LCA Databases

Life Cycle Inventory Data:

Development of a Common Format

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Abstract

This article describes the work carried out by the Promoting Sound Practices (PSP) working group of SPOLD (Society for the Promotion of Lifecycle Development) on the development of a common format for reporting life cycle inventory data in a comparable and transparent way, and hence towards the eventual goal of a decentralised network of life cycle inventory databases. Establishing such a database network depends on the achievement of consensus amongst potential users, data owners and data generators. Accordingly, building consensus has been, and will continue to be given, a high priority in this work. As well as a summary of the consensus building activities, this article provides an outline of the developing format and an indication of the next steps planned, some of which are already underway.

Keywords: Life cycle inventory analysis; life cycle inventory databases; data format; database network; consensus building

1 Introduction

This paper describes recent work carried out by the Society for the Promotion of Lifecycle Development (SPOLD) on the development of a common format for life cycle inventory data[1]. The work forms part of a continuing programme of work sponsored by SPOLD to improve the availability, transparency and comparability of life cycle inventory data.

The Promoting Sound Practices (PSP) working group is comprised of the authors of this paper. It was set up by SPOLD in December 1994, with the prime objective of assisting its members, and the wider LCA community, and facilitating their search for available LCI data, with a consistent format and with well documented data quality characteristics. The need for greater access to good quality environmental data has been recognised by the EU, in its Fifth Environmental Action Programme (European Commission, 1992), and in the specific context of LCI data by SETAC and in the EU's ecolabelling scheme (SETAC, 1994, European Commission, 1994). The PSP's ultimate aim is a network of databases covering materials and services. The objective is not to create a new database in parallel and/or in competition with the already numerous and scattered currently available initiatives, but, by means of a common format, to harmonise those data sets that already exist and those that will be generated in the future by individual data owners.

2 The SPOLD Database Project

Accordingly, the PSP has been developing a common format for the reporting of LCI data. The use of such a format will improve the transparency and comparability of LCI data and represents an important first step towards the establishment of a database network by providing a common basis for communication. To achieve such a format required the PSP to co-operate and build a consensus about its use, for all current and future LCI data, with LCI data

[1] **Addendum:** While this paper was submitted for publication, a more prescriptive version of the format (cf. section 5) was developed for the purposes of the multi-user test that started in April 1996 with 24 participants. The complete current version of this format can be obtained on diskette from the SPOLD office. Avenue E. Mounier 83, Box 1, B-1200 Brussels, Belgium, upon payment of 25 ECU (1,000 BEF) to cover distribution cost.

handling experts, LCI data owners and LCI data generators. The establishment of a such a consensus is being given prime importance in the project.

As well as developing the format, the PSP has also prepared a directory of sources of LCI data, as a first step in facilitating access to the data that are available. This work is completed; the directory was published by SPOLD in November 1995 (SPOLD, 1995a). This directory includes information, not only on the many reports and commercial software packages which contain LCI data, but also on the numerous data gathering initiatives which have been completed or are underway under the sponsorship of industry trade associations and national authorities (for example, BIANCHI, 1995, APME, 1992, 1993a-c, 1994a-c, 1995, CEFIC, 1995, although there are many others, see *Table 1*). The existence of these many LCI data gathering initiatives reinforces the importance of such a co-ordinated approach.

The relationships between these strands of the PSP's work and with its plans for the future are illustrated in Figure 1. The directory has been completed, but in an updated, and electronic, form it could form the basis for a set of "yellow pages" to guide users to potential sources of data in the database network. The remainder of this paper focuses on the development of a common format for reporting data. Further details of this work can be found in a report prepared by Axel SINGHOFEN (SPOLD, 1996).

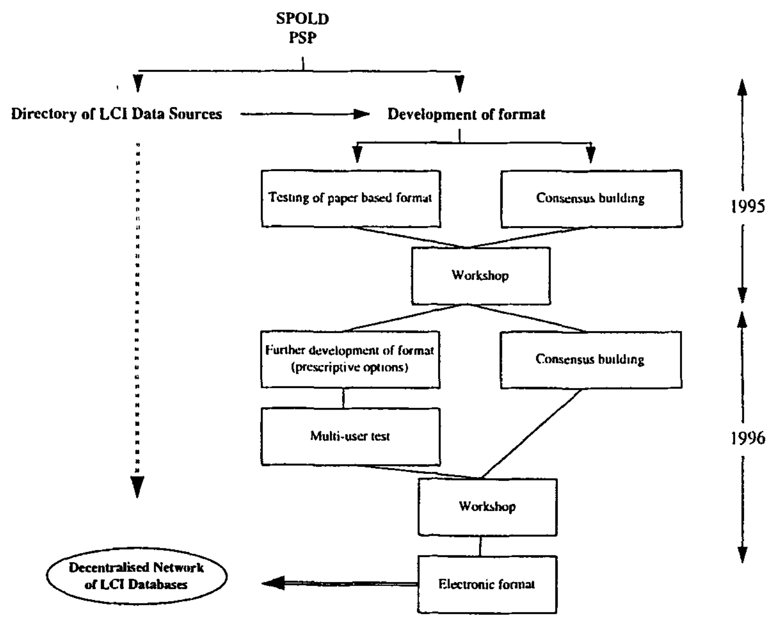

Fig. 1: The work of the SPOLD PSP

3 The Development of a Common Reporting Format

The PSP recognised that its first task was to ensure the development of a consistent format for all the data that are already available. Accordingly, a draft format *on paper,* based on the requirements considered crucial for data transparency, was developed, to serve as a basis for a future electronic format. To test this format, two programmes of work were carried out simultaneously: technical validation and widespread consensus building *(→ Fig. 1)*. Within the framework of the technical validation, the draft paper format was applied to existing studies in order to explore the extent to which the format was comprehensive, practicable and scientifically sound.

In parallel, LCI data handling experts and LCI data owners (about 50 persons altogether), mainly in Europe, were consulted to bring together as much expertise as possible for the development of the format and to build the necessary consensus about the use of this format for current and future LCI data. These people were sent the draft format prior to a meeting in person, and feedback from the discussions and from the technical testing were taken account of in successive revisions of the format. The consultation process was given the highest priority, as the format can only succeed on the basis of a wide consensus. To help build a further consensus, the format was presented at a workshop held on October 24th, 1995 in Brussels (SPOLD, 1995b). A list of the people consulted before the workshop and of those participating in the workshop is given in Table 1. In the consultation and at the workshop, a high degree of interest in creating such a format and acceptance and support for the work has been found. However, it was also recognised that there was still considerable work needed before the database network could become a reality. In particular, there is a need for a more wide ranging, multi-user test of the format.

Key issues raised during the development and testing of the format and during the consultation process are summarised in the next section.

Table 1: List of organisations and individuals consulted

Association/institute	Contacted person(s)	Association/institute	Contacted person(s)
AB Volvo	J. Wennsten	FEFCO	J.-P. Lardillon
ADEME	D. Violle	FINNBOARD	E. Peippo
Aluminium association	C. Hebestreit	Franklin Associates	D. Janzen
APME	A. Griffiths, V. Matthews	Fraunhofer Institute	G. Goldhan
Boustead	I. Boustead	IDEA	S. Alber
Carbotech AG	F. Dinkel	IFEU	J. Giegrich, U. Mampel, U. Meyer, M. Schmidt, A. Schorb
CAU GmbH	W. Klöpffer	IKP	I. Pfleiderer, K. Saur, M. Schuckert
Chalmers Industriteknik	T. Ekvall, L. Persson, T. Rydberg, L. Salmi	INCPEN	J. Bickerstaffe
Chalmers Techn. Highschool	R. Carlsson	International Iron & Steel Inst.	T. Jones
Chem Systems	T. Holloway	IPU	N. Frees
CML	G. Huppes, P. Mulder	ISOPA	E. Weigand
COGNIS	W. R. Jäger	Joint Research Center	M. Johansson, H. Kröckel
Continental Can Europe	C. J. van Dongen	KCL	A. Kärnä, H. Wessmann
Danfoss A/S	O. Willum	Miljøbalans	G. Sundstrøm
dk-Teknik	A. Schmidt	Netherl. Energy Res. Found.	C. Warmer
Dow Corning Europe	M. Vermeulen, T. Yong Yap	Oeko-Institut e.V.	U. Fritsche, L. Rausch
Ecobilan SA	H. Teulon	PIRA	D. Cockburn, P. Nichols
Eléctricité de France	S. Gasser	PRé	M. Goedkoop
EMPA	S. Dall' Acqua, M. Fawer	RPS Consultants	N. Kirkpatrick
ETH	P. Frischknecht, E. Walder	STFI	A. M. Vass
Eur. Commission, DG III	P. Henriques	Unilever	D. Postlethwaite
Eur. Environment Agency	I. Anderson	University of Surrey	B. Solberg-Johansen
Eur. Partners for the Envnm.	G. Larosse, E. Pretell	VTT	Y. Virtanen
Eur. Zinc Institute	F. van Assche	Wuppertal-Institut	H. Zieschang
National initiative	**Contacted person(s)**	**Working groups**	**Contacted person(s)**
Canada	A. Huseini	CEFIC	L. Cavalli (Enichem), F. Hirshmann (Unilever), C. R. Huertas (CEPSA), M. Stalmans (P&G), E. Souter (P&G)
France	V. Denby-Wilkes	SETAC Data Handling Group	D. Ceuterick (VITO), R. Clift (Univ. of Surrey), S. Dall'Acqua (EMPA), E.Eriksson (CIT), A. v. Dam (TNO), B.L. van der Ven (TNO), J.C. Vis (Unilever)
Germany 1 (UBA)	J. Reiche		
Germany 2 (IÖW)	F. Rubik		
Holland (TNO)	A. van Dam		
Italy (Ecobilancio)	V. Laflèche		
Japan	S. Suda		
Sweden (IVL)	L.-G. Lindfors		
Switzerland (EMPA)	K. Richter, M. Zimmermann		
US (Batelle)	K. Humphreys		

4 Key Issues

4.1 Paper vs. electronic format

Prior to the creation of an electronic data exchange format, all of the specific requirements of a common format need to be defined explicitly. In view of the differences between the various existing sources of data, these requirements have first to be defined on paper. Working on paper has several drawbacks such as layout restrictions, a maximum of two information levels (text plus footnotes), no ability to hide subordinate information, limits to the amount of data which can be managed, and the impossibility of automatisation. Electronic data management avoids layout restrictions by the use of pop-up menus and hypertext, and allows the automatic processing of large quantities of data. The electronic translation is therefore an indispensable step for the future data exchange network. However, it cannot be built until all of its requirements have been defined. Therefore, the format was first of all developed on paper.

4.2 Management of existing data vs. future data (descriptive vs. prescriptive approach)

The format should ideally fulfil a double purpose. Firstly, it should harmonise existing data to the highest extent possible and, secondly, it should serve as a possible standard for future LCI-data management. These seem to be conflicting objectives. A retrospective format has to be all-comprehensive, allowing the reporting of data from all existing studies with as much information as possible; while a prospective format would attempt to set one standard for data collection and reporting. A completely descriptive approach could undermine the initial goal of a *common* format, since it could potentially require revision to accommodate every new data set. A prospective format with pre-defined options for reporting the data, minimum documentation requirements, and appropriate data quality standards would provide good comparability between different studies. This would be enhanced by a presentation in a standard set of units. However, there is a danger that important information in the original data sources may be lost due to incompatibilities with such a pre-structured format.

At the beginning of the work, the first priority was the management of *existing* data. It was therefore decided not to start with complete prescription in the format. Instead, the issues relating to which information is needed are prescribed, but the way this information is provided is left open to description. The intention was to deliver an easily understandable structural backbone for the major facts without losing the individual properties of each data set. In the course of the consultation phase, the focus has switched more to an entirely prescriptive approach as the desire for a *future* standard method of data management became apparent, and consensus about the general idea of the format was achieved.

4.3 Management of unit processes vs. systems

To be widely applicable, data need to be collected and reported at a disaggregated level along the lifecycle, i.e. unit process data are required. It is only at the disaggregated unit level that all the basic information describing the data can be provided. Unit processes deliver the basis for transparency, and are a prerequisite for meaningful aggregations. In the context of the format, unit process data are those which represent a *horizontal* aggregation (= average) of similar unit operations (e.g. operated at different sites or by different companies). The aggregation of different activities (e.g. production and transportation; or, production and energy generation) will not be considered a unit process, even when these activities are only reported as a unit. These *vertical* aggregations will be called sub-systems.

There was a view amongst several practitioners that different formats would be necessary for unit processes and systems. The format was regarded as useful for the reporting of unit processes, but it was difficult to see how data on systems could be presented using the same format. However, the life-cycle inventory is almost a holistic structure, i.e. a part of the system (unit process), shows the same information needs as the more complex whole. Furthermore, a unit process may be broken down further into smaller unit processes, so that it becomes a system itself; or, a system might be used as a unit on a higher level. Therefore, the same format should be applicable for both unit processes and systems.

4.4 Aspects and dimensions of data quality

Data quality is one of the major fields of discussion in LCA. This article does not attempt to provide a comprehensive overview of all of the various arguments within the ongoing debate. However, an outline of some of the arguments which are relevant in the context of developing the format is warranted.

Data quality is intrinsically limited, since vagueness and uncertainty are inherent to all data. The acceptability of a particular level of vagueness or uncertainty depends upon the specific application of the data. What is important is that it must be possible to judge the relevance of the uncertainty, i.e. the influence of the uncertainty on the overall results of the LCA. The data quality of a unit process or of individual data records can be described with various quality indicators. A distinction can be made between *absolute* and *relative* data quality indicators. Absolute indicators reflect the inherent quality of a data set irrespective of its application. Such indicators include the references consulted, the collection method used, with its precision, and the method used to verify the data. Relative indicators describe the degree of system fidelity with regard to the content, scope, time, geography and technology level of the unit process data under consideration.

A sound discussion about data quality can only be held for transparent data sets. This is why the format advocates full documentation on a modular basis. Further details are given in the outline description of the format presented in the next section.

5 The Current Format in Outline

In this section, the format structure that has resulted from the technical testing and the external consultation is described briefly. More detail can be found in the report on the data format (SPOLD, 1996). Reference should be made to this report for a full understanding of the format and its rationale. In addition, as indicated in **Figure 1**, the format is continuing to be developed further and some changes to the detail can be expected, although the broad structure is likely to remain the same.

The format itself is broken down to five major parts. In the first three parts, *qualitative* information (= documentation) about the numeric data is given. These *qualitative* parts are crucial to the understanding of the validity and applicability of the *quantitative* data that will be given in the fourth part. The structure chosen is given in outline in **Table 2**.

Table 2: Main structure of the format

Part	Function
A	To present all relevant information about the identity of the data set (who did it? what was done? how was it done?)
B	To set out the model valid for the data set (what is included/excluded? which assumptions were made?)
C	To represent the data set graphically
D	To present the actual data
E	To list references

In parts A and B, crucial information about the applicability of the data set is given. These parts should therefore always be consulted in detail before the numeric data that follow in part D are used.

Part A: Identification of the data set

The structure of part A is illustrated in **Table 3**, which also includes example entries. It should be noted that these ex-

Table 3: Part A of the format – Identification of the data set

Part	Section	Field	Descriptor	Example entry (not all for the same data set)
A	General	A1	Reference code	oilincin.ipu (unit process of incineration of waste oil given by the Instituttet for Produktudvikling)
		A2	Record *(date, name, address)*	entry: 28/11/95, A Singhofen, SPOLD, Av. E Mounier 83, Box 1, B-1200 Brussels
		A3	Generator *(name, address)*	H Erichsen, IPU Life Cycle Centre, Tech. Univ., Bldg 403, II, DK-2800 Lyngby
	Function	A4	General reference *(title, editor, date)*	Ökoinventare für Energiesysteme, 1. Auflage. Bundesamt für Energiewirtschaft, Bern. March 1994
		A5	Category	electrical energy
		A6	Classification	not yet used – could be used for trade classification (NACE, PRODCOM)/chemical identity (CAS number)
		A7	Name	used lubrication oil incinerated
		A8	Unit of reference	1 kg
		A9	Time	1991
		A10	Geography	Denmark
		A11	Technology level	UCTPE average
		A12	Technology	standard incineration of all wastes except for hazardous and hospital wastes, all operations with flue gas cleaning (45 % wet and 55 % dry flue gas cleaning)
		A13	Representativeness	temporally: data come from different sources dating back to 1989 geographically: 100 %
	Source	A14	References	average data for all Danish incineration plants [Miljøstyrelsen, 1989]
		A15	Collection method	a weighted, qualified average from the varying number of sources for the data referring to each unit sub-system was estimated; these averaged unit sub-systems were then linked according to their output to calculate the aggregated total, including the main recursive system of feedback loops.
		A16	Verification	qualitative discussion of the data according to a judgement template with the following criteria: completeness, level of aggregation, credibility of the data source, estimations, uncertainty

ample entries are taken from different data sets, one of which is a unit process and the other of which is a system, and that they are given for illustrative purposes only.

Part A is sub-divided into three sections called *general, function* and *source*. The first section (**general**) starts with the reference code that attributes unique identity to each data set. This is followed by information about who put the data into the format (record) and about who carried out the data collection (generator and general reference).

In the second section (**function**), data fields are reserved for broad categorisation and professional classification of the process described in the data set, e.g. according to trade statistics (NACE, PRODCOM) or chemical identity (CAS number). In addition, there are fields for the unit of reference, time frame, geography, technology level and the technology valid for the process represented in the data set. The last data field of this section is intended to show how representative the data are for the stated time frame, geography, etc. This field is relevant to relative indicators of data quality, as described above.

The last section of part A (**source**) provides for background information about how the data collection was carried out. Information is requested about the references consulted, the data collection method used and the verification procedures performed. These three headings parallel the three aspects of absolute data quality described above.

Part B: System model

The main concern of part B of the format is to present the boundaries of the unit process or system. Its structure and contents are illustrated in **Table 4**. In this case, all of the example entries are from the same data set, representative of a system. Some of the fields are only valid for systems. This is the case for B1 and B4 – B6. In field B1 (sub-systems), the unit processes making up the system should be listed.

Cut-off rules and co-products, including their allocation rules, are relevant at both the unit process and system level and are given in fields B2 and B3.

The following three fields (B4 –B6) are designed to allow some general information to be provided about three, often

Table 4: Part B of the format – System model

Part	Field	Descriptor	Example entry
B	B1	Sub-systems	extraction + processing of hard coal from open-cast mining, off the mining site, coalexo.bew, BEW 1994, 50 % extraction + processing of hard coal from underground mining, off the mining site, coalexu.bew, BEW 1994, 50 % (...)
	B2	Cut-off rules	infrastructure of second order, office and administration requirements, noise
	B3	Co-products and their allocation rules	no co-products from conversion into electricity, refer to upstream unit processes
	B4	Energy rules	all electricity treated as if it were supplied by the UCPTE grid
	B5	Transport model	– typical transport distances are defined for basic materials (mainly used for construction of infrastructure), e.g. steel: 200 km by train, 100 km by truck, gravel... – detailed assessment of the actual transports for fuel materials – 50 % capacity utilisation assumed (except ship transport: empty trips are given separately)
	B6	Waste model	no allocations from recycling systems to production systems = no allocation of the energy reclaimed by recycling = no assessment of the disposal of those materials that are recycled => recycled material only assessed with the inputs/outputs related to recycling within the recycling system
	B7	Other assumptions	– area assessment: extent and duration are assessed (...) – accidents are assessed according to their frequency of occurrence in relation to the energy delivery (...)
	B8	Data parameterisation	no details

very important, parts of a system: the energy model, the transport model, and the waste model. However, providing this information should not be considered a substitute for providing data on the actual unit processes.

Finally, there is space for assumptions which have not been covered so far (other assumptions) and a field to indicate non-linear data relations (data parameterisation).

Part C: System structure

In part C, the unit process or system is represented graphically. The graphics that were developed for this purpose represent the present state of discussion and will be refined with the further development of the format. They are not like the common engineer's flow chart, but are intended to provide both a representation of the synthetic structure of the system *and* the way the data are reported. The graphics therefore reflect both the system and the data structure.

A nomenclature has been proposed for the resulting graphics. However, this is not described in detail because it is likely to change as the format is developed.

Part D: Data

Based on the context described in parts A and B, and the structure represented in part C, the numeric data follow in part D. These quantitative data are provided under three headings: inputs, outputs and mass/energy balances as shown in **Table 5**.

Within the inputs and outputs, a distinction is made between flows from/to the *technosphere* and flows from/to *nature*. LCAs are often referred to as cradle-to-grave studies. To establish this overall picture, it is necessary to be able to trace all flows back to natural resources and forward to emissions into nature. This can only be achieved if it is clearly reported whether incoming flow, x say, is a primary material or a material produced by another system, the contribution of which would then have to be added in a cradle-to-grave approach.

There is also the third section, *others*, which fulfils a double function. Some of the resources used cannot be easily accommodated within the concepts of technosphere and nature, e.g. the 'area of land used'. Furthermore, in some existing data sets, the distinction between the two may not be clear for some of the flows described, e.g. for 'waste water discharges' (to treatment or to a river?). Thus it is necessary to offer a default section in order not to lose data.

Data 1: Inputs

The actual data structure is best understood as a matrix *(→ Table 5)*. Top-down, the three sections (technosphere, nature, others) are given. The known inputs from the technosphere are further sub-divided into materials/fuels and electricity. Rather than distinguishing between materials and fuels, which can be very difficult, it is proposed to list them together and to give, where applicable, both the mass and the energy value, as they are the two aspects of the same thing. The *mass* unit, the *average* value and its *uncertainty* constitute the first group of columns of the horizontal axis of the matrix. The same structure is repeated for energy in the next group of columns with an indicator whether net or gross calorific values are given. A third group of columns at the very right of the matrix is reserved for *specific* documentations referring to each single record. This is an extension of part A which provides information

Table 5: Structure of part D of the format
(shading indicates box is not relevant for this particular section/sub-section)

Part	Section	Sub-section	Type of flow	mass unit	average	uncer-tainty	energy unit	average *net-gross*	uncer-tainty	source	additional
D	D1 Inputs	Known inputs from technosphere	Materials/fuels								
			Electricity								
		Known inputs from nature	Raw materials/ raw fuels								
		Other known inputs									
	D2 Outputs	Known outputs to technosphere	Products and coproducts								
			Wastes to treatment								
		Known outputs to nature	Emissions to air								
			Emissions to water								
			Emissions to soil								
			Non-material emissions								
		Other known outputs									
	D3 Mass and energy balances										

at a broader, more general level. Hence, there is a column called *source* (as in part A) to indicate the individual references, collection methods and verifications per piece of data and the column *additional* for specific qualitative information.

Data 2: Outputs

The same structure is repeated in the outputs, where two sub-sections for outputs to technosphere (products and co-products, and wastes to treatment) and four sub-sections for outputs to nature (emissions to air, water, soil and non-material emissions) are applied. For non-material emissions, the appropriate unit (e.g. Bq, dB) should be given in the energy unit column.

In the outputs, a further sub-division has been introduced to distinguish between actual substance parameters and indicator parameters. In principle, if actual flows are given in the inputs, the same should be done for the outputs, as a prerequisite for a mass balance. However, in practice, this is often not easy, if not impossible, and indirect parameters such as AOX have often been used instead. It needs to be made clear in the format that these are indicators only and cannot replace information about the actual flows. These indicators should be listed separately and are excluded from the balances.

Data 3: Mass and energy balances

The third section of part D allows any mass and energy balances which have been carried out to be reported. Due to the difficulties of setting up a complete mass balance, let alone an energy balance, it is not the intention that the input and output data should be added nor should the totals be compared with each other in the data format, unless the original data set contains such a partial or a complete mass/energy balance. The intention is only to record those mass and/or energy balances that have been carried out by the data generator, as they can provide a verification of completeness.

Part E: List of references

The format concludes with part E in which the bibliography of the references that have been used within the documentation of the sources (field A14) can be given.

5 Next Steps

In all of this work, SPOLD has seen its role as co-ordinating the work that already exists and building consensus about a common data format. The feedback received over the past year has indicated a high degree of interest, acceptance and support for the work. It has been pleasing to see a general agreement about the requirements for a common LCI format emerge. It will be important to ensure that this consensus continues with the further activities (illustrated in *Fig. 1*) leading eventually to a commonly accessible LCI data exchange network. SPOLD is concerned to avoid the development of incompatible, competing systems and will be seeking the widest possible involvement in its consensus-building approach.

The feedback from the consultation and the workshop was in favour of further testing and development of the format and, in particular, a multi-user test. A multi-user test, to explore whether the format is applicable to a wide range of processes and whether data generators interpret the format in the same way, is currently underway. A broad group of data owners is participating. It consists of two parts. Firstly, participants are being asked to enter at least one data set (chosen to provide a good test for the format) from their own data into the format. This will serve to check the broad applicability of the common format to different kinds of original data. At the same time, it gives the participants hands-on experience with the format, which could trigger specific proposals for improvement. Secondly, participants are being asked to enter two *specific* data sets (one for a unit process and one for a system) *selected by the PSP* working group. The entering of the same data set into the format by different people should help to check and improve the consistency of the format. It should also help to further improve the explanations and use instructions provided with the format.

In addition, in preparation for such a multi-user test, the following developments of the format are already underway:

1. First of all, the format is being developed with prescriptive options for field entries. In spite of their 'constraining' character, conventions are considered helpful tools: 'pre-thinking' of the required information facilitates the data entry, since it helps to clarify what is required. Multiple-choice options are being defined for the data documentation fields. The most commonly encountered situations will be listed and an open option will still allow the inclusion of situations not explicitly listed.
2. Another major step towards data standardisation is the creation of a standard dictionary. For the sake of data compatibility, it would then be useful to establish a minimum list for the reporting of input, and especially output, flows, based on this standard nomenclature.
3. Testing should then be followed by the translation of the format into an electronic form on the basis of an appropriate database software. This electronic format with some sample entries will then deliver the foundation for the data exchange network, based on distributed databases (operated by various data owners) that are joined together by a common search mechanism and a universal data exchange interface (based on the electronic format).
4. In addition to these technical considerations, it will be vital to continue to build a consensus. It will be of prime importance to maintain the dialogue with all interested parties at every step of the process. The development of such a data exchange network is a major task: it will require both broad support and a substantial financial basis.

6 Postscript

Following the multi-user test, which culminated in a workshop in Taormina in May 1996, the format has been further developed to take account of the lessons learned. The focus is now on developing an electronic version. Specifications for such an electronic version were presented and discussed at a workshop in the Netherlands on 5 November 1996.

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Members
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