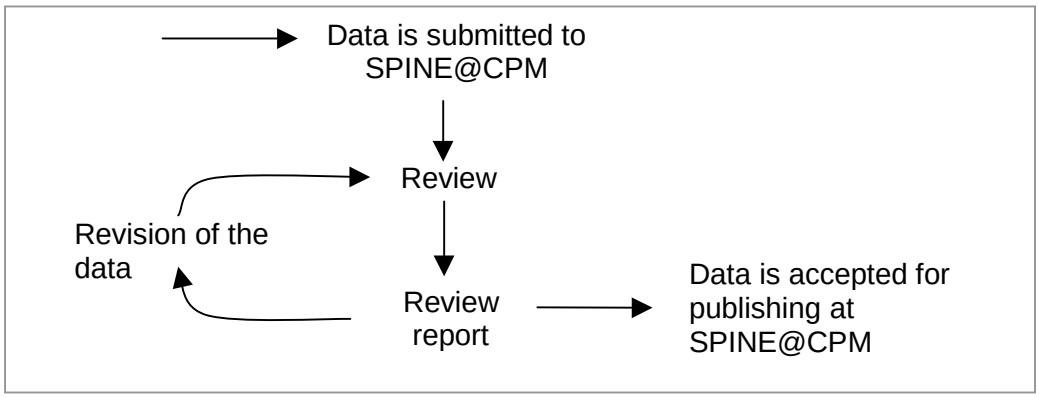
The ease of interpretation of the documentation.

General procedure for data review at SPINE@CPM

Ideally, all different aspects of review should be covered before data is published. It is however in most cases not possible for one person to cover all the aspects of the documentation. Therefore, at this moment data submitted to the SPINE@CPM data administration will be reviewed regarding *the completeness of the information, the conformance with the format and the text handling.* There will be a lowest level of documentation below which the data is not accepted for publishing.

Review regarding the agreement of the information with the original source may not be done at SPINE@CPM. It must be assumed that the data supplier has taken actions to ensure the agreement of the submitted information with the original source, e.g. by internal review. Review of the agreement of the information with the original source should ideally be done by the person(s) responsible for the original source. The review may also be done by someone with experience of the technical system that is described. Otherwise this type of review is a very resource demanding task, since it in reality would imply a review of both the original source and the reformatting.

The general procedure for review at SPINE@CPM is outlined below.



Data is submitted to SPINE@CPM, where the documentation of data is reviewed and a report of the review is written consisting of comments regarding the documentation. The data may then be accepted for publication, or may be returned to the data supplier together with suggestions for revision and supplementary information. The suggestions for supplementary information and revision may be:

- *Compulsory*, i.e. data may not be accepted to SPINE@CPM without further revision of the data supplier
- *Recommended*, i.e. the data can be accepted to SPINE@CPM but the data supplier is recommended to make further revision before the data is published

Revisions should be prioritised in the following order:
1. Completeness of the information
2. Conformance to the documentation format
3. Text handling

If no revisions are made regarding recommended revisions, the reviewer's comments will be published together with the data.

Depending on the quality of the initial work the review process may be more or less time consuming, both for the reviewer and the data supplier. The review process may also be iterative.

It should be recognised that the data will also be reviewed when the data is used. Any revisions made to the data made due to comments from data users should be submitted to SPINE@CPM. This will continually lead to a development, both of the data and of the documentation criteria.

References

1. *Krav på datakvalitet CPM:s databas 1997,* CPM-rapport 1:1997

Appendix III. Data methodology report

Target groups

- LCA practitioners and analysts

See also: Appendix XII, An example of a sufficiently documented data set

Introduction

During phase one of the database project, a project was held within the CPM group aimed to define *requirements on data quality* that should be used for data that would be published in the CPM database. Data quality is however a relative concept, since the quality of a specific LCA-data set is very much 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, both systems may deliver the same product but be different in all other aspects.

The relevance and the reliability of an LCA-data set in a specific application may however only be determined through a thorough knowledge of the system and of the data. Sufficient documentation of the data is thus fundamental in order to avoid misuse and misinterpretation of the data. The result of the data quality project was therefore *documentation requirements* defined in the report of the subproject [1]. In order to avoid misuse and misinterpretation, the documentation must always accompany the data, whenever data is communicated.

The documentation requirements

The documentation requirements, as defined within the CPM group, concern:

- *Description of the technical system that is represented by the data*, i.e. what systems have been included in the system.
- *Details on how the data acquisition for the system was performed*, i.e. purpose of the data acquisition, choice of functional unit and system boundaries, use of allocation methods etc.
- *The inventory data*, i.e. the numerical data on flows of material and energy going into and out from the technical system
- *Description of methods used to obtain the numerical data*, e.g. calculational methods, measurement methods, assumptions etc.
- *Recommendation on the use of data*, e.g. certain cautions and limitations on the applicability of data.

The requirements provide a *structured documentation format for LCA-data*. A detailed description on how to work with the documentation requirements is found in a handbook for the practical work with data [2]. The requirements may be used to document data for any type of system that is studied in LCA; individual processes, plants, cradle to gate production systems for specific materials etceteras.

Data documented according to the documentation requirements should be self-sufficient and ideally not need further investigation for the data user to be able to assess the relevance of the data. However, in practice the general ambition may vary depending on if the data will be communicated externally or not. External communication of data will generally require a more thorough documentation of data than data that will only be used within the organization. The documentation is especially important if the data is not documented elsewhere, e.g. in a publicly available report.

Documentation of data may be done using a SPINE database and an application that facilitate insertion of data into the database according to the requirements e.g. SPINE@CPM Data Tool. The documentation can however also be done using a pen and paper or a word processor for the text (e.g. Word) and a spreadsheet application (e.g. Excel) for the numerical data, provided that the correct format is used. The only difference is that it in most cases is simpler to handle and store the data in a SPINE-database, when working with several different data sets. There are also several features that are simplified when working with a database, e.g. the address register and handling of nomenclatures.

Using CPM documentation requirements during an LCA study

The input data plays an important part in every LCA-study. Knowledge of the input data is therefore a prerequisite for a reliable LCA. The documentation of data and the documentation requirements is therefore an important support during the different phases of the LCA:

- Data acquisition
- Interpretation of the result
- Reporting the study
- Review of the study

They should therefore be seen as a methodology, rather than as a set of requirements.

Data acquisition:

During the data acquisition, the documentation methodology will help the practitioner to organize all input data in the study, through the structured report format.

It should be recognized that the knowledge of a specific LCA-data set is generally greatest at the time of the data acquisition. Vital information on the data set is likely to be lost if the data is not documented at the time of the data acquisition. To go back afterwards and try to recreate the information is generally very time consuming and consequently expensive. The documentation of data will thus facilitate efficient shared use of data and databases, since the information is easily available and may thus be reused in several applications and by several users.

The requirements or methodology also serve as a checklist for data acquisition and critical review of data. The ambition is that they should help to determine the relevance and reliability of the data for the application. Data, for which it is difficult or impossible to obtain the required information, must be considered as being very unreliable.

Interpretation of the result

The interpretation of the result is facilitated through a thorough knowledge of the input data. The practitioner will be well acquainted with every part of the studied system, and know exactly what data that may be unreliable. This will reduce the risk for erroneous conclusions and misinterpretation of the result of the study.

Reporting the study

The reporting of the study will begin during the data acquisition, by the documentation of the input data. Excerpts or entire transcripts of the documentation of the input data may then be used as a basis for the report of the study.

It should also be noted that the ability of the SPINE-structure to store composite system means that a study performed in SPINE, using the documentation criteria to document the data, would be fully *transparent* both with regard to the complete study and with regard to the input data. The study may thus be reported in a SPINE-database using e.g. a special browser. There is however at present no software tools that supports this type of reporting.

Review of the study

Review of the study is facilitated, since the study as well as the input data is transparently documented. All the information on the input data is easily accessible. This may in the long term decrease the cost to review LCA-studies.

Working with documentation of data

The documentation requirements were developed to allow for documentation of data regarding all types of different technical systems studied in life cycle assessment e.g. individual processes and plants, composite systems, cradle to gate etc. The data may be acquired from all available data sources e.g. acquired at specific production processes or plants, literature, other life cycle assessments etc.

Naturally, the documentation of data is easier if the person responsible for the documentation of data also has been involved with the original data acquisition, e.g. with the direct data acquisition on a production plant. The documentation will in such case only involve a report of the data acquisition procedure.

When using data from different types of written reports, the main part of the work with data will be to interpret and analyze the material. In order to avoid duplication of efforts it is important that the work with the interpretation is documented. Otherwise the next data user will have to do this work again. In many cases the person performing the documentation have been in touch with the person responsible for the original material, and have thus acquired information that might not be available in the original published material. Of course, this acquired information should also be documented together with the data.

It should also be remembered that any information regarding inconsistencies in the material and comments by the person that has done the interpretation of the material might be equally valuable for a data user. It should however be clearly stated in the documentation that this type of

information regards views of the person responsible for the documentation. 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, for example. If data have been revised or modified from the original source, the reason and the basis for such revisions must be documented.

There will however always be a risk 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.

Working with aggregated data

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 it consists, thus allowing individual documentation of each subsystem.

The advantage of this approach is that the composite system will be fully transparent. Also, the composite system will be easier to update, since each subsystem may be updated individually. For instance a cradle to gate system for some material may be updated regularly.

However, if it is not feasible or possible to use this approach; 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.

Nomenclature

Working with documentation of data for a technical system requires use of several different nomenclatures, e.g. regarding names of substances that enters or leaves the system, names of environmental types etc. Use of common nomenclatures will facilitate the communication of the data. Suggestions for nomenclatures was therefore developed within the CPM group for five of the nomenclatures needed in the work with the documentation requirements; Substance, Environment, Geography, Sector and ProcessType [2]

It is however difficult to develop a nomenclature that may serve all needs. This especially applies to the Substance nomenclature, since different industrial sectors uses different nomenclature. New substances are continually introduced. To further complicate things, generally every data source uses its own nomenclature that often is not specified. It is therefore important that the new substances is specified and defined. Whenever in doubt of the naming of a substance, always use the naming used in the original source.

Regrettably, the substance nomenclature developed within the CPM group is not sufficiently specified. Many substances that are represented in the nomenclature are group names whereas

others are base chemicals. There is a large room for individual interpretation. A difficulty with using the group names is that the substance will be defined differently every time the substance is used. A substance that is used in an activity may have an entirely different meaning in another activity. There is a great risk for misinterpretation.

The other nomenclatures should not require additions of new names yet, except for the sector nomenclature. There are however international standards that can be used for the sector nomenclature.

Further development of the documentation criteria

The documentation requirements deal with documentation of data. However, there are no requirement to specify the person(s) responsible for the documentation, or if the documentation has been reviewed. The person(s) responsible for the documentation should also be allowed to give some general comments regarding the work with the documentation.

Guide on the text handling may need to be developed for the descriptive fields such as description of technical system. The technical description could be simplified with a flow chart over which processes are included (without having to insert data for each process step). This is a feature prepared for in the SPINE structure. There are however at present no software tools, which utilizes this feature.

There are no requirements for how to report available information on how a system is connected to other systems, which may or may not be represented in the database. The information is valuable when using the data. For instance information on the suppliers of different materials may be given.

When using SPINE for documentation, the structure only allows one juridical person to be recorded as commissioner, practitioner and reviewer. However, in most cases several organizations and persons have been involved with the work. Also the individuals may have had different responsibilities for the specific data set. This needs to be specified. A brief general comment on the person may also be needed (e.g. position).

At present, there are no available software tools that utilize handling of composite systems according to the documentation requirements. The SPINE@CPM Data Tool was developed to support the handling of individual data sets according to the documentation criteria. The Ecolab software utilizes handling of composite systems but not handling of data according to the documentation requirements. Combined use of the two tools could fulfil the requirements.

References

1. *Krav på datakvalitet CPM:s databas 1997*, CPM-rapport 1:1997
2. Pålsson A-C, *Handbok vid arbete med datakvalitet och SPINE*, CPM-rapport 6:1997

Appendix IV. Education

Target groups

- LCA practitioners and analysts
- Manager or co-workers with environmental responsibilities

See also: Appendix XII, An example of a sufficiently documented data set

Background

The data documentation criteria, which were defined within the data quality subproject, meant a new way of working with LCA [1]. And since all data in the CPM database shall conform to these new requirements the meaning of them needs to be explained.

Educational material has been developed for this purpose, and during the project practical education sessions has been held, in the form of "Supervised LCA-data insertion" [Appendix IV].

The immediate purpose for this material and the sessions has been to help LCA practitioners to start working with LCA-data in agreement with the documentation criteria.

The overall purpose has been to test and further develop the criteria in practical cases, and to find out about the difficulties that the users experiences, in order to design effective courses and improved educational material.

Education material

The report from the subproject defining the documentation criteria was not written as a manual and was difficult to interpret. Therefore a manual for how to practically work with the documentation criteria has been written [2].

In parallel with the development of the manual, the software *SPINE@CPM Data Tool* was developed. This software therefore conforms well to the manual, and has successfully been used for educational use. [Appendix IX]

The software is supplied also with a help file, so that the user can get help on the most basic issues on how the software should be used when working with LCA data documentation.

In addition to the software and the manual, the official SPINE web-site also contains a description for how to document LCA data in agreement with the CPM documentation criteria. [http://deville.tep.chalmers.se]

Supervised LCA-data insertion

The most efficient way to learn how to work with LCA data documentation is by practically working with it. This was the philosophy behind "Supervised LCA-data insertion".

The aim was to teach this work while reaching practical results in the form of acquired data.

The sessions were held at the workplace of the participant, individually or in small groups. At each session, an LCA-data set was interpreted and thoroughly documented according to the documentation criteria.

The education was essentially based on the handbook and the CPM software *SPINE@CPM Data Tool* was used. These sessions were held at almost all of the CPM member companies.

Generally one initial session was held, after which the participant was left to work unsupervised. The result of the work has then been reviewed, and comments and suggestions on the result have been fed back to the participant.

The participants has been free to choose to work with LCA data on any type of technical system, but has been recommended to work with data they are well acquainted with. Also, they were recommended to work with data concerning small technical systems, as opposed to cradle to gate systems, for example, since these are generally more easy to document correctly.

It was required that the data should not be secret, but should be submitted to CPM to be published at the SPINE@CPM database.

Examples of data sources chosen during the sessions were an environmental report, results from an LCA-study and data for individual processes or plants.

The intention was that each CPM member company should work with and submit five LCA data sets to SPINE@CPM, within the scope of “Supervised LCA-data insertion”. During the progress of the education sessions, it was also decided that the CPM members should have only *limited* access to data at the SPINE@CPM database until the five data sets were submitted. When the data from the sessions were accepted, the company would get a password for unlimited access to all data in SPINE@CPM.

However, these rules has not been correctly understood by all CPM parties, which has made it difficult to fulfill this relation between limited database access and education sessions. At the end of the project the entire database will therefore be accessible for the entire CPM group, whether or not they have fulfilled their commitments in this respect.

Experiences

The concept with education through practical work is successful. All participants have acquired a basic understanding on how to work with documentation of LCA-data.

The education was primarily focused on documentation of individual LCA-data sets. This means that handling of documentation of composite systems was put aside. However, to motivate the documentation of individual systems, there is a need also to focus on documentation of composite systems. There is however at present no software tool available that supports this way of data handling.

It was also identified that it is important that education on handling of LCA-data should include also education on general LCA methodology. The data handling will thus be set in a context.

Further education

It is not economical to continue with supervised individual sessions for teaching LCA data documentation. Instead the CPM data administration will give courses on LCA data handling, based on the experiences drawn from the database project.

References

1. Krav på datakvalitet CPM:s databas 1997, CPM-rapport 1:1997
2. Pålsson A-C, Handbok vid arbete med datakvalitet och SPINE, CPM-rapport 6:1997

Appendix V. Data acquisition at SPINE@CPM data administration

Target groups

- LCA practitioners and analysts
- Manager or co-workers with environmental responsibilities

See also: Appendix XII, An example of a sufficiently documented data set

Introduction

The goal within the SPINE@CPM data administration is to increase the accessibility of sufficiently documented LCA-data. This may be done through a common view of data and a common methodology for documentation of data, as defined within the CPM-group [1]. Using the methodology when working with LCA-data will increase the number of available sufficiently documented data. Establishing a network of databases that use the same methodology will increase the accessibility of data. The data may easily be transferred between databases [Appendices I and IX]. The administration of data can be done close to the source of data, where data may be updated regularly.

Data sources

There are principally two different types of available data sources:

- *Direct data acquisition on production sites*
  - owned by companies within the CPM group
  - suppliers to companies within the CPM group
  - other companies
- *Other data sources* e.g. literature, LCA-studies, theoretical modeling of technical systems, commercial databases, trade associations, etc.

Depending on how *data from production sites* are acquired, the data may be sufficiently documented. However, the accessibility of data is generally restricted due to secrecy agreements between receiver and supplier of data and the data supplier often need to know for what the data will be used [Appendix VIII].

Data in *other data sources* may or may not be sufficiently documented. However, the format of the documentation varies between different sources, which may make it difficult to interpret the information. Further investigation may also often be needed. Such data sources thus generally need to be interpreted and analyzed to convert the data in conformance with the CPM documentation requirements. The accessibility of such data may also be restricted due to copyright etc.

Data acquisition so far at SPINE@CPM

So far different approaches have been tried out to acquire data for the SPINE@CPM database:

- Specific projects within the CPM group aimed at acquiring data
- Request for 5 data sets from members of the CPM group for full access to the SPINE@CPM database
- Project employment for specific data projects
- Relations to organizations and networks outside the CPM group

A list of data that was acquired in each approach can be found in Appendix XI.

Specific projects within the CPM group aimed at acquiring data

Two projects were performed within the database project specifically aimed at acquiring data: *Assessment of forms and policies for data acquisition and database input* (original Swedish name: Datainmatning) and *Industrial data acquisition* (original Swedish name: 48 enhetsprocesser) during phase two.

Assessment of forms and policies for data acquisition and database input during phase one of the database project was performed in parallel with the project that defined the requirements for data quality that should be used in CPM database. As the data quality requirements emerged as requirements for documentation, there were no available data that was documented according to the requirements. A need for prioritizing on what data to acquire was identified, to fill the database with data in accordance with the needs of the participating companies. It was therefore decided to focus on data for energy production and transportation, since these types of systems generally is included in all life cycle assessments.

The *Industrial data acquisition* projects aimed at prioritizing a number of unit processes and acquire data for the processes that was prioritized. The unit processes that were decided ranged from individual processes to full cradle to gate systems for some selected materials. Data acquired within the project should be documented according to the documentation requirements. Representatives of the companies that participated in the project each committed to different processes.

The participating companies have, due to limited resources for the work, had difficulties to fulfil their commitments. The deadline for the project was set 5 December 1997. At the time of writing this report 13 February 1998 there are still several commitments that have not been submitted to SPINE@CPM. Companies that was most successful in fulfilling their commitment worked with data concerning activities that were both prioritized at their company and in the database project.

Also, when the project was started, most of the participating companies had not started working with data according to the documentation criteria. The education material was just finished at the time of the start of the project and the education called Supervised LCA-data insertion had just begun [Appendix IV]. This delayed the start of work with data within the commitment.

Request for five data sets from members of the CPM group for full access to the database

To encourage the participating companies to work with data according to the documentation criteria, restrictions on the access to the database were introduced. *For full access to the database*, each of the members of the CPM group should submit five data sets, sufficiently documented according to the documentation criteria. Partly, this was a test to see how the different types of commitments may work within CPM.

The companies were intended to work with the five data sets within the scope of the education "Supervised LCA data insertion" and use data already available at the company [Appendix IV]. The five data sets were not intended to be part of the commitment within 48 unit processes. However, since the education was started at the same time as the *48 Unit Process project*, several of the participants wanted to start working with data for the commitment within this project. The participating companies also had different size of commitment within the 48 Unit process project. This led to an unequal workload between the parties of CPM.

The attitude towards the commitment has been positive. However, the fact that the SPINE@CPM database did not contain many data probably led to a low priority to fulfil the commitment. Only one company has at this time fulfilled the request.

Project employment for specific data projects

Environmental reports

During the spring of 1997, two students at Chalmers University of Technology did a project within their education on behalf of the CPM database project to explore if environmental reports could be used as a source for LCA-data [2]. The project was continued during the summer 1997, when the students were project employed to convert data from environmental reports to LCA-data, in conformance with the CPM documentation requirements. It was assessed if it was possible to directly use the data for LCA, if some information generally was missing and also evaluate the time it took to report the data according to the format [3].

Their findings showed that the reports generally did not provide sufficient information for LCA-applications without further research and contacts with the company.

LCA study

One of the two students also worked with documentation of data for the production of different types of building materials. Thomas Björklund at Technical Environmental Planning at Chalmers acquired the data for an LCA-study performed during the fall of 1996. The aim was to transfer the data to the SPINE@CPM database, but also to evaluate differences in the documentation of data in the written report and in the SPINE-database according to the documentation criteria.

The work showed that it might be difficult to document a specific data set in an LCA-study only using the information provided in the LCA-study. The original source is needed to sufficiently document the data. In many cases Thomas Björklund needed to be consulted regarding

information that is not found in the written report. Much would have been gained if the data had been documented during the course of the LCA-study [4].

Relations with networks and trade associations

NGM (Network for Freight Transportation and the Environment).

CPM is participating actively in the work of NGM (Network for Freight Transportation and the Environment). The members of NGM consists of organizations representing road, rail, air and sea transport companies, interest groups, authority, university, research institutes etc. The ambition within NGM is to compile and document all relevant environmental interventions associated with all modes of goods transportation, and to localize gaps of knowledge.

One working group has during the last two years compiled available data on energy use and emissions for the operation of different modes of transport. The work has so far been published in one report for the members of NGM, that has been reviewed by among others CPM [5]. The data has also been documented according to the documentation requirements at CPM. The result is 50 well-documented activities on different modes of transportation.

The work is conducted on a continual basis and the data will be updated regularly when new knowledge arises and due to development of new technology. The network will also publish the data via Internet. The SPINE-format has been proposed as a basis for the publication of the data.

STFI (Swedish Pulp and Paper Research Institute)

STFI compile LCA-data on Swedish pulp and paper production. The ambition is that the data will be accessible for the parties of CPM. The technical solution for how this will be done is however not yet established. STFI are interested in the technical solutions developed within the CPM database project [Appendix IX]. STFI also intend to use CPM documentation criteria and SPINE to document the data. This work has not yet started due to limited resources for the work at STFI.

Suggestions for further data acquisition at SPINE@CPM

Request for data and co-ordinate work with data in the parties of CPM

The different approaches that have been explored have showed that it is difficult to motivate projects to acquire data for its own sake. The work of data has so far been of the character to document available data. However, for the data handling methodology to be truly efficient it must be integrated into the LCA-activities at the companies. Whenever new data is acquired the ambition should be to document the data according to the documentation criteria. This will facilitate both internal and external multiple use of data. Data that may be published should be submitted to the SPINE@CPM data administration for review.

To encourage submission of data to SPINE@CPM, each of the parties of CPM will be *requested to submit at least five data sets a year* in order to obtain full access to SPINE@CPM. The data that is submitted should be in line with the company's own priorities, and not constitute extra

work for the company. The review of data will function as a check that the company complies with the CPM documentation requirements.

In order to avoid duplication of efforts, CPM may be used as a forum where plans for data acquisition in the parties of CPM may be discussed. Work with data can thus be coordinated. Joint data acquisition projects in line with the priorities at the participating companies may be initiated and run e.g. within the scope of the applied research area.

Develop relations to organizations outside the CPM group that work with LCA-data

In order to increase the accessibility of sufficiently documented LCA-data, CPM will work to seek relations to organization that work with data within different areas of expertise. The aim is to spread the data handling methodology outside the CPM group [Appendix I]. Through a common view of data, a network of databases within different areas of expertise may be developed.

References

1. *Krav på datakvalitet CPM:s databas 1997*, CPM-rapport 1:1997
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5. *Energi- och emissionsuppgifter för godstransporter i Sverige. Ett konsensusdokument för övergripande jämförelser mellan transportslagen, Lägesbeskrivning november 1997*, NGM (Nätverket för Godstransporter och Miljön), 1997

Appendix VI. What's in 'Emission Possible'

Target groups

- Environmental strategic planners
- Manager or co-workers with environmental responsibilities

Introduction

Emission Possible is about *sufficiently* documenting data at site or even process level; documenting data acquisition, documenting site maintenance, documenting statistics, etceteras in order to supply not only LCA applications with sufficiently documented data, but also to supply the entire environmental management systems with this *quality resource*. The long-term goal is to decrease the cost for data while at the same time increasing the data quality. This can be done by developing methods for data documentation and data administration as well as integrating these methods into the structure of the environmental system.

Today's situation regarding data supply will not change by today learning how to document measured and logged data at production sites. But in the long run, by securing that all measured data is correctly administrated and sufficiently documented, the data supply problem will disappear.

Background

Critical experiences

Within the different data acquisition subprojects within the CPM database project, it became apparent that data are not originally acquired in accordance with the CPM data documentation requirements [1] [2] [3]. This implies that today not even a *theoretically* notorious data reviewer could find documents revealing the conditions under which the original data has been acquired.

Still, the documentation requirements are crucial for LCA to ever become a reliable decision support tool, and therefore the present situation must be overcome. It needs to be possible to reveal the quality and meaning of environmental data.

General data documentation

Basically there are two types of LCA data source types:

1. Data from *real measurements* on processes.
2. Data acquired from *models* of processes and technical systems.

Some models are validated using data from measurements and some data from measurements are validated or made complete by using data from models. Some measurements are made solely to model, or simulate, a real measurement. Of course, any measurement is based on a model of the physical entity being measured. Therefore, in practice it is impossible to distinguish between purely modeled and purely measured data.

Modeled data

There are many different ways to model a specific process or other technical system, each modeling approach leading to a different data result. To enable a data user to *derive* the *relevance* of the data set from the relevance of the model it is important to supply the data with a documentation of the model. The relevance cannot be derived from the numerical data only.

For modeled data to be useful in LCA, the documentation needs to describe different environmentally significant properties of the model of the technical system for which the data set are applicable.

- The mathematics and/or statistics used to derive the numerical data from the model.
- The conditions under which the modeling were made, and the assumptions and simplifications made due to these conditions.

Measured data

There are also many different ways to *measure* data on processes. Different measurement equipment may be used or measurements may be made at different sampling frequencies or different locations within the technical system may be analyzed. The process may run at different production levels during the measurement. In addition, a site, for example, may be differently maintained or may be differently partitioned for reporting.

Due to the degrees of freedom and potential differences, the numerical data resulting from measurements does not bear enough information for an analyst to judge the relevance of the data. As for the modeled data, each measured piece of data needs to be supplied with sufficient documentation.

For measured data to be applicable for LCA, the documentation needs to describe

- Different environmentally significant properties of the technical system for which the data set are applicable. Examples are unexpectedly included or excluded subsystems, production level and descriptions of allocations made on numerical amounts of physical flows shared by other subsystems.
- The methods used and procedures applied to recalculate and reformat the data entities from the data sources into the form in which the data set is published. For example, the mathematics and/or statistics used to derive a numerical data from log files and continuous or discrete sampling.
- The analytical conditions under which the measurements were made, and the assumptions and simplifications made due to these conditions, i.e. if the data were acquired due to the local EMS measurements policy, due to a specific reporting occasion or due to quarterly environmental reporting to government.

Documenting measurements at production site

At all instances at a production site, where a figure is acquired, three basic facts are known:

1. The physical entity being measured or logged, and its position within the site or production line.
2. The method used for retrieving the data, such as the measurement or the registration method.
3. The data, i.e. the amount or other numerical or statistical representation of the measured entity.

Emission Possible aims at extending the recording of the measured data also to include:
- Documentation of the physical entity being measured.
- Documentation of the measurement's position at the production site.
- Documentation of the method used to retrieve the figure, together with a description of the equipment used.

A documentation of this kind will build a practically physical foundation for all kinds of environmental control, auditing and reporting, since the physical origin of any figure would be well known.

Documenting data manipulations of the reporting

There are numerous uses for environmental data, of which a few are:

- Within a production site the data may be used by the process control, in order to optimize processes also in regards of environmental parameters. Data for this purpose would typically be some environmental parameters related to the production of the entire site.

- At company level the environmental aspects of the production of the different products may be analyzed, either at site level or by having a whole systems view, like an LCA. In this case, data from the production site need to be reported in terms of the amounts of the environmentally significant flows in relation to the product.

- For environmental reporting, both within the company and towards the government, for example. For governmental reporting, the data is often compiled on the basis of yearly production, for declaring emission outlet during the year.

For any type of data use, the measured data needs to be interpreted, in most cases also reported and reformatted.
For the case when a process is to be *controlled* by the use of environmental data, the *relation between the environmental data and the process* needs to be identified. When the data is to be used for environmental product analyzes, such as LCA, the *relation between the environmental parameters and the product* needs to be identified.

When the production process or site delivers a single product, the relation between the environmental data and the process and the environmental data and the product, respectively, are equal. Otherwise the environmental data from the entire production site needs to be allocated to the different products.

A product allocation is formulated as a process model, in simple cases in due with a detailed process analysis, and, in the case of a more complex production process it is made in due with a

modeling of that process. In order to obtain product allocated environmental data, the measured data needs to be recalculated and reformatted, in correlation with that process model. This means that a product allocated data report includes a *mix* between measured data *and* modeled data.

As for the case of process allocation, any reporting of environmental data is preceded by some sort of manipulation of the measured data. This implies that the report can be interpreted in many different ways, and again, the figures in the report cannot themselves inform the reader of a correct interpretation. Therefore, the data manipulation made for the report needs to be documented sufficiently.

A report should include:
1. A reference to each included measured data and its documentation.
2. The method used for manipulating the data, such as the statistical methods and any process models applied.
3. The resulting data, i.e. the amount or other numerical or statistical representation of the reported entity.

Data administration and responsibilities

For any management or control system to be stable, it needs to be integrated with its administrational surrounding. Therefore, Emission Possible directs it ambitions not only to identify the technical aspects of measurements and documentation, but also aims at identifying roles within the organization at the production site, who naturally could shoulder the responsibility for the data handling.

The reporting might naturally be centered within the environmental management system, but the responsibility for measurements and documentation of measurements might more naturally be placed closer to the production or maintenance.

The project

Emission Possible

In order to learn what problems might be associated with sufficient documenting of measured data and reporting at a production site, the CPM companies were asked to participate in a joint project. The idea of the CPM project was that each company should complete a local project at one or more production sites, to gather and document data on environmentally significant flows associated with one of the company's products.

Each local project is expected to include four different levels of results:
1. The technical system associated with the product should be identified and modeled in terms of allocations of physical flows.
2. The environmentally significant flows should be identified and measured.
3. Data should be fully documented in regards of measurement techniques and statistics, as well as in regards of the methods and procedures used for formulating a product related data report.
4. The technique for the documentation, and its organizational residence should be sketched.

The documentation should not be made for LCA alone, but for all kinds of environmental reporting and other environmental data needs, within the company and outside. Special considerations should be taken towards the possibilities for the data documentation to be used as support for the environmental management systems.

The organization

The overall organizational structure is a number of separate projects within the participating companies. Each company should pick at least one production site within which the project should be run. The participants of the company projects should have frequent meetings at CPM, to present and discuss their approaches, problems and results.

The participating companies are Vattenfall, Ericsson and Stora.

A number of well-reputed competence groups were invited to participate in a reference group, for to discuss and criticize the case studies performed within the participating companies.

Participating in the reference group are SIS, SMS, IVL, CPM, Nordic Port and CIT.

Present status

The first information meeting for the project was held in June of 1997 and the start meeting were held in October the same year.

Due to the large ambition of the project, the first step was expected to result not in a set of ready and general operational tools, but in a documentation of the problems associated with an implementation of a method for documentation of environmental data at the site level.

At the time for this report to be written, all companies have identified production sites for the project. When this report is written, February 9, 1998, practical work has started yet only at Ericsson.

References

1. *Krav på datakvalitet CPM:s databas 1997*, CPM-rapport 1:1997
2. Erixon M., Ågren S., *Miljörapporter som underlag till livscykelanalys*, CPM-rapport 5:1997
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Appendix VII. Standardization of LCA data documentation format

Target groups

- Environmental strategic planners
- Computer technicians and administrators

Background

A proposal for a new ISO work item

The proposal is enclosed at the end of this Appendix VII.

The lack of a standard

Within the database project the lack of a common format for LCA data was identified early. For data to be useful they need to be understood by the data user, and when many similar data sets are to be interpreted efficiently they need to be similarly formatted.

Much of the interesting and general LCA data today is published in many different LCA reports, each of which is differently structured. Interpretative documentation of input data is merged with the documentation of the methodological discussions and the discussions on how to interpret the result. Of course it is time consuming to read an LCA report in order to acquire numerical data sets and the interpretative documentation of the data set, and to reformat and rewrite the data into the SPINE@CPM database.

If the LCA reports would have had a common format, both for the entire reporting and for the original data within the reports, much time would have been saved and more data could have been acquired and inserted into the database. The time consuming interpretation and the reformatting of the data from the report could have been spared.

If the data in the reports had been inserted into a SPINE database already during the data acquisition for the LCA study, together with a sufficient documentation of the data, then there had been no need even to *reenter* the data from the printed report into the database. Instead, the LCA analyst could have printed the data and documentation directly from the database. And the documentation would have been readily available for another study, and for another analyst to easily interpret and use the figures in the database.

Storing data documentation together with data is useful for a single practitioner, as notes of what a specific data set stands for. But the full advantage of storing documented data in a database comes as many data users wish to share data between each other. Such a situation demands the agreement of a common data documentation format.

Within the CPM database project it has been necessary to agree on common ways to interpret the SPINE database format. Already from the beginning SPINE was designed for full data documentation, but no software tools supported this way of working. Also there had been made no agreements on how to practically interpret the format.

A first step towards a common agreement on interpretation was formulated in the quality criteria report [1] and in terms of a set of draft nomenclatures [2]. Later, when people at the CPM companies started to work with data acquisition, the interpretation was also formulated in a practical manual for how to work with data documentation [2]. The result is that SPINE and the CPM database work has started to formulate an *ad hoc* CPM *national* LCA data documentation standard. This work shows that it is definitely *possible* to reach a standard on this issue, and that there is much to gain from such a standard, in regards of data access, data quality and data economy.

An international standard for LCA data documentation therefore can be seen as the most effective and efficient long-term goal for the whole CPM database ambition.

Expected results from the standardization

A common format for LCA data documentation will naturally lead to an increased supply of data, since today the large costs for data lies in the interpretation and reformatting of data of different formats. But there also are many other positive results and expected synergy effects of such a standard.

Since LCA data originates from measurements at production sites [Appendix VI] the LCA data documentation standard needs to be integrated with the standards of the environmental management system. This means that the result of the standardization of the LCA data documentation format will be a *useful tool* for the standard of the environmental management.

Governmental environmental reporting, customer's requirements for environmental information, such as LCA data, supplier's environmental information and company's internal environmental information today holds many different formats. Therefore the compilation of reports and the interpretation of information require much work and are prone to errors. A common format and a common interpretation will effectively reduce the cost and increase the quality in all environmental information handling.

Environmental labeling Type III is based on LCA and the intention is that it will be used for communicating environmental aspects of products. In order for this to work, it is necessary that the LCA data, on which the Type III life cycle assessments are based, are credible. This is difficult, but may be possible only if there is a common agreement on how data should be documented. Therefore, a standard for LCA data documentation will *enable* the Type III environmental labeling.

References

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Appendix VIII. LCI data questionnaire

Target groups

- LCA practitioners and analysts
- Manager or co-workers with environmental responsibilities

Background

Many of the companies performing LCAs acquire their LCA data by asking their suppliers to fill in LCI data questionnaires. These questionnaires have been separately developed within the different companies. Even though the different companies have designed them for basically the same purpose, their design has turned out differently.

Since many companies of course have the same suppliers, this situation makes it difficult for the suppliers. It is time consuming, since the same data needs to be filled in into different papers, and it is confusing, since different questionnaires shall be interpreted differently. This in turn leads to difficulties with receiving data and difficulties with the data quality.

Coordination is needed for to reduce the number of different forms.

During the latest years different attempts to coordinate have been made, such as within the international SPOLD group and within the Swedish Product ecology association. The results of these works, however, has been extremely general and complex questionnaires, requiring the knowledge of an LCA expert to be understood.

Therefore it was suggested to use the CPM data administration as coordinating platform, to design a common, simplified questionnaire, which could be used by all CPM companies when acquiring data from their suppliers.

The ambition was to compile the different approaches from SPOLD, the Swedish Product ecology association, SPINE and the company internal questionnaires, in order to design a common, simple LCI data form.

Simple LCI data questionnaire; LCI data form

The CPM data administration invited to a one-day mini-workshop to design the basic layers of simple LCI data questionnaire.

The workshop found that is not easy to find a simple questionnaire applicable for all situations. Simplicity requires much preparatory research, in the form of predefined sets of required environmental parameters (differs widely between different types of suppliers). Much competent work and experience is required to find these predefined sets of parameters, far exceeding the ambition of a one-day workshop.

Another reason for the difficulties with designing simple questionnaires is that the questions asked by LCA practitioners are unusual and difficult to interpret by any ordinary supplier. To simplify a set so that the target can interpret it, much knowledge about the suppliers' processes and technical equipment should be added to the questionnaire. But again, this requires much competence and experience and could not be solved in a one-day mini-workshop.

However, it is possible to design a questionnaire in terms of what types of information should be asked for. And it has even been possible to make this pretty much simpler than previous coordinated attempts.

The result is enclosed with this report.

About questionnaire communication

In order to correctly use a questionnaire, or a data form, it is important to understand that this is *communication* between to parties.

Sending a form to an unknown organization, requiring an unknown person to fill it in, will most likely lead to an unpredictable result with great risks for errors and misinterpretations. Therefore a form or a questionnaire should never be the first contact with the organization from which data is required. And it should definitely not be sent to the supplier without any further explanations.

Instead it is important to lead an open *dialogue* with the data supplier. During the mini-workshop it was stressed that the supplier should get information on what the data should be used for, and it was suggested that the result of any use of the data should be communicated back to the supplier.

This because it otherwise may be difficult to motivate the supplier to do the extra work that the form requires. If possible, a *mutual* interest in the data should be identified in cooperation with the supplier.

It was suggested that a demand for LCA data should be part of the business contract between the customer and the supplier, thereby enabling a strong motivation for the supplier to provide the LCI data.

The questionnaire difficulties

There are a number of typical problems associated with the contents of a questionnaire, of which some of the most obvious will be described here.

System boundaries and allocations

Any LCA practitioner deals with problems concerning different aspects of technical systems, systems boundaries and allocations. The boundary of any technical system must be identified in order for it to be correctly assessed and included with the life cycle of an LCA study.

Also, in order for the LCA practitioner to correctly interpret a data set acquired from a supplier, it is important to know that the environmental parameters associated with the product to which the data set relates are correctly allocated and correctly reported, at least from the producer's point of view.

Therefore any data form must include questions, which gives the supplier the possibility to reply to these important LCA data issues.

However, system boundaries and allocations in regards of environmental parameters are unfamiliar concepts to most people. They may also lead to different associations to non-LCA practitioners.

Therefore, any questionnaire including questions of these kinds must also be thoroughly explained to the supplier, so that there is no risk of misinterpretation and reporting errors.

Unknown information

It is common that LCI data questionnaires include questions about data of which the supplier have none or little knowledge.

Examples of this are questions about the environmental performance of the production of the suppliers' suppliers, and of the suppliers' service providers, such as different transport companies' environmental performance, etceteras.

Such information might be of interest in order to assess the supplier's environmental management system or their general environmental awareness, but they should not be included with an LCI data form.

An LCI questionnaire is sent for to acquire the best available data from a primary source, the producer of goods or the provider of service. Therefore any supplier or provider should not be mislead or confused with questions about production or service processes they are not experts on, or not even familiar with.

However, it may be asked, for example, about distances and choices of transport type or transport provider, for the goods transports, so that an LCI data questionnaire can be sent also to the appropriate transport service provider. Hereby enabling the possibility to acquire also the transport data from the primary data source.

It should be considered also that asking questions of which the supplier has no knowledge might lead to unwillingness to fill in the form.

Need for further development

The designed LCI data form has not been tested in a real data acquisition situation. Therefore its qualities cannot be verified. In order to improve the form, it therefore has to be tested, preferably in a number of reviewed case studies.

Also, in order to make the form as simple as it should be, the form should be supplied with different predefined sets of environmental parameters for different types of production processes. This could preferably be done in cooperation with different industrial research institutes, within which knowledge of these parameters can be expected.

For efficiency, the form should not be based on papers, but rather be computer based. With such, the simplicity could be improved by help systems, multimedia presentation etceteras. It would also enable the data provided by the supplier to be easily communicated directly into the database of the LCA practitioner

Appendix IX. Technical administration of SPINE@CPM

Target groups

- LCA practitioners and analysts
- Computer technicians and administrators

Introduction

This report describes the technical environment of *SPINE@CPM*. Physically this environment consists of a SPINE Oracle database in a HP UNIX OS, a Windows NT based web server with Active Server Pages, a number of MS Access databases and a number of installations of the software *SPINE@CPM Data Tool*, developed within the database project.

An overview of the system

Data entering the system

Data is inserted into the *SPINE@CPM* database system by using the *SPINE@CPM Data Tool*. As a norm for how to correctly insert data into the system there is a report and a handbook describing the data documentation requirements at CPM [1]. Before any data is accepted as public *SPINE@CPM* data, the data is being reviewed in accordance with the current data documentation requirements [Appendix III].

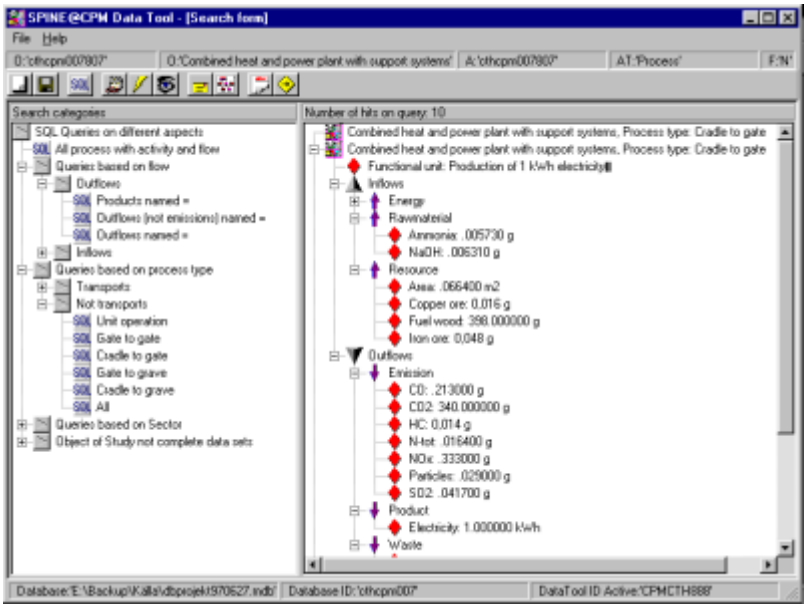

Figure 1. The query form of the *SPINE@CPM Data Tool*.

Communicating data within the system

Every instance of the *SPINE@CPM Data Tool* is supplied with a Microsoft Access SPINE database. Anyone entering data into this database can easily move data to any other similar database, by simply dragging data from the data source and dropping it into the destination database. For this to work, both databases must be connected to the data tool. It is possible to connect to *any* ODBC compliant relational database holding the same SPINE format [Appendix X].

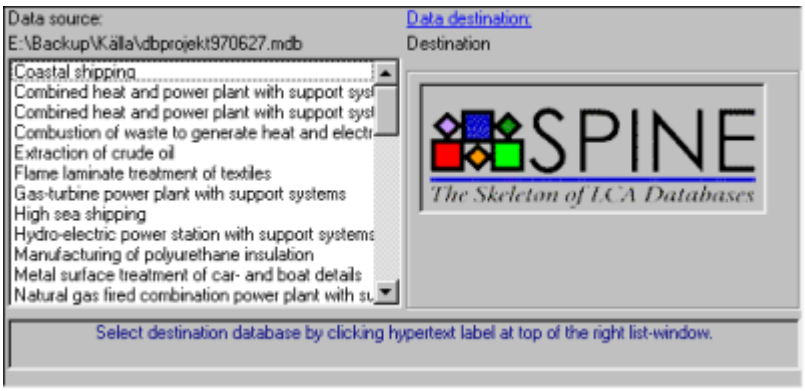

Figure 2. The window of the *SPINE@CPM Data Tool* where it is possible to move data between databases.

The CPM companies submitting data into the *SPINE@CPM* system has the possibility to work with the *SPINE@CPM Data Tool* and a local copy of the SPINE MS Access database. After they have finished their work, they send their local database by mail or diskette to the CPM data administration, for review. Accepted data are first moved into the *SPINE@CPM* MS Access Gateway database, for final editorial work and review, and are then moved to the *SPINE@CPM* Master Oracle database.

Publishing data

During the project different data publishing methods has been tried, beginning with a database web server software named DbWeb, from Microsoft. That was a first quick solution, but it was quite inflexible and there were incompatibilities between connections to the DbWeb configuration database and the connections to the databases holding data.

The next solution was to publish HTML-formatted ’data sheets’, created as reports by *SPINE@CPM Data Tool*. This solution, of course, was stable since the data sheets were static web pages, but also rigid, inflexible and difficult to administrate.

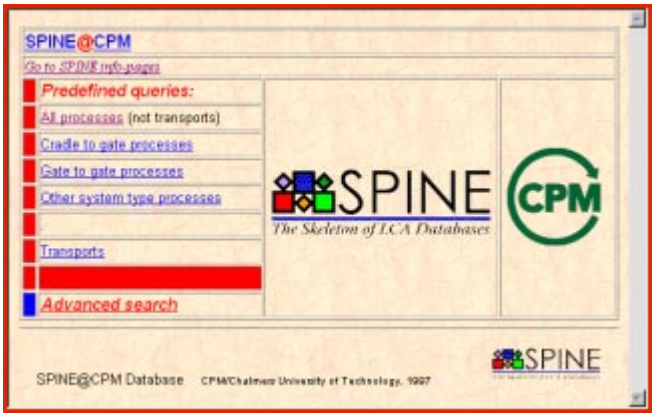

Figure 3. The document head of a SPINE-formatted web page.

At the time of the final reporting of the results of the database project, data will be published using a dynamic web solution. This solution is based on Microsoft's Active Server Pages, and the user can quite freely define queries to the database, or select any of a set of *predefined* database queries.

The data storage

The Oracle database is used for secure and safe storage, and is therefore outsourced in regards of operating systems administration, backup and service. Physically the machine is situated in a safe computer room at a systems administration company in Göteborg. All *database* administration is maintained from the CPM localities.

Data is transported to the Oracle database in the same manner as when communicating data between any other SPINE databases, by *SPINE@CPM Data Tool*.

The whole system

The software parts described above, such as the *SPINE@CPM Data Tool* (figure 1) with local databases, the data transfer module (figure 2), the oracle database and the Active Server based web server, together forms a complete distributed database system for *SPINE@CPM* data administration and handling.

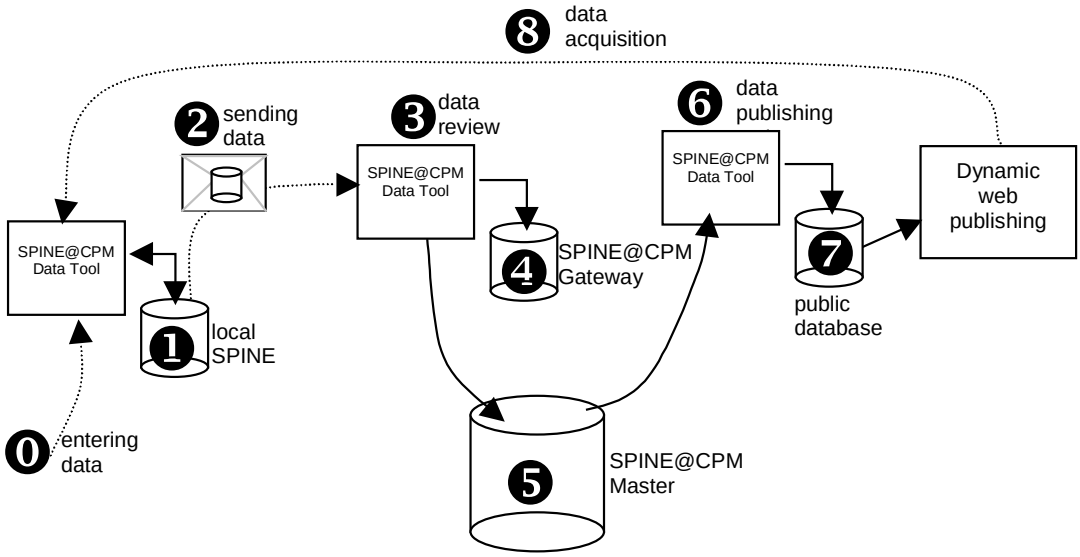

Figure 4. The *SPINE@CPM* distributed database system.

Figure 4 shows a model of the distributed *SPINE@CPM* database system:

0. Data enters the system by being typed in to a local SPINE database by the use of *SPINE@CPM Data Tool*. This can be done anywhere at the CPM companies, at Chalmers or by any other data supplier.
1. The local copy of the SPINE database can be either the MS Access database, which is supplied freely with the *SPINE@CPM Data Tool*, or it may be any other type of relational and ODBC compliant database having a *SPINE@CPM* compatible [Appendix X].
2. Data is sent to CPM by, for example, attaching a whole MS Access database file to an e-mail or by sending a diskette holding the file. If only a few data sets are to be published from a larger database, these data can be moved from the larger database into a smaller MS Access SPINE database using the *SPINE@CPM Data Tool*.
   Note: Nordic Port has been expected to release software for communication of SPINE data sets, but such software has not yet been realized.
3. The database sent to CPM is reviewed using the *SPINE@CPM Data Tool* [Appendix II].
4. When the review has accepted the data, it is moved into the *SPINE@CPM* Gateway database, a local copy of the MS Access SPINE database, used for refinishing and late reviews, before data is sent to the *SPINE@CPM* Master database.
5. Data entered into the *SPINE@CPM* Master database has been reviewed, and can be used for publishing. Any data in this database is sure to hold all *SPINE@CPM* data documentation and quality requirements. As these requirements where formulated at the moment when the data set were inserted into the database. This is important to hold in mind, since the documentation and quality requirements will change as knowledge and understanding increases. No data will be removed from the *SPINE@CPM* Master database.
6. When publishing data, data is copied from the *SPINE@CPM* Master database into a local MS Access SPINE database, using the *SPINE@CPM Data Tool*.
7. The local public database will hold a subset of the total *SPINE@CPM* data set, and is published through Internet through the use of MS Active Server Pages and an ODBC data connection. In the beginning, the published data subset will be the whole of the

SPINE@CPM Master database, but as time goes, both old and new data sets will reside in the master database, and only the newer will be published.

8. There are a number of ways in which the Internet published data may reach the data users' databases:
   a) Data can be visually read and manually reinserted into a SPINE database. (Not recommended due to the time this approach will consume)
   b) The web page can be stored on the client's local machine as an HTML-document, and the data can be reinserted using the *SPINE@CPM Data Tool* by the many integrated data insertion functions. (Should be avoided, unless the user has very good knowledge of how to use the data tool, text editors and spreadsheet programs.)
   c) A copy of the published database may be acquired from the CPM data administration and data may then be inserted into the client's local database by moving data sets with the *SPINE@CPM Data Tool*. (Strongly recommended, but for users to fully take advantage of this solution in regards of their SPINE LCA software, such as EcoLab, they should contact either their LCA software vendor, such as Nordic Port, or the CPM data administration. [Appendix X])
   d) The CPM data administration and Nordic Port AB has, during the database project of CPM's phase 1, worked and have held open discussions regarding the development of a common data communication protocol and software. At the time when this paper is written, no results have yet come to the user's service. (Data communication software and a common protocol together form the best general solution, but there still are a number of steps to be taken towards this solution.)

The strength of the system lies in its modularity:

- The *SPINE@CPM Data Tool* is a standalone software, which can be used on any Win32 platform. The local MS Access database that is shipped with the *SPINE@CPM Data Tool* can be copied and shipped to any other *SPINE@CPM Data Tool* user. And any data set from one such database can be moved to any other database, ensuring full data communication capabilities.
- The other module, the web pages for publishing data from a SPINE MS Access database, can be viewed as an add-in module for the data tool. It consists of a number of Active Server pages (*.asp) that can be shipped to any user who may want to publish SPINE data.

This modularity simplifies data administration and so reduces its costs. (It should be pointed out here, that CPM has no intentions to commercially exploit the *SPINE@CPM* solution, but is ready to *support* any commercial exploitation that also supports the needs of *SPINE@CPM*.)

In the two following chapters, the *SPINE@CPM Data Tool* and the *SPINE@CPM* web solution will be presented in more detail.

The software: SPINE@CPM Data Tool

Background

There were two reasons for starting to develop the *SPINE@CPM Data Tool*:

1. No software suitable for documenting and reviewing LCA data could be found on the market. The only available SPINE compatible software, EcoLab, was designed for performing numerical LCA-studies, i.e. designing flowcharts and performing calculations, and it neglected most of the systems analytical aspects of LCA, such as systems identification.
2. Since the data documentation requirements defined within CPM were new, no methodological approaches existed regarding how to work with these requirements. By developing software in parallel with the methodological development, the software could be designed to fully support efficient data handling within CPM.

Since the project included no budget for developing software, most of the software has been developed on voluntary bases, outside the project's budget.

Originally there were two intentions with the software:

1. The *SPINE@CPM Data Tool* should be used *only* within the CPM data administration, due to the fact that CPM shall not compete with any commercial software vendors.
2. The data tool should be exchanged with similar software as soon as such are commercially available, since CPM has no budget for developing software of this kind.

However, still, in the beginning of 1998, *SPINE@CPM Data Tool*, is the *only* software that supports LCA data documentation in accordance with the CPM data requirements. And, since the data suppliers must have a suitable data tool to work with, the data tool has been shipped to anyone who wanted to fulfill their data commitments to CPM by using this tool.

During the development of the software it has been designed as an extremely specialized tool for data documentation and data review, and it is not likely that a similar kind of a data tool will ever be commercially available. Therefore CPM has no longer any intentions to abandon the development of the tool. However, it should be stressed that *CPM* at this moment neither has any intentions of *commercializing SPINE@CPM Data Tool*, nor makes any commitments regarding future versions.

Data handling functions of the software

Supporting Documentation Using the CPM and SPINE Nomenclatures

The first ability implemented into the *SPINE@CPM Data Tool*, was the handling of nomenclatures and a method for easily finding and inserting names from the nomenclatures into the data fields of a SPINE LCA data set.

Originally this implementation was made to exemplify the use of the five nomenclatures, as they were outlined within the nomenclature subproject within phase 1 of the database project. [2]

The main and consistent idea for how nomenclatures are used within *SPINE@CPM Data Tool* is shown schematically in figure 5.

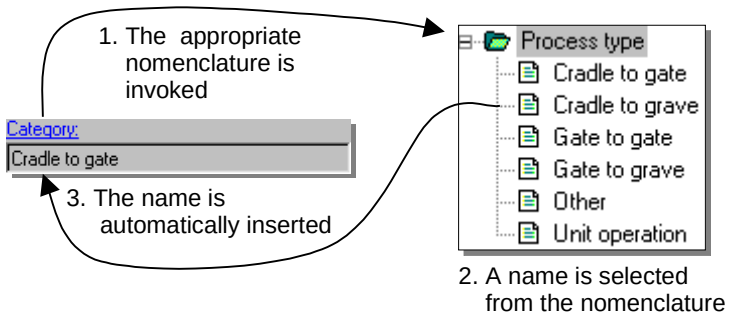

Figure 5. The *SPINE@CPM Data Tool* principle for working with nomenclatures.

1. At the position where the name is to be inserted the user can invoke the appropriate nomenclature window. This is done either by clicking the hypertext label above the text field (all ordinary text fields) or by double-clicking the field where to insert the name (in the flow table).
2. The nomenclatures are represented as hierarchical tree views, and the user can add or delete new nomenclature items whenever so is found necessary. The appropriate name is selected by a click of the mouse.
3. By yet another click of the mouse, on a button with the caption *'Pick this'*, the selected name is inserted into the appropriate text field.

SPINE@CPM Data Tool handles also information on addresses in a similar manner. Addresses are first inserted into the separate address register of SPINE, the table *JuridicalPerson*, and an address is automatically inserted into an address field of an LCA data set by a few mouse clicks. The implementation of these functions were crucial for making possible a practical way of working with the CPM documentation requirements, since about a third, 13 of 37 of the required data fields holds either values from the nomenclatures or values from the address register.

Supporting work with data text documentation

In agreement with the data quality criteria, as formulated within CPM [1], any data set needs to be described using many different text fields. Therefore, to make text handling easy, the data tool has been supplied with a number of functions which supports text handling.

The Editor

In the *SPINE@CPM Data Tool* any data field containing text can be viewed in the *Editor*. The editor is invoked by clicking the hypertext label above the text field.

Within the Editor the user can view and edit the text of any data field, without being limited by the size of the text fields.

The Editor also allows for opening and editing text files saved from any other program, which is useful, when data is to be inserted into SPINE after it has been produced using, e.g. any text

editor. This could be the case if data and documentation from e.g. an LCA study should be inserted into a SPINE database.

It is also possible to save the contents of any text field into an RTF-formatted file, using the Editor's save-command.

The report writers

The *SPINE@CPM Data Tool* supports rational documentation of LCA data, but the relational database technology does not automatically support insertion of this documentation into, for example, an LCA report. This fact could make it difficult to motivate LCA practitioners *both* to document data sets in the database *and* to create well-documented LCA reports.

Therefore *SPINE@CPM Data Tool* can create text reports of all documentation on a data set, as well as a spreadsheet compatible report of all numerical data.

The idea with this is that it should pay for an LCA practitioner to do a thorough data documentation already during the data acquisition phase of the study, so that not only the figures may be reused by other practitioners, but also the entire data documentation. And this should be achieved with requiring the least of additional work for the first practitioner.

It is also possible to create an HTML formatted report, which the user can open with any HTML browser, such as MS Internet Explorer or Netscape Navigator. These reports can be browsed through, by clicking hypertext marks within the report.
By the use of these reports, it is also very simple to publish LCA data on Internet, by just moving these reports to the directory of an Internet web server.

Working with many databases

At the data review function within the CPM data administration, single data sets needs to be moved from the data submitters' databases into the *SPINE@CPM Gateway* database, from the gateway database into the *SPINE@CPM Master* database and from the master database into the public database [Figure 4] [Appendix I].

In the future it is expected that this data transfer should be done by the use of standardized communication protocols and software designed for this purpose [Appendix VII]. In the meantime it was expected that Nordic Port AB should deliver a temporary solution, but this has not yet been done. Therefore *SPINE@CPM Data Tool* includes a module for moving single data sets

The SPINE@CPM master database

The machine

The *SPINE@CPM master* database consists of a HP UNIX, including a system unit, a screen, an extra external hard drive and a backup band station, together with an Oracle database server.

The administration and backup of the machine is outsourced to Göteborgs Datacentral, and one person there is responsible for the systems administration and backups.

The competence on Oracle systems is hired when needed, and has yet only been called for to install the database system.

The security

The idea with having the *SPINE@CPM Master* database is based on security and safety. Therefore it was important to

- have a copy of the database at a location distant from the gateway database.
- install the master database on a well-documented system
- leave all administration and maintenance to competent personnel
- ensure a database which should not accidentally or intentionally be tampered with

The database server allows establishment of connections only from machines situated at the CPM localities, and only a few persons have access rights to the system.

Backup is made every night and is taken to a bank vault once a week.

In addition, every night after a day's changes a copy of the *SPINE@CPM Gateway* database is uploaded to a directory at the master server machine.

The web solution: SPINE@CPM

The Dynamic Web Solution

The *SPINE@CPM* web publishing database consists of an MS Windows NT server with Internet Information Server and Active Server Pages. The dynamic pages are written as server side scripts using VBScript language. Client side scripts has been avoided, both for the reasons of complexity and to avoid any client side problems.

The web publishing consists of one static page and five active server pages, together with one MS Access SPINE database.

The dynamic web solution is recommended for institutions having a need to report more than about 5-10 data sets.

The static web solution

For institutions, like smaller companies and single projects, with a need to report only a few data sets, it is recommended to use the possibility of *SPINE@CPM Data Tool* to create HTML-formatted reports. Such reports can be easily copied to the directory of any web server, and may be published as any other web page.

References

1. *Krav på datakvalitet CPM:s databas 1997*, CPM-rapport 1:1997
2. Pålsson A-C, *Handbok vid arbete med datakvalitet och SPINE,* CPM-rapport 6:1997

Appendix X. Requirements on a SPINE database, for making it SPINE@CPM Data Tool compatible

Target groups

- Computer technicians and administrators

Introduction

The requirements in this appendix are often based on the assumption that an entire nomenclature structure can be filled, in accordance with the nomenclatures defined at CPM [1]. Practically these requirements imply access to the nomenclatures already in a SPINE format. It is recommended to use the database shipped with the *SPINE@CPM Data Tool* for this.

Since the mostly spread software tool used for working with a SPINE database is Nordic Port's EcoLab, this appendix will give extra descriptions for how to deal with such databases. It should be observed, however, that the requirements might differ widely between different situations, when having used different versions of different software before adapting your SPINE database to the *SPINE@CPM Data Tool*.

If you face any problems in your attempts, please don't hesitate to contact the CPM data administration.

IdSeq

IdSeq is a table originally introduced by Nordic Port AB for handling Id-sequences:

IdSeq
TableName *Varchar(40)*
IdValue *Integer*
IdString *Varchar(9)*

From the beginning, the table should be filled with values similar to the ones shown below, in table A1. The value IdString xxxyyy000 should be replaced with the database id as described in the SPINE report [2]

TableName	IdValue	IdString
Activity	200	
Substance	200	
QMetaData	200	
Geography	200	
Juridical	200	
Database	0	xxxyyy000
ObjectOfStudy	200	

Table A1. Default values of the IdSeq table.

ProcessType

The table *ProcessType* should be filled with nomenclature values in accordance with the CPM nomenclatures for Process types. [1]
Note 1: If you have used software that has inserted any data into this table, prior to the adaptation to *SPINE@CPM Data Tool*, you may need to manually edit the nomenclature so that it remains consistent and continuous after the adaptation.
Note 2: Observe that the foreign key constraints between the tables *ObjectOfStudy* and *ProcessType* should always be maintained.

QMetaDataType

The table *QMetaDataType* should be filled with names for metadata types in accordance with the CPM nomenclature. [1]

Note 1: If you have used software that has inserted any data into this table, prior to the adaptation to *SPINE@CPM Data Tool*, you may need to manually edit the nomenclature so that it remains consistent and continuous after the adaptation.
Note 2: Observe that the foreign key constraints between the tables *QMetaData* and *QMetaDataType* should always be maintained.

Sector

The table *Sector* should be filled with sector names in accordance with the CPM nomenclature. [1]

Note 1: If you have used software that has inserted any data into this table, prior to the adaptation to *SPINE@CPM Data Tool*, you may need to manually edit the nomenclature so that it remains consistent and continuous after the adaptation.
Note 2: Observe that the foreign key constraints between the tables *ObjectOfStudy* and *Sector* should always be maintained.

The Substance Nomenclature

The tables *Substance* and *SubstanceCategory* should be filled with substance nomenclature in accordance with the CPM nomenclature. [1]

Important: Ensure that the root of the nomenclature is identified as 'the value of Superior' = 'the value of Subordinate' in the table SubstanceCategory. For example: If 'Anything' is the root of the substance nomenclature and has the Id = '0', then in the table SubstanceCategory there should be one row having '0', '0', as values.

Note 1: It is *not* recommended to fill the substance nomenclature structure with the CPM nomenclature if you have used your database for a long time using some other software, this because it is likely that there would be many doublets of many substance names.
Note 2: Observe that the foreign key constraints between the tables *ObjectOfStudy* and *Sector* should always be maintained.

Environment

The table *Environment* should be filled with names of environmental types in accordance with the CPM nomenclature. [1]

Note 1: If you have used software that has inserted any data into this table, prior to the adaptation to *SPINE@CPM Data Tool*, you may need to manually edit the nomenclature so that it remains consistent and continuous after the adaptation.
Note 2: Observe that the foreign key constraints between the tables *ObjectOfStudy* and *Sector* should always be maintained.

Geography

The table *Geography* should be filled with geographical names in accordance with the CPM nomenclature. [1]

Note 1: If you have used software that has inserted any data into this table, prior to the adaptation to *SPINE@CPM Data Tool*, you may need to manually edit the nomenclature so that it remains consistent and continuous after the adaptation.
Note 2: Observe that the foreign key constraints between the tables *ObjectOfStudy* and *Sector* should always be maintained.

ObjectOfStudy

If the database was new and empty prior to the adaptation to *SPINE@CPM Data Tool*, only the first step below, need to be taken to adapt the table *ObjectOfStudy*. If, however, Nordic Port's EcoLab (this far up to version 3.0) has been used for inserting data, also the steps 2-4 needs to be followed:

1. Add one field named *ActivityType* [varchar(15)] to the table *ObjectOfStudy*. (This because an error in the original modeling of SPINE.)
2. For each row in the table *Activity*, create one row in the table *ObjectOfStudy*, so that the database ends up having the same value in the field *Id* and the same value in the field *Name* in both these tables, and also the same value in the field *ActivityType* of the table *ObjectOfStudy* as in the field *SubType* of the table *Activity*.
3. For each row in the table *Activity*, copy the value of the field *Id* into the field *ObjectId*. (Step 2 and 3 because EcoLab ignore SPINE's possibility supply data on technical systems with an *identification* of the technical systems.)
4. For each row in the table Activity, create one row in the table Inventory, so that the database ends up having the same value in the field *Id* in both these tables. (This because *SPINE@CPM Data Tool*, in contrast to EcoLab, *requires* a documentation of the inventory phase of the data acquisition.)

References

1. Pålsson A-C, *Handbok vid arbete med datakvalitet och SPINE,* CPM-rapport 6:1997
2. Steen B. Carlson R, Löfgren G, *SPINE, A Relation Database Structure for Life Cycle Assessments,* Swedish Environmental Research Institute (IVL), IVL-Report B 1227, Göteborg, Sweden.

Appendix XI. List of activities in the SPINE@CPM database 1998-02-16

Total: 174 activities

Target groups

- LCA practitioners and analysts

Data acquired in: Specific projects within the CPM group aimed at acquiring data

Assessment of forms and policies for data acquisition and database input (original Swedish name: Datainmatning)

Data on different types of goods transportation from A-M Tillman, "Goods transportation in life cycle assessment" - 10 activities

Documentation and review of the report done by: Ann-Christin Pålsson, CPM/TEP, Chalmers University of Technology
Coastal shipping
High sea shipping
Rail transport - 10 trucks
Rail transport - 10 trucks
Rail transport - 52 trucks
Rail transport - 52 trucks
Tankers
Truck, long distance transportation
Truck, regional distribution
Truck, urban distribution

Data on electricty production from Brännström et al "Livscykelanalys för Vattenfalls elproduktion" - 9 activities

Data documented by: Ann-Christin Pålsson, CPM/TEP, Chalmers University of Technology
Combined heat and power plant with support systems
Gas-turbine power plant with support systems
Hydro-electric power station with support systems
Natural gas fired combination power plant with support systems
Nuclear power plant with support systems
Oil condensing power plant with support systems
Swedish electricity production system
Vattenfall electricity production system
Wind power plant with support systems

Industrial data acquisition (original Swedish name: 48 enhetsprocesser)

Data on silviculture inventoried by STORA Corporate Research AB - 5 activities

Data documented by: Göran Swan and Ola Svending, STORA Corporate Research
Documentation reviewed by: Ann-Christin Pålsson, CPM/TEP, Chalmers University of Technology
Tree plant nursing
Soil preparation
Planting tree seedlings
Clearing of young forest
Fertilizing in silviculture

Data on production on selected polymers from APME reports - 11 activities

Data documented by: Sophie Louis, Volvo Technical Development
Data submitted to SPINE@CPM: 29 January 1998. Documentation not yet reviewed
Flexible PUR foam
General Purpose Polystyrene (GPPS)
MDI - PUR precursors
PET
Polyether-polyols - PUR precursors
Polyethylene
Polypropylene
PVC
Rigid PUR foam
TDI-PUR precursors

Data on degradation of pulp based on a theoretical model – 2 activities

Data documented by: Ellen Riise, Mölnlycke AB
Data submitted to SPINE@CPM: 22 January. Documentation not yet reviewed
Degradation of chemical pulp, CP, in a landfill
Degradation of chemo-thermo-mechanical pulp, CTMP, in a landfill

Data on production of copper from K.H. Bruch et al "Sachbilanz einer Ökobilanz der Kupfererzeugung und - verarbeitung" - 28 activities

Data documented by: Alena Ashkin, ABB Corporate Research
Data submitted to SPINE@CPM: 2 February. Documentation not yet reviewed
Copper casting and drawing to 8mm wire
Copper casting and drawing to 0.6mm wire
Copper casting and drawing to 0.06mm wire
Copper casting, drawing and laquering to 0.6mm wire
Copper casting, drawing and polmer coating to 0.6mm wire
Copper continuous casting
CuZn37 continuous casting

CuNi10Fe semicontinuous casting
CuSn6 continuous casting
CuNi10Fe extrusion and pilgering of tubes
CuNi10Fe extrusion and drawing of tubes
CuZn37 casting and extruding over core to tubes
CuZn37 casting and rolling to strips
CuSn6 casting and drawing to wire
CuSn6 casting and rolling to strips
CuZn37 casting and drawing to wire
CuZn39Pb2 casting and pressing to rods
Red brass sandcasting
CuZn37Pb chill casting
Copper ore mining and concentration
Primary copper production
Copper alloy casting of block metal from scrap
High purity copper production from primary raw materials
High purity copper production from secondary raw materials
Copper extrusion and drawing to profiles
Copper extrusion and drawing to tubes
Copper skew rolling, pilgering and drawing to tubes
Copper rolling to strips

Data acquired in: Request for 5 data sets from members of the CPM group for full access to SPINE@CPM

Data on electricity production based on Frischknecht R. et al "Environmental Life-Cycle Inventories of Energy Systems" - 6 activities

Data documented by: Helena Greijer, ABB Corporate Research
Documentation reviewed by: Ann-Christin Pålsson, CPM/TEP, Chalmers University of Technology
Hydro electricity energy system
Lignite electricity energy system
Natural gas electricity energy system
Nuclear electricity energy system
Oil electricity energy system
Stone coal electricity energy system

Data on production of PU based on a theoretical model and production of latex rubber – 2 activities

Data documented by: Ellen Riise, Mölnlycke AB
Data submitted 22 January 1998. Documentation not yet reviewed
Production of latex rubber
Manufacturing of PU elastics

Data acquired in: Project employment for specific data projects

Data on different building materials from T. Björklund et al. "LCA of Building Frame Structures" - 17 activities

Data documented by: Maria Erixon, project employed for the database project at Technical Environmental Planning, Chalmers University of Technology
Documentation reviewed by: Thomas Björklund, Technical Environmental Planning, Chalmers University of Technology
Cement production
Coarse mortar production
Glulam wood production
K30 ready mixed concrete production
K40 ready mixed concrete production
Mounting profile production
Ore-based steel production
Particleboard production
Plasterboard production
Pre-stressing wire production
Reinforcement bar production
Sawed construction timber production
Scrap-based steel production
Steel jointing production
Steel rail production
Swedish reinforcement steel mix
Swedish sheet steel mix

Data from environmental reports of specific companies - 25 activities

Data documented by: Maria Erixson and Sara Ågren, project employed for the database project at Technical Environmental Planning, Chalmers University of Technology
Combustion of waste to generate heat and electricity
Flame laminate treatment of textiles
Manufacturing of polyurethane insulation
Metal surface treatment of car- and boat details
Preparation and anti-corrosive treatment of construction steel
Printing works
Production and assemblage of parts to the engineering industry
Production and refining of metal components
Production of cameras, magazines and accessories
Production of lubricating oil
Production of nonylphenol and dinonylphenol
Production of paint and anti corrosion agents
Production of paint, thinner and enamel mainly for surface treatment of steel
Production of plastic strips and film

Production of PVC
Production of self-adhesive labels etc used in the manufacturing, food and pharmaceutical industry
Recycling and temporary storage of metals
Retapping of cooling medium in tanks
Steeping of gas tanks
Storage and distribution of chemicals and intermediate storage of hazardous waste.
Treatment of hazardous waste from industries and municipalities
Treatment of oil-contaminated waste water
Treatment of sewage
Waste disposal
Waste disposal of building, industrial and hazardous waste

Data acquired in: Relations to organisations and networks outside the CPM group

Data on freight transports from material compiled within NGM (Network for Freight Transports and Environment) - 59 activities

Road Transports - 26 activities

Data documented by: Ann-Christin Pålsson, CPM/TEP, Chalmers University of Technology
Documentation reviewed by: Michael Björkman, BTL (Bilspedition Transportation and Logistics), contact person for road transports in the work of NGM
Heavy truck with trailer, max 60 tonnes, future
Heavy truck with trailer, max 60 tonnes, manufactured after 1996
Heavy truck with trailer, max 60 tonnes, manufactured before 1992
Heavy truck with trailer, max 60 tonnes, manufactured between 1992 and 1995
Truck with semitrailer, max 42 tonnes, future
Truck with semitrailer, max 42 tonnes, manufactured after 1996
Truck with semitrailer, max 42 tonnes, manufactured before 1992
Truck with semitrailer, max 42 tonnes, manufactured between 1992 and 1995
Heavy truck with international semitrailer, max 40 tonnes, future
Heavy truck with international semitrailer, max 40 tonnes, manufactured after 1996
Heavy truck with international semitrailer, max 40 tonnes, manufactured before 1992
Heavy truck with international semitrailer, max 40 tonnes, manufactured between 1992 and 1995
Heavy truck, max 24 tonnes, future
Heavy truck, max 24 tonnes, manufactured after 1996
Heavy truck, max 24 tonnes, manufactured before 1992
Heavy truck, max 24 tonnes, manufactured between 1992 and 1995
Heavy truck, max 18 tonnes, future
Heavy truck, max 18 tonnes, manufactured after 1996
Heavy truck, max 18 tonnes, manufactured before 1992
Heavy truck, max 18 tonnes, manufactured between 1992 and 1995
Light truck, max 8 tonnes, future

Light truck, max 8 tonnes, manufactured after 1996
Light truck, max 8 tonnes, manufactured before 1992
Light truck, max 8 tonnes, manufactured between 1992 and 1995
Light truck, max 3,5 tonnes, diesel driven
Light truck, max 3,5 tonnes, gasoline driven

Rail transports - 10 activities

Data documented by: Ann-Christin Pålsson, CPM/TEP, Chalmers University of Technology
Documentation reviewed by: Ingela Melkersson, SJ Stab Information, contact person for rail transports in the work of NGM

Diesel driven freight train, future
Diesel driven freight train, T44 engine
Electrically driven combi train, future
Electrically driven combi train, RC engine
Electrically driven freight train 230 metres, future
Electrically driven freight train 230 metres, RC engine
Electrically driven freight train 700 metres, future
Electrically driven freight train 700 metres, RC engine
Electrically driven system train, future
Electrically driven system train, RC engine

Sea transports - 10 activities

Data documented by: Ann-Christin Pålsson, CPM/TEP, Chalmers University of Technology
Documentation reviewed by: Elisabeth Sörheim, Swedish Shipowners' Association, contact person for sea transports in the work of NGM

Ferry, 700-7000 tonnes
Ferry, 700-7000 tonnes, future
Freighter, 2000-8000 dwt
Freighter, 8000-2000 dwt, future
Freighter, larger than 8000 dwt
Freighter, larger than 8000 dwt, future
Freighter, smaller than 2000 dwt
Freighter, smaller than 2000 dwt, future
RoRo vessel, 2000-30000 dwt
RoRo vessel, 2000-30000 dwt, future

Air transports - 4 activities

Data documented by: Ann-Christin Pålsson, CPM/TEP, Chalmers University of Technology

Freight plane, MD-82
- 300 km
- 600 km

Passenger plane, MD-82
- 300 km
- 600 km

Data on emissions from engines from material compiled within NGM (Network for Freight Transports and Environment) - 9 activities

Data documented by: Ann-Christin Pålsson, CPM/TEP, Chalmers University of Technology

Diesel engine, Euro 0
Diesel engine, Euro 1
Diesel engine, Euro 2
Diesel engine, future
Locomotive two-stroke engine
Medium speed, four-stroke diesel vessel engine
80 % engine load
20 % engine load
Slow speed, two-stroke diesel vessel engine
80 % engine load
20 % engine load

Commitments that not yet have been submitted to the SPINE@CPM database 1998-02-16

Data committed within: Industrial data acquisition

Data on water purification

Responsible for the data: Peter Arvidsson, Akzo Nobel Surface Chemistry

Data on combustion of bio fuel with sulphur and nitrogen purification

Responsible for the data: Mikael Severinsson, Perstorp AB

Data on felling of forest

Responsible for the data: Göran Swan, STORA Corporate Research

Data on combustion of selected fuels

Responsible for the data: Maria Münter, Vattenfall Energisystem AB

Data committed within: Request for 5 data sets from members of the CPM group for full access to the SPINE@CPM database

Data for recycling of different metals from the Ecris project

Responsible for the data: Jörgen Wennsten, Volvo Technical Development
The documentation was not completed due to new work assignments

Data on "cradle to gate" systems for tensides based on:

Coconut oil
Tallow

Palm kernel oil
2 fatty alcoholethoxylate
Responsible for the data: Peter Arvidsson, Akzo Nobel Surface Chemistry

Data on "cradle to gate" systems for:

Urea pressmass
Laminate floor
HD-polyethene
Additives for concrete, type Peramin F
Responsible for the data: Mikael Severinsson, Perstorp AB

Data on manufacturing of cotton

Responsible for the data: Ellen Riise, SCA Mölnlycke

Appendix XII. An example of a sufficiently documented data set

Target groups

- LCA practitioners and analysts
- Manager or co-workers with environmental responsibilities

SPINE@CPM Data Tool, Reporting Descriptive Data,

Description of the technical system; The Object of Study

ActivityId: cpmcth002206
ObjectOfStudyId: cpmcth002206

<> Name:

Truck, long distance transportation

<> Category:

Unit operation

<> Sector:

Land transport

<> Function:

Operation of heavy trucks and trailers with total gross weight 40-52 tonnes, used in long distance traffic. The available loading capacity with regard to weight is 25-32 tonnes.

<> Geographical location:

SiteId (in table JuridicalPerson): CPMCTH0001997-04-30352
Name:
MailAddress: Sweden
Telephone:
Fax:
EMailAddress:

<> Owner:

OwnerId (in table JuridicalPerson): ABBCR0001325 2
Name:

MailAddress:
Telephone:
Fax:
EMailAddress:

Details on how the data acquisition was performed; The Inventory

---

---Persons and organisations involved with the data acquisition---

<> Practitioner:

PractitionerId (in table JuridicalPerson): cpmcth002209
Name: Tillman, Anne-Marie
MailAddress: Teknisk Miljöplanering
Chalmers tekniska högskola
412 96 Göteborg
Telephone: 031-772 21 22
Fax: 031-772 21 72
EMailAddress: amt@vsect.chalmers.se

<> Reviewer:

ReviewerId (in table JuridicalPerson): cpmcth002205
Name: Pålsson, Ann-Christin
MailAddress: CPM, Teknisk miljöplanering
Chalmers Tekniska Högskola
412 96 Göteborg
Telephone: 031-772 21 81
Fax: 031-772 21 72
EMailAddress: acp@vsect.chalmers se

---Purpose of the data acquisition---

<> Commissioner:

CommissionerId (in table JuridicalPerson): cpmcth002206 5
Name:
MailAddress:
Telephone:
Fax:
EMailAddress:

<> Intended User:

LCA practitioners

<> General Purpose:

To fulfil a need for standard values to calculate energy use and exhaust emissions from goods transports.

<> Detailed Purpose:

To compile a set of standard values for energy use and exhaust emissions from available literature, and update standard values from an earlier investigation in: Tillman, A-M., Baumann, H., Eriksson, E., Rydberg, T. 'Livscykelanalyser för förpackningsmaterial - beräkning av miljöbelastning` SOU 1991:77, Allmänna förlaget, Stockholm, 1991.

---Choice of functional unit---

<> Functional Unit:

tonkm, 50 %

<> Explanation of Functional Unit:

The energy use and exhaust emissions are calculated with reference to the transportation of 1 ton goods, 1 kilometre, with an utilisation level of 50%.

---Choice of system boundaries---

<> Nature Boundary:

Emissions to air from combustion of the fuel are included. Other environmental impacts from the operation of the vehicle are not included.

<> Time Boundary:

The aim was that the figures should represent the active fleet in 1992.

<> Geographical Boundary:

Sweden and other countries with a similar fleet.

<> Other Boundaries:

Utilisation level with regard to weight: 50%.

Excluded systems:
-Production and distribution of the fuel
-Manufacture and maintenance of the vehicle

-Establishment and maintenance of an infrastructure

<> Description on use of allocation methods; Allocations:

N/A

<> Systems expansions:

N/A

---Recommendations on the use of data---

<> Applicability:

The data are only applicable for an utilisation level of 50 %, of the available loading capacity with regard to weight. This is a conservative assumption for the level of use. An utilisation level of 50 % is however fairly representative for long-distance transport in Sweden when empty return trips are included. The utilisation level has a large influence on the energy use and emissions per tonkm.

The values are intended as an average of the active fleets in 1992. The data are only intended as standard values and should not be used for detailed study of transportation.

<> About Data:

The emissions were calculated from the energy use and emission factors. The emission factors that were used, and the basis for them can be found under QmetaData for the entire data set.

<> Notes:

---Administrative and general information on the data set---

<> Copyright:

<> Availability:

Public

<> Publication:

Tillman, A-M. ‘Goods transportation in life cycle assessment. Standard values for energy consumption and emissions.‘ In: Life Cycle Assessment - Inventory Analysis Methodology: Overview, Recycling, Electricity and Transports, Swedish Waste Research Council (AFR) report nr 74, April 1995

Documentation and review of the report done by: Ann-Christin Pålsson, CPM/TEP, Chalmers University of Technology

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<> Date Completed:

1994-04-01

Flow data

Direction	*FlowType*	*Substance*	*Quantity*	*Min*	*Max*	*SDev*	*Unit*	*Environment*	*Geography*
Output	Cargo	Cargo	1				ton		
Input	Cargo	Cargo	1				ton		
Output	Emission	SO2	0,085				g	Air	Sweden
Output	Emission	NOx	0,81				g	Air	Sweden
Output	Emission	CO	0,31				g	Air	Sweden
Output	Emission	CO2	66				g	Air	Sweden
Output	Emission	HC	0,08				g	Air	Sweden
Input	Resource	Diesel	0,9				MJ	Technosphere	Sweden
Output	Emission	Particles	0,09				g	Air	Sweden

Description of methods used to obtain the data; Flow Meta Data

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---For the entire data set; General Flow Meta Data---

Meta Data Id: cpmcth002227

<> Time period during which the data was acquired; Date Conceived:

1985-1994

<> Type of method used to obtain the data; Data Type:

Derived, unspecified

<> Description of Method:

Data compiled from different literature sources. The emissions were calculated from emission factors; the emission factor for each specific substance was multiplied with the energy use. The emission factors were:
SO2 0,0094 g/MJ
NOx 0,9 g/MJ
CO 0,34 g/MJ
CO2 73,4 g/MJ
HC 0,09 g/MJ
Particles 0,1 g/MJ

For details on how the emission factors and energy use were obtained, see metadata for each specific substance. Metadata for NOx, CO, CO2 and HC can be found under NOx

<> Represents:

<> Literature reference:

Tillman, A-M. ‘Goods transportation in life cycle assessment. Standard values for energy consumption and emissions.‘ In: Life Cycle Assessment - Inventory Analysis Methodology: Overview, Recycling, Electricity and Transports, Swedish Waste Research Council (AFR) report nr 74, April 1995

<> Notes:

-

---Specific for each flow; Specific Flow Meta Data---

-->Substance Name: SO2

FlowNumber: 3
Substance Id: cthcpm007710
Meta Data Id: cpmcth002210

<> Time period during which the data was acquired; Date Conceived:

1992

<> Type of method used to obtain the data; Data Type:

Legislated limit

<> Description of Method:

The Swedish ordinance for sulphurous fuels allows a maximum of 0.2 weight-% sulphur in diesel, equivalent to 0.094 g SO2/MJ.

<> Represents:

<> Literature reference:

SFS 1987:286. "Förordning om ändring i förordningen (1976:1055) om svavelhaltigt bränsle" Svensk författningssamling 1987

<> Notes:

-

-->Substance Name: NOx

FlowNumber: 4
Substance Id: ABBCR0001224
Meta Data Id: cpmcth002235

<> Time period during which the data was acquired; Date Conceived:

1989-1993

<> Type of method used to obtain the data; Data Type:

Unspecified

<> Description of Method:

The values are an average of emission factors (g/MJ) that were calculated from data found in Lenner, 1993.

Emissions and energy use in Lenner were reported in g/tonkm and kWh/tonkm respectively (table 3, page 14) for two types of transports:

- short distance (distribution) - an average value for 7-tonne and 14-tonne vehicles with an average load factor of 48%
- long distance - 50-tonne truck with trailer with an average load factor of 60%.

Emission factors in g/MJ were calculated by division of the emission factor (g/tonkm) with the energy use (kWh/tonkm) for the transport. A mean value of the calculated emission factors was then used.

The figures stated by Lenner were calculated from data reported by Hammarström (1). The data in Hammarström (1) were based on measurements by the ECE R49 13-mode method, conducted by the engine exhaust laboratory of the Swedish Motor-Vehicle Inspection Co. The measurements can be found in Laveskog.
The 13-mode method results in energy use and emissions in g/kWh, where kWh is related to the work done by the engine. Lenner has thus made corrections to these figures to make them represent a real traffic situation. The corrections were assumed to follow earlier relations between 13-mode data (g/kWh) and data representing a real traffic situation (g/km) described by Hammarström(2). Energy use and emissions in g/tonkm were obtained by division with the cargo weight (ton).

<> Represents:

<> Literature reference:

Lenner, M. `Energiförbrukning och avgasemission` VTI meddelande nr 718, Statens Väg- och trafikinstitut 1993

(1) Hammarström U `Bränsle- och emissionsfaktorer för kallstart och varmkörda motorer` VTI notat T 119, 1992.

(2) Hammarström, U. "Trafik och avgasutsläpp - utblick mot 2015. Emissions- och bränslefaktorer för vägtrafik. VTI notat T 84, 1990.

Laveskog, A "Utsläpp från tunga dieselfordon. Mätningar 1980-1988" Bilavgaslaboratoriet. Rapport 3579. Naturvårdsverket. 1989

<> Notes:

-

-->Substance Name: Diesel

FlowNumber: 9
Substance Id: ABBCP0001467
Meta Data Id: cpmcth002214

<> Time period during which the data was acquired; Date Conceived:

1992

<> Type of method used to obtain the data; Data Type:

Unspecified

<> Description of Method:

Simulation calculations conducted by AB Volvo of the energy use for heavy trucks and trailers with total weight 40-52 tonnes. Utilisation level with regard to weight: 50 %. The energy use are calculated as a mean value between the energy use at full load with regard to weight (25-32 tonnes) and the energy use at an empty transport.

The simulations were conducted for the F12 and F16 Volvo models manufactured in 1987. The energy use for an empty truck varied between 0,26-0,31 litres/km, and at full load between 0,37-0,49 litres/km. The energy content in the fuel were 36,0 MJ/litre.

<> Represents:

<> Literature reference:

de Val, D. `Schablonvärden för energiförbrukning vid godstransporter med lastbil.` Teknisk rapport, LM-54969, AB Volvo, Teknisk Utveckling, 1992

<> Notes:

Simulation using diesel-driven Volvo trucks manufactured in 1987 was used with the aim that the values would represent an average value of the active fleets 1992.

Note that the energy use for new trucks are lower. The values will therefore need to be updated regularly.

-->Substance Name: Particles

FlowNumber: 10
Substance Id: ABBCR0001339
Meta Data Id: cpmcth002247

<> Time period during which the data was acquired; Date Conceived:

1985

<> Type of method used to obtain the data; Data Type:

Unspecified

<> Description of Method:

Not known. The original reference was Umweltbundesamt. The value was used in Tillman et al.

<> Represents:

<> Literature reference:

Tillman A-M, Baumann, H, Eriksson, E, Rydberg, T. ‘Livscykelanalyser för förpackningsmaterial - beräkning av miljöbelastning`. SOU 1991:77, Allmänna förlaget, Stockholm, 1991

Umweltbundesamt, Germany, 1985

<> Notes:

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---SPINE@CPM Report generator by Raul Carlson, A-C Pålsson, Chalmers University of Technology, 1997

END OF DOCUMENT