Forschungszentrum Karlsruhe
in der Helmholtz-Gemeinschaft

Life Cycle Initiative

Minutes of the International Workshop on Quality of LCI Data

October 20th to 21st, 2003

Forschungszentrum Karlsruhe, Germany

Natural Resources Canada

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
Joint Research Centre

Bundesministerium für Bildung und Forschung

UNEP

IKP Universität Stuttgart GaBi
Institut für Kunststoffprüfung und Kunststoffkunde

Preface

This document contains the minutes of the three parallel working sessions at the international Workshop on Quality of LCI Data. The minutes have been compiled by the moderators and rapporteurs and were circulated amongst the participants for additional comments. The results shall serve to:

- inform each participant on discussions in all sessions
- to identify "issues and research directions" for a summary document
- fertilize the LCI working group of the UNEP/SETAC Life Cycle Initiative and other related ongoing activities.

Christian Bauer
Secretary
Karlsruhe, April 8th 2004

Rapporteurs and Moderators

Session A:

Tomas Rydberg, European Commission - Joint Research Centre (EU)
Marc-Andree Wolf, University of Stuttgart – IKP (Germany)

Session B:

Toolseeram Ramjeawon, University of Mauritius - Faculty of Engineering (Mauritius)
Raul Carlson, Chalmers University of Technology – IMI (Sweden)

Session C:

Johannes Kreissig, PE Europe GmbH (Germany)
Pippa Notten, 2.-O LCA Consultants / University of Cape Town (South Africa)

Local Organising Committee
Liselotte Schebek, Forschungszentrum Karlsruhe, (chair)
Christian Bauer, Forschungszentrum Karlsruhe
Jens Buchgeister, Forschungszentrum Karlsruhe
Achim Stadtherr; Forschungszentrum Karlsruhe
Jens Warsen, Forschungszentrum Karlsruhe
Sibylle Wursthorn, Forschungszentrum Karlsruhe
Julia Pflieger, University of Stuttgart, IKP

Supporting Organisations
Bundesministerium für Bildung und Forschung (BMBF)
European Commission – Joint Research Centre (JRC)
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Natural Resources Canada (NRCAN)
UNEP/SETAC Life Cycle Initiative
Universität Stuttgart – Institut für Kunststoffprüfung und Kunststoffkunde (IKP)

Workshop Secretariat
Christian Bauer
Forschungszentrum Karlsruhe GmbH
Institute for Chemical Chemistry -
Department of Technology-Induced Material Flow
Hermann-von-Helmholtz-Platz 1,
D-76344 Eggenstein-Leopoldshafen
fax: 0049(0)7247-82-6715
Email: lci-quality@itc-zts.fzk.de

UNEP/SETAC International workshop on LCI data quality, Karlsruhe, Germany 20-21 October 2003.

1 Minutes and conclusions from Session A: "Quality Criteria and Measurements"

Rapporteurs/Moderators: Tomas Rydberg and Marc-Andree Wolf

with comments received from Andreas Ciroth, Chris Foster, Rolf Frischknecht

1.1 Introduction

1.1.1 Overarching questions:

Common issues for all the session to discuss had been presented:

- ***Appropriateness of LCI data***
- ***DQ Information for (facilitation of) review***
- ***Vision (for quality of LCI data-sets)***

1.1.2 Session-specific questions:

According to the WS schedule session A dealt with the following issues:

Criteria for data sets, methodology and uncertainty; criteria for databases, methodology, consistency, and reliability; subjective and objective methodology and modelling choices; quantitative vs. qualitative measures; stochastic vs. systematic errors.

Out of these issues three topics and the following session-specific questions had been formulated for the group to discuss:

Criteria and indicators

"Which criteria and indicators on inputs and outputs, unit process raw data and LCI result level exist and which can be recommended and why?"

Combination:

"Is it feasible/necessary to combine qualitative and quantitative DQ information to the level of LCI results and how?"

Limitations:

"Limits of DQ-information – How can subjective choices be dealt with?"

1.2 Work sessions

As introduction to the topic, 3-4 presentations were given in the beginning of each of the working sessions. This was done in order to present various views related in broad terms to the topics of the session, as linking higher level questions with specific topics and approaches presented.

1.2.1 Work session 1: Tuesday 20/10, 14.00 – 16.00

1.2.1.1 Presentations

The following presentations were given:

- "Use of Generic Data in LCA" by Fleischer, G.; Dose, J.; Hildenbrand, J.
- "Allocation applied on co-production processes in large LCI process network databases" by Frischknecht, R.; Jungbluth, N.
- "An integrated approach to uncertainty assessment and management" by Notten, P.; Petrie, J.

1.2.1.2 Discussion

The group had attracted about 30 participants, and initially a short introduction by each of the participants was made.

The discussion as such was mainly dealing with the issue of appropriateness of LCI data. A general statement was made that it is the user who must decide on the appropriateness of the provided LCI data in the context of his specific application, goal and scope. From this follows, that the LCI data provider/author has to provide enough information so the user can actually derive qualitative or - if possible - quantitative appropriateness information. The appropriateness of LCI data involves typically also upstream processes and its technology- or import-mix-information. An effective supply of the relevant information for efficient judgement of LCI data appropriateness by the user was argued to be critical.

The question how to identify real differences in LCI data of different time, geography and technology was risen and the fig. 2 below given; uncertainty in single data can

lead to seemingly different data, while actual significant differences my be small. This is however only valid for certain elementary flows and situations, while for other large differences exist. As long as the uncertainty is not known; differences can not be tested for. It was also argued, that if such specific uncertainty information was available, we would not have the need to discuss these issues; the real situation is different, however, why this observation should be considered less actual.

The criteria for LCI data of technology (level), geography and time (valid time and/or time when data were recorded) were brought up as most important for addressing appropriateness. Moreover, specific applications (such as for GHG inventories) may require only specific limited elementary flows to be provided with the LCI data. Regarding the way how the necessary information could or should be provided to the user, ISO 14048 was named, but is was also argued, that still experience has to be gained, which of its parts are useful/applicable in practice.

Regarding data collection it was found, that one crucial point is, that it is done where the (technical) knowledge is and not were mainly LCA knowledge is.

It was also concluded, that it is not in every case necessary to quantify information prior to aggregate or summarise it. E.g., data quality may be judged as ‘good’ in the overall view.

The issues of Combination, Limits, Review and Vision, were essentially left for discussion in subsequent work sessions.

The following Figures 1-2 illustrate some of the findings/discussions:

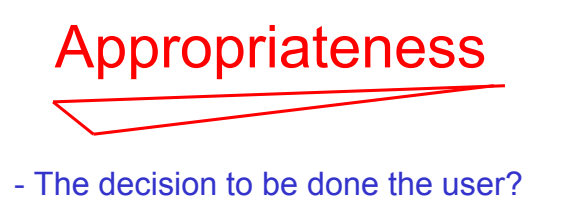


Fig. 1 Appropriateness of LCI data

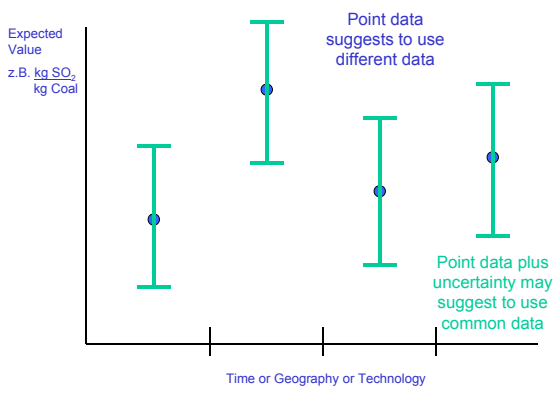


Fig. 2 Differences in data ? - exact data vs. uncertain data

1.2.2 Work session 2: Wednesday 21/10, 09.00 – 11.00, 11.30 – 13.00, 14.00 – 15.30

1.2.2.1 Presentations

The following presentations were given:

- "Uncertainty calculation for LCI data: reasons for, against, and an efficient and flexible approach for doing it" by Ciroth, A.
- "An expert system approach to LCI database management" by Notten, P.; Weidema, B.
- "A method to aggregate LCA-results with preserved transparency" by Erixon, M.; Carlson, R.; Pålsson, A.-C.
- "A New Inventory Data Model and Method for Uncertainty Evaluation in Life Cycle Assessment" by Sugiyama, H.

1.2.2.2 Discussion

The participants divided themselves up into three groups: Two groups worked on topic 1, and one group worked on topic 2 (see below). This way, each group consisted of about ten persons; this was felt as an appropriate working size of groups.

Topic 1 was to address the following issue: "Identify concepts for DQ in relation to different applications and divided up on the three headings Inputs/Outputs, Unit process, and LCI results."

Topic 2 was to address the following issue: "Aggregation and 'Quantifying or not quantifying' the quality information?"

1.2.2.2.1 Topic 1

Within the two sub-groups, denoted “red” and “green”, elements (**concepts, criteria, words**) necessary to describe LCI data quality were identified in relation to inputs/outputs, unit processes and LCI results. The main outcome of the discussions can be found in Figures 3 and 4.

Input / Output	Unit process	LCI results
- Time period - Process - Technology - Geography - Source/Reference - Data Type - Range - Uncertainty - Representativeness	- Completeness - Process description - Reference flow - Co-products allocation & identification - System boundaries (temporal, spatial, technological, etc) - Originator - Reviewer - Availability - Representativeness - Time period - Process - Technology - Geography	- Cut off rules - Allocation procedures or avoidance - System boundaries - Transport inclusion

Figure 3. Elements/concepts to describe (LCI) data quality, as found by the ”red” group in work on topic 1

Input / Output	Unit process	LCI results
- Parameter uncertainties - Source of data (DB, asociation) - Human error*	- (Documentation) - Human error - Model limitation*	- System human error - Model limitation - Measurement

Input / Output	Unit process	LCI results
- Type* - Measurement* - Multiple sources*	- Type - Measurement - Data gaps* - Data source - Technology - Multiple sources* - Boundary limits* - Functional unit	- Type - Data origin* - Process gaps – substitution - Technology - Geographical* - Data source* - Multiple sources* - Boundary limits - Functional unit* - Allocation factors - Open/closed recycling

Figure 4. Elements/concepts to describe (LCI) data quality, as defined by the ”green” group in work on topic 1. An asterisk (*) indicates a core element, i.e. a view that this element is particularly relevant.

In their work, the “red” group took a broad approach to define elements of quality (e.g. listed “uncertainty” as one element) while the “green” group focused on elements constituting sources of uncertainty. The apparently different output from the two groups is therefore to be regarded as complementarity.

As a second task, the groups were asked if priority could be given to certain elements in relation to different LCA uses. The uses suggested were product development, product comparisons, product declarations or End-of-life scenario assessment. Both groups concluded, that no such priority could be made, i.e. information on all the identified elements were stated as being potentially important, irrespective of the intended use of the LCA. It was however said, that for the actual information given on the elements, there could be differences making data appropriate to be used for one type of LCA but not for another.

In this context it was also requested, that a reasonable (and finally payable) compromise has to be found, in order, that LCI data compilation is affordable, primary data owners (mainly industry) is willing/able to provide the data, and the information is handable in practice. One suggestion was to provide a guidance for minimum data quality requirements.

1.2.2.2.2 Topic 2

The discussion on the **aggregation** question the following arguments were brought up: All sources of uncertainty can be important. A selection of which types of information relevant to address both uncertainty and especially representativeness of LCI data one has to deal with and which options to handle them is given in Fig. 5 according to the ongoing discussions. Sensitivity analysis was argued to be able to help to identify the most relevant uncertainties. Quality indicators should be based on the result of sensitivity analysis. Accepted level of uncertainty is dependent on the application and the specific needs (decision support, information only, public comparison etc.). The level of uncertainty grows from input/output –> unit process –> system LCI especially since different types of error on higher level (mixing of data of different appropriateness, i.e. especially systematic errors) interact. On the other hand many stochastic errors on the elementary flow level level each other out, what leads to decrease of certain uncertainties.

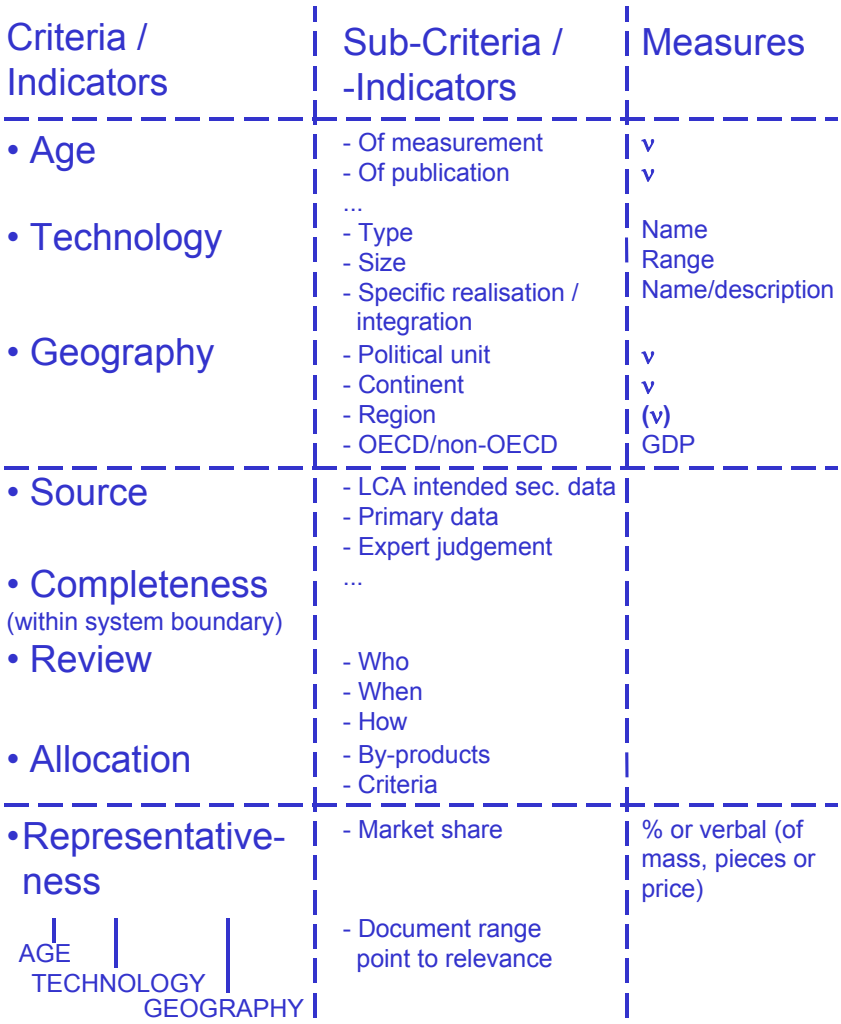


Fig. 5 Indicators and criteria for addressing LCI data quality and representativeness

The appropriate way to assess uncertainty depends on the type of uncertainty (systematic, stochastic, measurement value, calculated value, appropriateness etc.). This lead over to the second question **whether to quantify or not to quantify** (isolated and aggregated) quality information. The discussion went on whether and in how far qualitative data quality information can be quantified and aggregated quantitatively at all (mechanistically) or whether human beings are better in doing this, what lead to some discussion on the review issue. The above Fig. 5 helped to structure the discussion. In this context it was also pointed out, that in comparisons of product systems, often large parts of the systems are identical and that hence these and the uncertainties they carry can and have to be let aside when assessing the significance of differences of the two product systems. A simple calculation of the uncertainties of the two complete product systems would result in a too high uncertainty, especially if they only differ by one component or material.

1.3 Conclusions

- ***Appropriateness of LCI data***

In contrast to data quality, the appropriateness addresses the suitability of a data set for a specific application (e.g. how good does a data set on technology A meet the need of a data set for technology B; independently of the overall quality of the data set for technology A; e.g. if only CO2-emissions are asked for, which might be provided in good quality for technology A and if in regard to CO2 both technologies are known to be equivalent, the data set of technology A can have a bad overall quality but a very good appropriateness for the specific need in this case). It was found to be in the responsibility of the data provider to provide data representativeness information. In order to be practicable, the most relevant, necessary information should be provided in an effective and efficient way. The user should be thereby enabled to assess the appropriateness of the data in his specific situation (goal and scope of the data application). Data quality information on the other hand should be provided by the data provider after an independent review.

- ***Criteria and indicators (for DQ issues)***

DQ information is independent of the application type. The specific application determines case-by-case which information and which level of quality is needed for which aspect of quality (e.g. for specific inventory information like Primary Energy if only this one is needed in the respective study). DQ indicators alone - be it on input/output, unit process or LCI result level - were found to be inappropriate for assessing data quality; an independent experts review is needed, which however should be supported by some DQ information. The need to develop a set of "minimum data quality information requirements" - in order to keep the compilation and documentation of these feasible - was found a necessary condition to be kept in mind. It was also found to be not always necessary to quantify prior to summarise it.

- ***DQ Information for (facilitation of) review***

The information named under "Appropriateness of LCI data" also helps reviewers to assess quality issues of unit process or LCI result data. The review will have to be performed on the level of unit processes and on the modelling of the product system. It has to be done by independent (technical) experts for material and energy flows of the process or product system under review together with independent LCA experts for methodological questions.

- ***Combination (of DQ information)***

It was seen to be appropriate to aggregate quantitative DQ information from the input/output or unit process level to higher levels such as aggregated LCI results.

It was seen to be NOT appropriate to quantify also all qualitative DQ information. Humans were seen to be better in such an assessment. Qualitative information, that was aggregated by expert judgement might be reported on the level of LCI results to allow users/reviewers to complete DQ information and to help them to assess appropriateness. The aggregation of quantitative and qualitative DQ information should be explored in practice to find out about options and limits regarding practicability, reliability and the necessary effort.

- ***Quality of data bases***

It was concluded, that LCI quality takes place at the level of the unit process or LCI result, but not on the level of the database. However, consistency among datasets e.g. due to use of the same background data with the same methodology for different datasets to be combined in a new product system was found to be one important issue to be considered when LCI modelling is done in practice. Thereby the systematic error can be lowered considerably.

- ***Vision (for quality issues of LCI data-sets)***

The majority considered human beings better in deriving higher level quality information especially if qualitative and interacting information is to be integrated as for LCI data. The automatic, full aggregation of any quantitative and qualitative DQ information was considered a vision. A review was considered the most probable long-term vision for assessing LCI data quality. This holds especially true as main systematic, structural and methodological errors do still occur in practice. The avoidance of such errors - which are also extremely difficulty to deal with quantitatively and which have to be assessed case-by-case by expert judgement - is one relevant issue to increase LCI data quality. (Technical) experts should collect the data specifically for LCA purposes and LCA experts should model the product system to lower this type of uncertainty and increase overall quality and reliability.

2 Notes from Session B: Documentation and Communication of Quality Information

Rapporteurs/Moderators: Toolseeram Ramjeawon and Raul Carlson

with comments received from Bo P. Weidema and Niels Jungbluth

2.1 Introduction, first session (B1)

The discussions in session B started with attempts to commonly describe the terms

- *Reporting/Documentation*, in terms of how to bridge the gap between the report and its target audience.
- *LCI and LCIA*, in terms of how to report Life cycle inventory (LCI) data to facilitate Life cycle impact assessment (LCIA).
- *Integration*, in terms of how to integrate data from different data sources into one LCI data report.

2.1.1 Reporting/Documentation

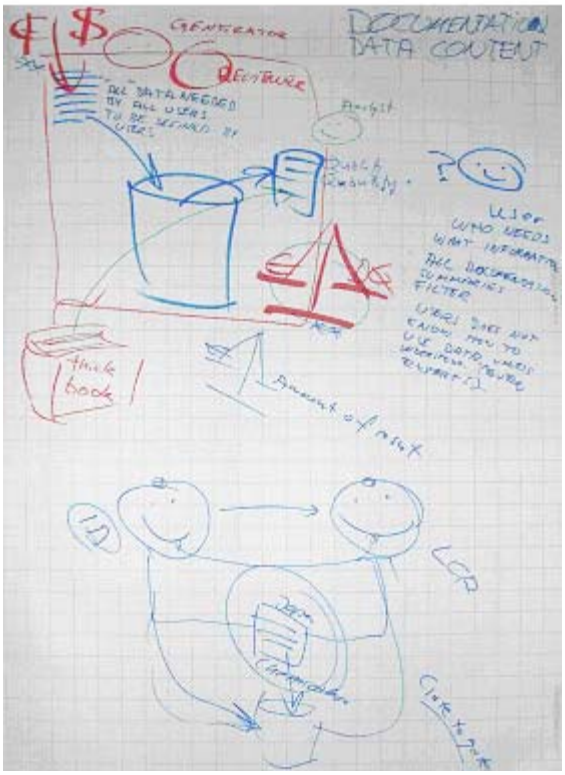


Figure 1. The sketch produced during the discussions about Reporting.

During the discussion in session B we sketched the figure 1, to aid our interpretations. In general the session concluded that to understand or define the gap between reporting / documentation and target audience, it was first necessary to understand the target audience, and from a definition and an understanding of those try to derive their information needs. After data are collected, calculated and modelled, the approach used should be transparent to users of data.

The relationship between cost for documentation and other quality aspects, as well as willingness to pay for this higher quality needs to be taken into account, unless there are explicit strict scientific requirements on the results.

There will always be a trade-off between completeness and practicability. There is also a question of efficiency(time/effort for documentation) as we can get more datasets with sufficient reporting.

In addition the session discussed that it is necessary to have access to all available information, but the access can be provided in different ways, either as in the ISO/TS 14048 format together with the LCI data itself, or as in the case of ecoSPOLD, as a reference to a report somewhere.

2.1.2 LCI and LCIA

Regarding how to report Life cycle inventory (LCI) data to facilitate Life cycle impact assessment (LCIA), the following were discussed:

- It is necessary that the LCI and the LCIA people use the same language. There is a need to organise the communities to work/communicate together, at least during specific projects (examples from Japan where such organisation had been done were mentioned). A certain cultural gap between the industrial perspective of LCI experts and the academic perspective of the LCIA perspectives were mentioned, and that this has implications regarding openness of results and documentation regarding the two areas.

- It is necessary to take into regard that when performing an LCI data collection, it is economically questionable to collect more data than can be distinguished by quantitative or qualitative LCIA methods that might be applied (examples mentioned were noise, land-use and waste). On the other side it is important not to disregard important aspects due to economic restrictions, lack of time or insufficient knowledge of the LCA practitioner.

- The types of impact assessment supported by the LCI is important from a user point of view. It was considered valuable if the LCI report (data set) holds documentation regarding how to perform impact assessment. At least the impact assessment-related basis for selecting data categories should be documented.

- It was stressed that there is an iterative relationship between LCI and LCIA.

- One core practical problem between LCI and LCIA reporting is the choices of nomenclatures. Much resources are spent on relating these to each other, and there is much to be gained from solving this problem.

2.1.3 Integration[1]

As support during the relatively short discussion regarding the integration of data from different data sources into one LCI data report, figure 2 was sketched. A result from these discussions was that the integration of data from different data sources are practically the ordinary work of LCI, and the principles and guidelines already mentioned in ISO 14041 might suffice.

It was also mentioned that, as a paradox, more integration (more information) can show a higher uncertainty (by which it was meant that more information leads to higher confusion, rather than uncertainty in a strict and formal meaning).

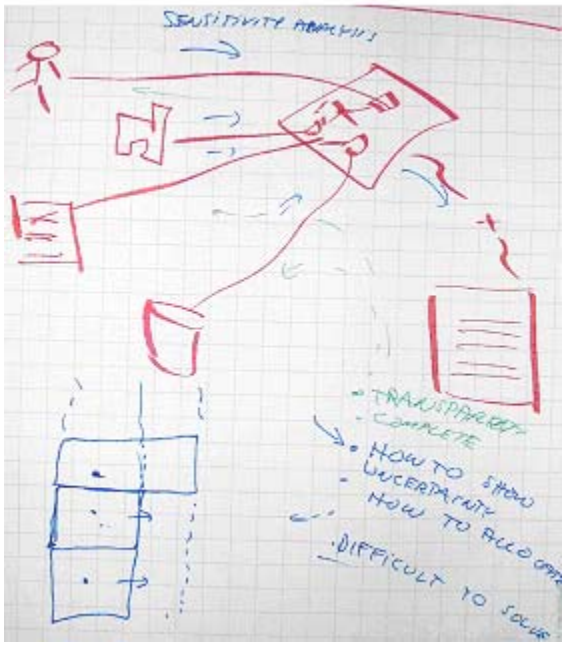


Figure 2. How to integrate data from different data sources into one LCI data report?

2.2 Work in subsessions B.2-B.4

During the second day of the workshop, the experts in session B first decided to understand their main and common objective as:

Identify core problems to solve in order to facilitate for any user throughout the world to simultaneously utilise all available LCI data sources and choose the "right data" with regard to the goal of the study when performing an LCA.

[1] Reference: "Procedural guideline for collection, treatment, and quality documentation of LCA data" from the CASCADE project (http://192.107.71.126/cascade/doconline/documents/LC-TG-23-001.pdf), especially chapter 5.2 on process description.

Problem definition 1. The problem identified by session B.

Regarding this commonly identified core problem, the attendees in session B decided to deliver some specific recommendations to the UNEP/SETAC working group on LCI data quality, and specifically to taskforce 2. It was decided that the first subsession of the day, B.2, should be used to together define some core elements from the discussions from day 1, and the second subsession, B.3, should be used to further define these core elements in smaller groups during subsession B.3. The third subsession of the day, B.4, should be used to present the results from the smaller groups for each other in the larger session forum, and to end with defining core work items to recommend to task force 2.

2.2.1 Results from subsession B.2

To understand the core problem presented in Problem definition 1 above, it was decided that session B first had to define the following two entities more in detail:

- The 'user', i.e. the one for which all LCI data sources in the world should be presented.
- The information needed by the user defined above.

Due to some deviating standpoints in the session, it was also decided that some could work with:

- Describing a vision for how end-users of LCI data sources are the end users of LCA results (reports).

2.2.2 Results from subsession B.3

The results from the different smaller groups are:

Defining the users

Figure 3 was used to identify the users from the viewpoint an 'information flow' model. The users within the yellow ellipse are the core users, and it was considered that the most appropriate user definition of all LCI data sources in the world would be the LCA experts (also understood as LCA practitioners).

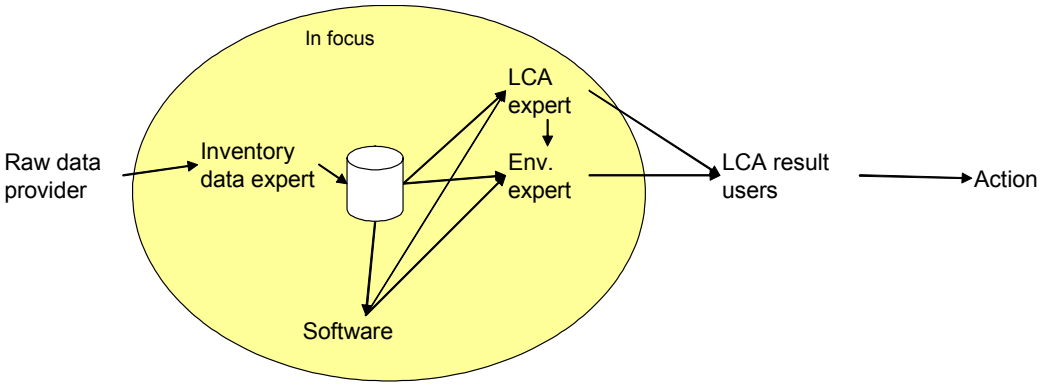


Figure 3. Identifying the user from an 'information flow' model.

Other identified users were:

- Staff inside companies
- Management (SME)
- Top management
- Reviewers, laywers, politicians etc.

Regarding the information that the identified users need:

The general information needs of the users in Figure 3 were listed as:

- Inventory data expert (needs all information)
- LCA expert (information needed to assess applicability)
- Environmental expert (LCA-expert up-/downstream and Raw data provider, Inventory data expert, and simple labels etc.)
- Software (technical information, fulfil LCA experts requirements)

And a useful sketch for understanding the general information needs of the other identified users were sketched as:

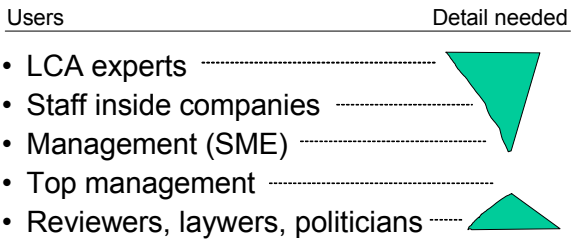


Figure 4. Users and their information needs.

- It was understood that in general the information needed by LCA experts is the same information identified when producing the ISO LCA data documentation format ISO/TS 14048, and which also has been identified by different regional or local expert groups when defining e.g. SPOLD, SPINE, and EcoSPOLD, and the data fields in different applications, such as SimaPro, GaBi, SPINE@CPM, EcoInvent, Sirii SPINE etc.

Specific anticipation of the users needs from the viewpoint of figure 3 i:

- Inventory data expert
    - needs all information relevant to compile an LCI data set about a process (unit or aggregated)
- LCA expert (and Environmental expert) (information needed to assess applicability and fulfill ISO 14040..)
    - Information defined by LCA data documentation formats, such as
        - ISO/TS 14048
        - EcoSPOLD
    - How do we agree on how to use and interpret the formats -> Guidelines for different subsets and structures. There is a need for harmonisation of philosophy/general framework(nomenclature, allocation, etc) for a data exchabge with no loss of quality between two formats.
    - There is a need for guidelines for how to present valuable information, such as the minimum data quality requirements.
- Software (Technical information, Fulfil LCA experts requirements)
    - Nomenclature
    - Translation between formats
    - How do we agree on how to use and interpret the formats -> Guidelines.

Further specific requirements were identified as:

Different levels of reports can be anticipated:

- (Report A) Minimum to be credible;
    - For LCI data bases consensus is there, technicalities need to be resolved.
    - Link LCI LCIA, many problems remain, and difficult to report
- (Report B) short identification of quality
    - Hotspot or contribution analysis, interpret the report A level data description
    - Uncertainty ranges

The minimum data quality requirements were listed as:

- Product/process name (e.g. electricity), adequately specified (e.g. voltage)
- Specific supplier or market
- Process description (drawing or in writing, and/or by specifying all inputs and outputs very precisely). Geography (e.g. Germany – that is where our plant is...)
- Technology (average, marginal, specific, e.g. eco-labelX“)
- Time period (e.g. 2004)
- Uncertainty, specified per flow
- Dialogue without industry slang and abbreviations.

Or identified in a table as:

	Unique field	Data origin	Suita-bility
Name	x		
Process description	x		
Geography		x	x
Time		x	x
Technology	x		
Data quality		x	?

There must be sufficient documentation about the above quality requirements so that future users may employ qualitative and quantitative methods as suggested by a number of authors.

Note: Though the adressed issues in subsession B.3 are very interesting for different people in the community of LCA experts and users, it must be stressed that the general results from this subsession cannot be used as they are. They needs to further elaborted and worked with. It is however likely that the subsession has addressed and mentioned many of the most important aspects that needs to be taken into account when solving the core problem adressed in Problem definition 1.

2.2.3 Results from subsession B.4

The result from subsession B.4 is the recommendations from the session B to taskforce 2.

The following aspects needs to be solved in order to facilitate for users anywhere in the world to utilise all different and available LCI data sources:

- Communication between different systems (databases and software)
    - Exchange format (further specify 14048), to describe how to handle exchange of concepts that has been formatted in a specific way in some other format (one example is the specification of literature references in EcoSPOLD, whereas the ISO/TS 14048 have this field formatted to allow exchange of a wider range of formats developed for different aims).
    - Nomenclatures
- Investigate the gap between LCI and LCIA data, especially coordinate the work between LCI and LCIA experts within UNEP/SETC in general and within specific projects. There should be clear guidelines from LCIA people on inventory data documentation.
- Systematic and credible uncertainty estimates of flow amounts at unit process level with transparent reporting. Since it seems to be relevant to add statistical information to quantities for which such is empirically lacking, this problem needs to be further sorted out.

All these three issues needs to be dealt with for users to make use of different LCI data sources in the world, and therefore these issues should be identified and highlighted as common working issues within the UNEP/SETAC Life Cycle Initiative.

3 Minutes of Session C: Application of Data Quality Information in Decision-Making

Rapporteurs/Moderators: Johannes Kreissig and Pippa Notten

3.1 1st Discussion Session, Monday pm

This first session was spent exploring the topic, “brainstorming” and expanding the list of questions handed out to the participants (see appendix 1 for full list of questions). Much time was spent discussion the broader issue of data “appropriateness” and a large list of sub-questions was generated. The moderator and rapporteur then condensed and combined these questions with those previously generated for session C to come up with the following questions to be addressed:

1. Who is using data quality information in decision making?
    - Who provides data quality information? Who needs data quality information?
    - What are the incentives/drivers? What are the barriers?
      (to both providers and users of data quality information).
2. What level of data quality information is being used?
   (by those identified in (1))
    - Is it sufficient?
    - What level of documentation is required (bearing affordability and practicability in mind)?
    - Who pays for data quality information?

3.2 2nd Discussion Session, Tuesday am

This session began with a general discussion on the use of data quality information in decision making. The following points were raised:

- Data quality information is used implicitly rather than explicitly.
- The particular audience is important, with different audiences requiring different types and levels of data quality information.

This led on to a discussion to define different audiences. The distinction between private uses (i.e. internal to the company conducting the LCA) with public or external uses (e.g. communication, policy making) was raised as a first broad categorisation. However, the group could not agree even at this very broad level of categorisation, with a number of participants preferring to see the distinction between private/public more as a transition from the one to the other. I.e. the distinction is not "black" and "white", and that whilst a study may start as internal or "business to business", it may later be decided to publish the study and perhaps undertake a critical review. In any study, the possibility to "go public" therefore needs to be kept open. This view was disputed by some other participants, who felt that in certain industries, studies are undertaken purely to support internal decision making (e.g. car manufacturers, building industry).

Two final points raised in the session:

- In either case, LCA (and the level of data quality information required) is an iterative process.
- Even for screening LCAs, or LCAs used purely to support internal decision making, uncertainty can still be important for comparative assertions (where the significance (size) of the differences between products is important in determining the need for uncertainty analysis / data quality information).

3.3 3rd Discussion Session, Tuesday am (after coffee break)

To help with determining different users / providers of data quality information for decision making, each participant was asked to fill out a card answering the following questions:

- What kind of affiliation do you belong to?
- Are you using data quality information in decision making?
  - Is this use qualitative, quantitative or both?
- In what context are data quality information used?

A table summarising the participants responses is given below.

Nr.	Affiliation	Use of data quality information (qualitative/quantitative)	Context of data quality information
01	Industry	None	Power industry
02	Industry	DQIs and quantitative (sensitivity analyses)	?
03	Industry association	Qualitative (DQIs) and DQS's (estimation of costs-use-effort/effects for each study)	Representing companies' interests in choosing LCI studies (Al-industries)
04	Industry	Qualitative judgment and quantitative (sensitivity analyses), depending on outcome of qualitative analysis	Product design / internal use
05	Industry	Most important data selected by sensitivity and scenario analysis, this data then assessed by statistical data, market polls, expert judgement (measurement, research, studies)	Political, external and internal studies
06	Academia	None (indicators)	Building materials (understanding the details of a process)
07	International organisation	Qualitative	Web-portal for LCI databases
08	Consultancy	a. Qualitative ("expert view") and quantitative (simple sensitivity analyses) b. Qualitative ("expert view") and quantitative (elaborate sensitivity analyses) c. Data quality indicators (ISO) and simple sensitivity analyses d. Elaborate qualitative evaluation (based on elaborate sensitivity analyses)	a. International LCA studies for industry b. Product comparisons (external) c. LCA for EPD, transfer to databases/communicatio n d. Policy studies (external)
09	Academia research, diplomas)	Qualitative and quantitative	Comparison (LCI) of process data (process optimisation)

Nr.	Affiliation	Use of data quality information (qualitative/quantitative)	Context of data quality information
10	Academia	Qualitative, scenario and sensitivity analysis	LCA (market flow analyses) to support decision process on policy and industry (at sector level)
11	Academia	Qualitative and quantitative DQIs (ISO-list of criteria, and sector specific priorities, e.g. timelines)	Data collection
12	Consultancy	50% qualitative (used only implicitly) and 50% quantitative (mainly sensitivity analysis)	Selecting the appropriate information for all systems under study
13	Academia/ consultancy	Qualitative DQIs for most relevant contributions to environmental performance indicators, quantitative DQIs are planned	Service for industry in Eco-Design, product policy, management
14	Academia (working in industry)	Usually qualitative (judgement made based on professional experience, usually by comparing various data sets or similar materials/processes) Can be quantitative (via sensitivity analysis)	Product selection and/or improvement
15	Consultancy	Quantitative (error propagation method, estimation of errors on relevant levels, if not indicated in database), communication with whiskers (min-max, or 20)	Streamlined and full LCA's
16	Academia/ consultancy	Quantitative (combination of probabilistic analysis, multivariate parametric analysis, and sensitivity/scenario analyses)	Resource industries, strategic to operational decisions
17	?	Quantitative (if information on used datasets is readily available)	Analysing and comparing LCA results
18	?	Quantitative (data collected in the company and valuated by international experts)	Tool provided to companies to evaluate potential improvements; used to identify weak points / establish priorities

From a very quick look at the responses, it was determined that participants could be roughly assigned into three groups,

a) those using only qualitative data quality information or none at all,

b) those using a combination of qualitative and quantitative data quality information (primarily sensitivity analyses),

c) and those using quantitative data quality information (more than just sensitivity analyses).

Group (a) (Table1: 01 – 07) was comprised mainly of industry respondents, whilst (b) (08 – 14) and (c) (15 – 18) was made up of academics and consultants. This rough grouping was presented to the participants, and the participants asked to assign themselves to one of the three groups. Each of these break-out groups then set out to address the following questions:

- What are the incentives for using data quality information to support decision making?
- What are the barriers?
- Is current data quality information sufficient for your decision-support needs, and why?

3.4 4th Discussion Session, Tuesday pm

To start this session, each of the three break-out groups reported back on their discussions.

Group (a) (industry):

Incentives

- to asses products with customers
- DQIs needed only if results are affected; system dependent
- especially for assertions disclosed to the public
- DQI not necessary for internal use

Barriers:

A significant barrier to the use of data quality information is that the overall concept of data quality is not well defined (i.e. what does "high" or "low" mean?). Accordingly, the following points were raised:

- The overall relevance of the data needs to be checked, not checked in a specific way for every data set.
- Trust in data providers (on a personal/emotional level) is more important than data quality information.
- - The trust in a data source depends on the personal expertise and knowledge of the data providerA further significant barrier for data quality information is time and money.
- insufficient measures to assess validity of DQI
- reference needed

The following fives pieces of data quality information were identified as being the most essential in determining the quality of a data set :

1. The original purpose for which the data was generated (i.e. to understand the context of the data)
2. The underlying scenarios and assumptions
3. The data provider
4. The age of the data
5. The geographical origin of the data

Group (b) (consultants/academics)

Incentives:

- stimulate data collection and speed
- enhance credibility and transparency

Barriers

- Re-educate managers
- human nature
- short sighted to see A better than B
- low data availability anyway; expensive
- not streamlined methods, but easy/accepted ones

The decision context for this group was defined as: to bring data sets into a universal database.

This requires:

1. the selection of data sets
2. identifying the intended user/audience
3. goal and scope dependency

The user/audience can differentiated into:

- decision supporters (LCA experts)
- decision makers (LCA non-experts, e.g. designer of products))

For the transition of information from one to the other, there is a need for an "intelligent choice" of data quality indicators:

- Data quality information is "nice to have" for the LCA expert, since they are able to compensate if information is lacking (although good documentation is always necessary).

- There is no alternative for the LCA non-expert.
- ISO-criteria are not sufficient as they all require interpretation if used in universal databases. I.e. they cannot be assessed by non-experts, e.g. "representativity" needs to be checked by an engineer.
- There is a need for more meaningful indicators for appropriateness, especially for the pre-selection of data sets. Methodological choices in pre-selection are equally important.

Group (c)

Incentives for using quantitative data quality information to support decision making:

- Showing quantitative uncertainty information stimulates improvements, both within the company and in its competitors (set a good example that other must follow to appear as good/certain in their environmental reporting).
- It also stimulates investments within the company by showing where environmental reporting is weakest and where effort (time and money) should be invested.
- It enhances the credibility of LCA studies, especially to those outside the LCA community, who may view the results of LCA studies with suspicion.
- It also enhances stakeholder trust in high consequence decisions.
- Finally, quantitative uncertainty information allows for better decision support as there is greater transparency in the results.

Barriers to using quantitative data quality information to support decision making:

- The availability of quantitative data quality information presents a significant barrier (the origin of the data is not always known, it is difficult finding good sources etc.).
- The education of managers / decision-makers is vital
    - Managers need to understand the importance of considering uncertainty information (or, at least, the dangers and short sightedness of ignoring uncertainty).

  - Need to understand that uncertainty analyses highlight where the weaknesses are in a study (e.g. to motivate for better data), rather than that high uncertainty means a "bad" study.

- Including quantitative uncertainty analyses increases the complexity of the study (increased time and money required for a study).
- There is a lack of fast, reliable and widely accepted methods
  - The method needs to be result or decision dependent (i.e. it depends on the significance of the differences between comparative options).
  - It needs to be an iterative process, where data quality may require refining if the outcomes are “close”.

Is current data quality information sufficient for decision-support needs?:

- Not really
- There is a need to streamline the process.
- There is a need to establish consistent methods and reporting.

Final Discussions

Following on from the report-backs, the following general points were raised:

- It is not meaningful to talk of "high" or "low" data quality, "suitable" or "appropriate" is closer to what we mean.
- Data quality is inextricably linked to documentation requirements (unless you implicitly trust the data provider).
- Standardisation / data quality requirements can only be defined if you know the possibilities (i.e. it is necessary to work from an application view point).
- A user of a data set does not want to have to read the entire report to know something about its quality. A set of clearly defined data quality indicators / information fields are therefore needed. This does not necessarily have to be an extensive list (a set of only five were identified as sufficient for group (a)).

The lack of interest / support for quantitative data quality information was surprising (predominantly by the industry-oriented participants), so a short discussion on quantitative data quality information was held. Even when faced with clearly overlapping results (i.e. that A no longer appears "better" than B when uncertainty information is included), the following viewpoints were put forward:

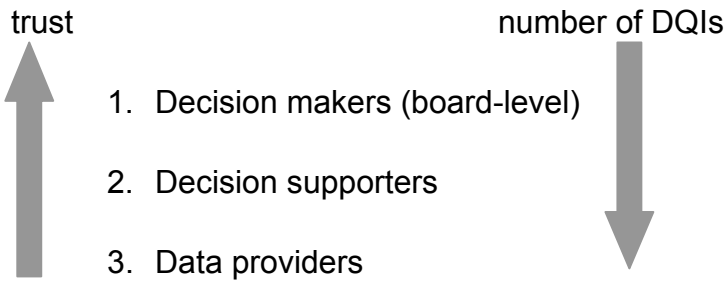
- Quantitative uncertainty analyses are primarily of benefit for learning about the process.
- They can be misleading, as they result in a false sense of precision.
- It is not clear what should be included in the uncertainty "whiskers" (i.e. there are many sources of uncertainty and quantitative studies are unlikely to include them all).
- Would rather work with a "whisker in your mind" approach, where qualitative or quantitative uncertainty information from sensitivity analyses is used implicitly when comparing options.
- Sensitivity analyses generally found to be more useful.
- Many of the barriers to the use of quantitative uncertainty information identified by group (c) (see above) were raised again. In particularly the resistance to providing managers/decision makers with quantitative uncertainty information was raised (with the argument that financial managers etc. do not provide quantitative uncertainty estimates, so it would "weaken" the environmental argument if environmental managers should do so).

Arguments for the use of quantitative uncertainty information were similar to the "incentives" raised by group (c) (see above).

Concluding remarks

The following unifying structure was proposed (and accepted by participants) as summarising and capturing the key conclusions of the day's discussions:

Data quality information is evident on three levels:



As one progresses from level 3 up to level 1 the need for data quality indicators decreases, whilst the need for trust (between the people at the various levels) increases.

Thus, in summary, for:

1. Decision makers
   - little data quality information required
   - trust in information providers is more important
2. Decision supporters (compilers of LCA studies)
   - data quality information / sensitivity analyses important
   - quantitative uncertainty methods potentially useful, but need to be further developed
3. Data providers (people gathering data, developing databases etc.)
   - transparency in methods and data most important
   - good documentation and data quality criteria critical
   - a better set of criteria need to be developed (ISO not sufficient)

Annex 1 of Group C: Full list of initial questions in Group C

Appropriateness of LCI data (various applications):

- How many data sets do we need to compare data sets ?
- Decision context: Which data do we need in which decision context ?
- How to define different data quality requirements for different applications ?
- "History" of data generation indicators ? – How to simplify ?
- Dependency of Goal and scope:
  - Is it a problem to have too much information ?
  - How to deal with confidentiality ?
  - How to deal with lack of data and aggregated data ?
- How to avoid the misuse of LCA ?
  - Is there a difference between internal and external use ?
  - Are there different criteria e.g. for reporting ?
  - Does the public really need a higher level of appropriateness ?

Data quality information for review

- Which parts are included ?
- Is there a need for clear commitments ?
- Where to focus on? Should there be a focus on Data Quality Indicators or technical information ?
- Under the restrictions of limited time and effort: should the focus lies on documentation, data collection or review ?
- Is a co-operation under the perspective of the review between institutes possible ?
- How to deal with old data ? How to define 'old'?
- Is it really possible to review LCI data sets ?

Decision Context

- In which context is which type of assessment conducted ?
- Is it possible to formulate long term goals at some quantitative indications ?
- Does information become worthless without Data Quality assessment ?
- How to differentiate between sources and uncertainty?
- Could data uncertainty be used for choices in the context of decision support ?
- How to make it practical without appearing irrelevant ?
- How to offer transparency without just confusing ?
- How to use Data Quality beyond the context of dependency ?
- Which data Quality Indicators are relevant for Decision making ?
- When do stakeholders have to be involved ?