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Draft final report of the LCM definition study

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UNEP/SETAC Life Cycle Initiative

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1. Introduction

Life Cycle Management (LCM) is for integration of the life cycle perspective and economic, social and environmental considerations into the overall strategy, planning, and decision-making processes of organizations concerning their product portfolio. The LCM framework refers to managing the total life cycle performance of goods and services in order to promote more sustainable production and consumption. LCM can be used for industrial organizations and others that require a system-oriented platform for implementing a preventive improvement and sustainability-driven approach to managing product systems. LCM can help business to comply with or more easily overcome future requirements arising from product-oriented governmental policy making such as integrated product policy (IPP) and extended producer responsibility (EPR).

The overall objective of the Life Cycle Management Program is to develop a strategic framework to assist industry in reaching a more sustainable product development, production and use of products. In the same time that framework will help governments developing policies for more sustainable production and consumption. In line with this goal, the program intends to educate relevant stakeholders about the value of a systems and life cycle perspective for decisions and decision-making processes, such as policy making, corporate strategy development, product design, production changes, purchasing and marketing.

The program aims to provide practical guidance for integrating various life cycle based concepts and tools for more environmentally friendly products and services into general environmental management practices and decision making. In addition to the traditional environmental considerations, the program will recommend best practices for integrating socio-economic aspects of sustainability into decisions and decision-making processes from a life cycle perspective. Wherever possible, relevant and meaningful indicators for all three dimensions of sustainability (i.e., economic, environmental and social) will be examined and recommended for use, to allow for internal, as well as external comparability, such as for benchmarking. Finally, based on the underlying multi-stakeholder approach, communication strategies applicable for life cycle information will be examined.

In this document LCM is described as a framework based on life cycle thinking with associated concepts and tools - e.g., eco-efficiency, product stewardship, Life Cycle Assessment (LCA), Life Cycle Costing (LCC) and supply chain management.

The UNEP/SETAC Life Cycle Initiative was officially launched in April 2002 during UNEP's 7th International High-level Seminar on Cleaner Production, in Prague. It is a co-operation between UNEP's Division on Technology, Industry and Economics (UNEP DTIE) and the Society of Environmental Toxicology and Chemistry. The main aim is to bring sound Life Cycle approaches into practice. For the achievement of this overall aim, three programs are developed within the initiative.

The first program concerns Life Cycle Management (LCM). The second and the third program focus on LCA, the second program dealing specifically with Life Cycle Inventory (LCI) databases and methods, the third program with Life Cycle Impact Assessment (LCIA) data and methods. In addition, the initiative initiates joint activities that exceed the subject of the individual topic areas.

1.1 General Aims of the Life Cycle Management Program

Unlike LCA, LCM is still at an early stage of development, with no universally agreed-upon definition[1]. While this is clearly a weakness, it also presents, at the same time, a great opportunity: the Life Cycle Initiative is in a position to develop/refine a definition of Life Cycle Management that meets user needs.

LCM is an integrated framework for managing the total Life Cycle performance of goods and services towards more sustainable forms of production and consumption. It compromises both existing analyses (analytical tools, checklists, methods and techniques) and practice (policy/corporate programs, policy/corporate instruments, and procedural tools), and provides an opportunity for proactively managing the economic, social and environmental performance of products and services in an integrated manner.

The Life Cycle Management Program intends to educate all relevant stakeholders about the importance of a using a systems and Life Cycle perspective to inform decisions and decision making processes, e.g., policy making, corporate strategy development and product design, purchasing decisions and consumption. These stakeholders include organizations of all sizes and across all regions.

The LCM Program is of central importance to the goals of the Life Cycle Initiative, whose mission is to "develop and disseminate practical tools for evaluating the opportunities, risks, and trade-offs associated with products and services over their whole Life Cycle", particularly with respect to putting Life Cycle thinking into practice and positioning LCA among other tools and concepts, as well as for disseminating findings and developing training programs—the outreach piece of the initiative.

[1] However, the elaborations of the SETAC Working Group on LCM (Hunkeler et al. 2003) may serve as a basis.

The LCM program serves a double function: to help governments promote an integrated approach for changing unsustainable patterns of production and consumption and to stimulate industry in proactively meeting the challenges of sustainable development. — More concretely, the program intends to help companies implement and governments disseminate Life Cycle thinking and practices in the value-chain, by that providing input into the development of an overarching policy/corporate framework, and to encourage the development of centers for disseminating recommended practice and success stories and encouraging dialogue, training, and information exchange.

The Life Cycle Management Definition Study started with six original aims:

- LCM Aim 1—Identify needs for Life Cycle assessment and Life Cycle thinking;
- LCM Aim 2:—Discuss the different applications of Life Cycle assessment and Life Cycle thinking in business and policy decision making; identify examples of successful applications; identify success and failure factors; and provide guidance on using Life Cycle assessment and Life Cycle thinking;
- LCM Aim 3—Discuss and clarify the roles of the various analytical and procedural tools, both detailed and simple, in Life Cycle management;
- LCM Aim 4—Investigate opportunities for including the social and economic dimensions of products and services in Life Cycle assessment and Life Cycle thinking;
- LCM Aim 5—Discuss and clarify the relationship of the present Life Cycle initiative to other programs and initiatives;
- LCM Aim 6—Educate stakeholders on the uses or the importance of LCA and Life Cycle thinking in promoting sustainable development Life Cycle assessment and Life Cycle thinking.

1.2 Process Followed to Develop This Report

This draft report was prepared based on input from a series of different activities, including:

a) A user needs survey was widely distributed and published through the Life Cycle Initiative´s web site to allow input from stakeholders worldwide, in the form of proposals, suggestions and constructive criticism. The user needs survey was complemented with telephone interviews and discussions at numerous conferences, meetings and personal interactions.

b) The Life Cycle Management Program was formally introduced and discussed at seven international conferences and workshops on four continents. Two of these events dealt specifically with the LCM Program.

- 1st Life Cycle Management Workshop, Copenhagen, Denmark, August 2001
- Workshop of the Life Cycle Initiative, Tsukuba, Japan, February 2002
- ISO Workshop on LCM practice and user needs in the developing countries, Johannesburg, South Africa, June 2002
- ACE Study Mission LCM, Sweden, June 2002
- Life Cycle Management Workshop on the LCM framework and implementation success factors, Chicago, USA, August 2002
- World Summit on Sustainable Development (WSSD) Side Event on LCA/LCM in South Africa, Pretoria, South Africa, September 2002
- OECD Workshop—Chemicals Product Policy, Tokyo, Japan, September 2002
- Workshop of the Life Cycle Initiative on the LCM framework and user needs, Barcelona, Spain, December 2002
- Workshop of the Life Cycle Initiative at the SETAC Congress in Hamburg, May 2003.
- Workshop on Management and Stakeholder Responsibility along the Life Cycle, Seattle, USA, September 2003
- Plus other events and speaking opportunities, where important information could be exchanged with many different audiences.

c) A team of authors collaborated in drafting this report.

d) A peer review team under the leadership of Kevin Bradley provided an excellent feedback and helped improving the quality of the report.

e) An ongoing consultation with the executive committee and leadership of the LC Initiative.

1.3 Context: State of the Art

LCM is a relatively new approach that brings together different elements of long-term existing practice. LCM provides a unique opportunity to bridge the activities of industry and governments. One of the major challenges of the Life Cycle Management Program is therefore to further develop and refine a definition of Life Cycle management that is generically applicable, globally relevant, practice-oriented, technically valid, scientifically sound and accepted by all stakeholders.

Life Cycle Management (LCM) is life cycle thinking into practice. It is elaborated differently in different activity fields. The following examples show different uses:

- In the chemical industry, years of experience with product safety and risk assessment are used in conjunction with life cycle thinking, product stewardship and eco-efficiency to inform decision-making processes.

- In raw material industries, particularly in metals and mining, Life Cycle thinking is part of integrated material management strategies, and LCA is used in complementary to Substance Flow Analysis (SFA) and Material Flow Analysis (MFA).
- For durable consumer products, current regulatory pressures, such as end of life regulations in Europe, drive the application of Life Cycle thinking in conjunction with either recycling assessments, design for recycling or design for environment. In addition, material restrictions and supply chain management are used jointly with, or supported by, LCA.
- For capital goods and in the retail industry, life cycle thinking is often used with Total Cost Assessment or Life Cycle Costing.

Across many sectors, the following observations on the use of Life Cycle thinking can be made:

- Life Cycle thinking can also be found behind the day-to-day business activities and decisions of organizations. These include: The use of Life Cycle applications to support the formulation of corporate policy and strategy, the development of sustainability initiatives and the implementation of sustainability programs;
- The integration of Life Cycle thinking and tools into environmental management systems (EMS)—for example, product-oriented environmental management systems (POEMS);
- The integration of Life Cycle thinking and tools into environmental reporting—for example, green accounting and environmental reporting;
- The integration of Life Cycle thinking and tools into integrated management systems —for example, by combining quality, occupational health and safety, risk, environmental management into one system;
- The integration of Life Cycle thinking and tools into product design and development processes;
- The integration of Life Cycle thinking and tools into purchasing decisions and (public, retail and private) green procurement;
- The use of Life Cycle thinking and tools in communications programs, including marketing and product labeling and declarations;
- The use of Life Cycle thinking and tools in conjunction with total cost assessment or Life Cycle Costing approaches and financial accounting.

Finally, Life Cycle thinking and tools have a variety of applications in other existing concepts and programs such as:

- Sustainable Consumption

- Cleaner production;
- Environmental performance indicators;
- Integrated product policy;
- Extended producer responsibility;
- Product Stewardship,
- Industrial ecology;
- Corporate social responsibility;
- Resource productivity, dematerialization, factor 4-10;

1.4 Definitions on Life Cycle Management

Existing definitions for LCM show a great variety in expectations and experiences. The following definitions show the variety and breath:

LCM is a flexible integrated framework of concepts, techniques and procedures to address environmental, economic, technological and social aspects of products and organizations to achieve continuous environmental improvement from a Life Cycle perspective. LCM, as any other management pattern, is applied on a voluntary basis and can be adapted to the specific needs and characteristics of individual organizations

SETAC Working Group LCM, 2003 (Hunkeler et al. 2003)

LCM assures that the processes used across projects are consistent and that there is effective sharing and coordination of resources, information and technologies. This Life Cycle spans the conception of ideas through to the retirement of a system. It provides the processes for acquiring and supplying system products and services that are configured from one or more of the following types of system component: hardware, software and humans. In addition, this framework provides for the assessment and improvement of the Life Cycle.

ISO/IEC 15288 CD 2, 2000

LCM is business management based on environmental Life Cycle considerations.

Petersen, 2001

LCM is the extension of the technical approach towards cleaner products and production though amending stakeholder views, by communication and regulatory tracking.

Remmen, 2001

LCM is a concept of innovation management towards sustainable products, by supporting strategic decision making and product development.

Saur, 2003

2. What is Life Cycle Management?

2.1 Why Life Cycle Management?

Increasing globalization, revolutions in information technology, rapid process and product innovations and chaotic marketplace demands are changing and shaping the business climate of the 21st Century. Our understanding of the complexity of the social, political, economic, technical and environmental connections that underlie systems increases with each new discovery in science and technology.

The emerging business climate will demand improvements in current ways of working, but also, more significantly, shifts in how organizations deliver products and services to customers. Firms in many sectors are already using management systems and Life Cycle Thinking to understand and improve their operations, products and services. However, a more comprehensive and holistic approach to decision making is needed if we are to significantly reduce pressures on natural systems and improve our abilities to navigate the complex realities of the emerging business climate.

There are many potential benefits of moving toward more sustainable practices and integrating these efforts into core operations. For firms with a strategy aimed at complying with existing regulations, a system that identifies and tracks releases offers the benefit of reduced liabilities and fines. Other firms may identify opportunities for cost savings and greater efficiencies in the use of resources. For companies with sustainable business practices in place, the emergence of environmentally conscious consumers and public sector purchasing departments can generate increased revenues, enhance their reputation and brand value and, increasingly, earn them a more favorable position with market analysts. Some firms will identify product or service adjustments that improve customer satisfaction, while others that integrate full system considerations into their core operations will define new technologies and innovative change. Overall, integrating efforts into core operations and decisions will allow a more transparent cost structure and will avoid false starts and inefficient investments.

To realize these benefits, many organizations have started to address the environmental aspects of their operations and products by implementing environmental management systems and conducting Life Cycle studies. While these tools can achieve improvements and bring about some change, their scope is limited and they fall short of enabling organizations to realize sustained benefits from their efforts. Interactions with the environment do not occur in isolation and must therefore be considered in the decisions of all levels of an organization.

There is no single program or technique that provides a completely satisfactory answer with respect to improving the overall environmental performance of operations, products and services. However, for an organization to respond to the decision making challenges of the emerging business climate in an economically and environmentally sustainable manner, it must go beyond the current capabilities of existing environmental management systems and the Life Cycle information gathered on existing products. An approach that identifies economically viable and environmentally compatible solutions is needed.

A Life Cycle Management approach can address these needs and form the basis of an effective business strategy by providing a framework for improving the performance of an organization and its respective products and services. Decisions taken at all levels of an organization have an influence on the overall impact a product or service has throughout its Life Cycle. The framework therefore needs to be integrated into the decision-making processes of all levels of the organization—i.e., in marketing, purchasing, research and development, product design, strategic planning, corporate reporting and management.

Life Cycle management as a concept has been discussed and defined by many organizations in both the private and public sectors and in academia. While definitions may differ slightly, they share a number of elements, which help highlight what distinguishes Life Cycle Management from other concepts.

2.2 Drivers for Life Cycle Management

It is understood, that using Life Cycle approaches contributes to environmental protection and sustainable development, helping to overcome global challenges. Those challenges include:

- Concentrations of the greenhouse gases like carbon dioxide and methane continue to grow.
- Toxic substances (including heavy metals and persistent organic pollutants (POPs)) continue to accumulate in polar and other sensitive ecosystems.
- The Millennium Development Goals state as targets for 2015 to halve the proportion of people living on less than one dollar a day, and to reduce by half the proportion of people without access to safe drinking water.

- The improvement in efficiency per unit of production has been offset by an increase in the volume of goods and services consumed and discarded.
- At current patterns of consumption and population growth, by 2100, we will need the resources of four planets to sustain us at decent living conditions.

In 2002, at the World Summit on Sustainable Development (WSSD), Governments called for decisive action to reverse these critical social and environmental trends. Doing so will require addressing underlying unsustainable patterns of consumption and production, as recognized in the third chapter of the WSSD plan of implementation. Thus governments were asked to promote:

- "Fundamental changes in the way societies produce and consume (…); indispensable for achieving global sustainable development",
- "The development of a 10-year framework of programs in support of regional and national initiatives to accelerate the shift towards sustainable consumption and production patterns that will promote social and economic development within the carrying capacity of ecosystems."

The LCM program is supposed to support UNEPs and broader efforts in achieving the above.

More specifically for LCM the following challenges will be center for the work program:

- How to link environmental and social improvements with business benefits?
- How to design policy programs and corporate efforts successfully?
- What are the most appropriate tools and approaches for different questions?
- What are capabilities needed?
- How to avoid false starts?
- Which incentives are required?
- What are the "right" leveraging points in the individual systems?
- Etc.

Many factors can influence an organization to consider environmental improvement and to develop clear policies, implement tools and structure programs that integrate LCM into their core operations.

Externally, these include legislation, as well as public pressure for many industry sectors. A public demanding accountability drives firms to improve stakeholder relations and their reputation with non-governmental organizations. Beyond their physical boundaries, firms are driven from one end of the

product chain by customers who demand environmentally superior products and from the other end by suppliers who may also impose environmental requirements.

Internally, a business striving for increased operational and resource efficiency may see in sustainability a business strategy for realizing these goals. Leading companies may undertake initiatives to increase market share and enhance their potential for innovation. More conservatively, internal drivers may include reduced fines and decreased liabilities, as mentioned previously.

Market: The market will also help drive the implementation of a Life Cycle Management framework. In terms of opportunity, the market offers significant advantages to firms that are the first to move on these issues. Increasingly, leading companies are linking Life Cycle Management initiatives to increased market share and innovation.

Public procurement policies can be very specific about systems for environmental management, materials content of certain products, as well as the sourcing and disposal practices of the firms they buy from. Product information, including consumer information tools and environmental labels, act as a driver for improved sustainability in certain product groups and service sectors.

Companies are increasingly driven to improve their environmental performance from both ends of their value chain; by customers at one end who are looking for environmentally superior products and, from the other, by suppliers who may also impose environmental requirements. As companies integrate environmental considerations into their product development processes, they must begin to involve actors up (and down) the product chain. Companies that supply components and systems and those that deal with the use and disposal of products find their environmental work driven by other actors in the system. To avoid playing 'catch-up' with a response-driven approach, firms are best to use an integrated, comprehensive, Life Cycle approach to manage their environmental impacts together with more traditional cost-driven supply chain management efforts.

Management: Institutional factors can play at least as important a role as technical factors in reducing the content of hazardous substances in products. In the case of product design and development processes, for example, design decisions take place within the broader corporate management structure, and a formal environmental management system with a policy, goals, performance measures and strategic plan that support environmental improvements will be a driver for successful integration of environmental performance concerns. LCM offers a framework that allows management to organize and align the various tools in such a way to exploit the synergies and interrelations between them.

Financial Sector: Increasingly, investors, insurance companies, banks and ranking institutions are driving firms toward sustainability and product Life Cycle optimization. Traditionally, investors look for funds with calculated risks and some level of predictability. As the characteristics of the business climate change, firms that do not have a comprehensive approach to understanding and managing their environmental and social impacts on the system in which they operate will be viewed as a bad-risk investment. This tend can be seen in the emergence of sustainability indexes such as the Dow Jones Group Sustainability Indexes and the FTSE4Good, which use social, economic and environmental criteria to assess and rank the sustainability of listed companies. While such ratings do not yet include a full Life Cycle perspective, there is a clear indication that this is a development to come.

Using the same logic, insurance companies are beginning to charge higher rates to companies who, for one reason or another, appear to be a greater risk in terms of their environmental or social performance, both of their operations, and their whole value chain and products.

Legislation: Today, there are existing regulations that target substances of concern, pending regulations targeting specific products and increasing policy emphasis on the sustainability of services and product service systems. Perhaps most well known are the EU directives on end-of-life vehicles and on waste electronics along with similar policy initiatives at the national level. While the ELV and WEEE directive stem from a waste prevention background, they use a product perspective, though only focus on the end-of-life phase rather than on the complete life cycle. Public procurement efforts, such as the Environmental Preferable Purchasing program in the US or other Green Procurement initiatives clearly are using a Life Cycle perspective, some specifically mention LCA and LCC.

The focus is on producers because they have the greatest knowledge and ability to adapt product design to proactively improve their environmental performance and meet legislated requirements. The existing regulatory framework also acts as a strong driver for firms to consider the environmental impacts of their operations, products and services. Liability for exceeding local air quality emissions limits, for example, can result in fines and, even licensing restrictions and costs. The threat of retrospective liability makes a clear case for a proactive Life Cycle management approach to understand all aspects of the organization and ensure Life Cycle information is available for decision making at all levels.

2.3 LCM Framework

LCM is being positioned as a framework that builds on existing structures, systems, tools and information. LCM is not meant to replace existing concepts, tools and programs, but rather offer a novel approach for improving the application of different systems, processes and tools. Figure 1 depicts the LCM framework.

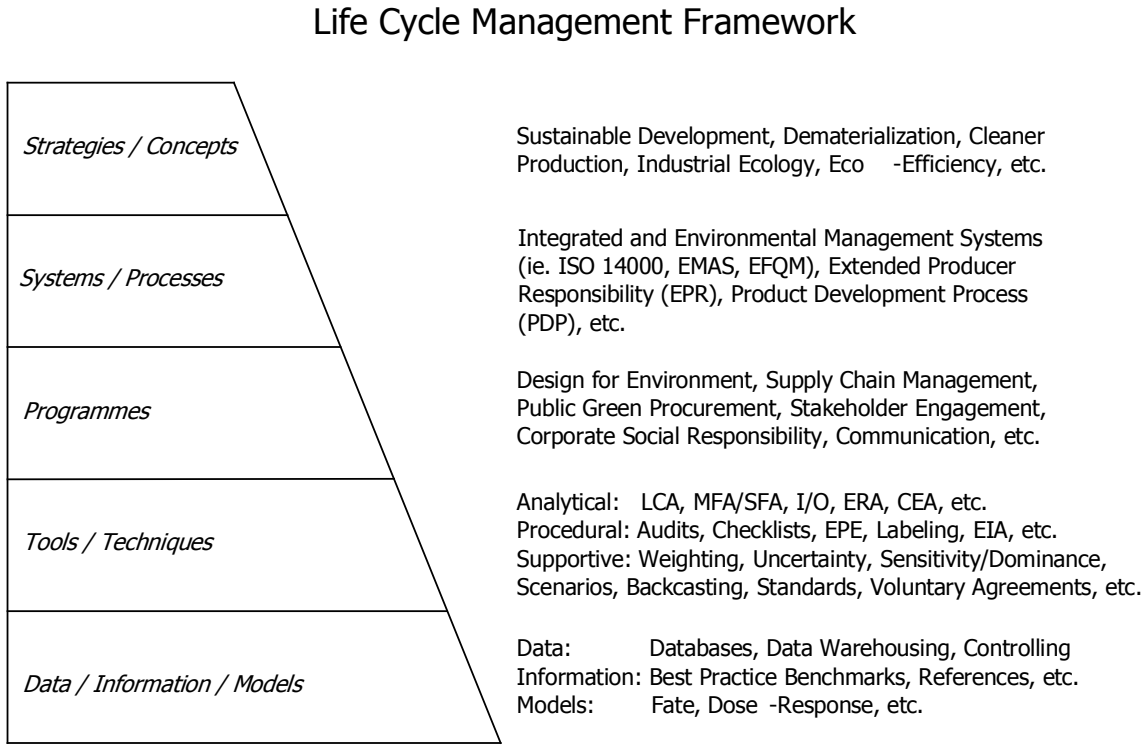

Figure 1: LCM Framework

To integrate environmental considerations into their everyday decision-making processes companies use various approaches and techniques. Environmental approaches and techniques can be described as operating at a management system level, a program level, or a technical level.

Companies can deploy each of these systems, programs, and tools in different ways. What follows is a description of some of the more common management systems, programs, and tools that are used to support environmental decision-making.

The toolbox for LCM needs to include both analytical and procedural tools. In this context, interfaces and recommended practice must be defined, when tools are used in conjunction with LCA (parallel or

sequential). This must build on an assessment of scientific background and the use of those other tools, including:

Procedural concepts, systems, programs and tools:

- Environmental management systems (EMS);
- Specific audits, certification, standards;
- Environmental accounting;
- Design for environment;
- Environmental labeling;
- Environmental impact assessment (EIA);
- Environmental reporting;
- Product stewardship;
- Extended producer responsibility.

Social and economic analytical concepts, programs and tools:

- Life Cycle costing (LCC);
- Total cost of ownership (TCO);
- Input-output analysis (IOA);
- Cost-benefit analysis (CBA);
- Stakeholder expectation analysis;
- Corporate social responsibility (CSR);
- Social accounting.

Environmental Analytical concepts, programs and tools:

- Life Cycle assessment (LCA);
- Input / output analysis (IOA);
- Simulation / modeling techniques;
- Environmental risk assessment (ERA);
- Substance flow analysis (SFA);
- Material flow analysis (MFA);
- Cumulated energy demand (CED);

- Environmental monitoring;
- Full cost accounting.

Communication programs and tools:

- ISO Type III labels (environmental product declarations);
- ISO Type II labels (environmental claims);
- ISO Type I environmental labels;
- Environmental reporting;
- Environmental certifications.

2.4 User needs

Based on the general aims of the LCM Program as laid out in the terms of reference of the LCM Definition Study, a user needs assessment was conducted. The existence of many different possible definitions for LCM mirrors the widespread expectations of what LCM should be. Definitions range from a pure industry implementation approach to integrated supply chain management with a major focus on product and service. Beyond those definitions, the governmental dimension, including integrated product policies and extended producer responsibility, needs to be included in the overall architecture.

Based on the user needs survey and ongoing additional consultations with stakeholders, LCM should build on existing environmental and socio-economic tools as described above.

The user needs survey confirmed the existence of strong drivers towards product orientation and the need for a paradigm shift from an end-of-pipe, single media, single substance and single site oriented environmental protection approach to a proactive innovation and preventive approach focusing on product, services, both in policy formulation and corporate strategies.

Life Cycle Management is at an early stage of development, at least as far a formal definition and harmonization of methodological approaches are concerned. Life Cycle management is increasingly being applied in business and policy making circles, although different names are used to describe what the LCM framework covers. It may very well be that LCM will remain an umbrella concept and that different tools, procedures and management systems will emerge under this umbrella. Based on results of the user needs survey and the experience of the draft author team and other stakeholders in the Life Cycle Initiative, a number of conclusions can be made:

- There is a need to link LC-related tools with procedural approaches, such as management systems, the product development processes, etc. The management of products and services along their whole Life Cycle has been identified as a key need.
- Consequently it is critical to understand and manage the interests of all stakeholders along the Life Cycle.
- There is a desire to link corporate and governmental strategies with communications tools, such as reporting, labeling, third party certified best practice (e.g., Forest Stewardship Council and Marine Stewardship Council).
- The key leverage point towards better products and services clearly is the product development process, that needs to be focused on the whole product Life Cycle.
- There is a need to develop performance-based approaches to stakeholder communications, and to better understand and manage stakeholder expectations.
- There is a need to develop and make available training materials and case studies. One major deliverable should be a reference publication, describing notable practice and successful implementations of Life Cycle Management.

The user needs survey and interactions with the user community suggested also a practical approach for implementing the LCM framework:

The field should be defined more precisely and address the questions: *Who are key players in LCM?* And *What are key enablers for LCM?* Understanding which actors have influence and control will allow possible areas for interaction and implementation to be identified.

- A suggested process for implementation is to use existing best practice case studies on specific sectors/products.
- Social and economic considerations are key in the overall sustainability discussion. In the beginning, the major focus of the LCM program will, however, be the environmental dimension. Economic aspects and social considerations will be added over time as knowledge becomes accessible.

3. LCM Programme Topics

Based on the results of the user needs study and discussions at two international workshops on Life Cycle Management, a program of actions has been identified for LCM over the coming years.

Task forces will be established for specific deliverables, such as: the organization of a workshop; the writing of a report; or, the development of an information system. This implies that task forces will be installed for a limited period of time, in line with the deliverable in question. Here the expertise in the given field specifically counts, and it will also be necessary to ensure an acceptable regional and stakeholder balance. The number of members will have to be adapted to the task at hand.

It is envisioned that theme champions and supporting teams will be essential to ensure consistency and derive the general results and findings. Since workshops may be the primary delivery route, a strong set of rules and procedures will be important in order to guarantee broad participation, participation of the theme leaders, and overhead financing of cross-functional efforts. These rules of procedure and participation will be established and agreed by the ILCP.

Context wise the following aspects serve as key guiding principles for the LCM program:

- Definition of LCM: not too critical today to have a final definition, this is work in progress; the practical implementation is a key objective.
- Important aspects are the systems/Life Cycle perspective, the triple bottom line approach sustainable development), keeping things at a practical level and supporting better decision making in government and industry.
- Overall guiding principles include scientific credibility, demonstrated applicability and successes, relevance, and accessibility.

While LCM can have strategic relevance, particularly in corporate strategy formulation and policy development, it is felt that, for the time being, the majority of applications and the major needs lie in implementing a systems perspective.

Priority Themes

Based on the level of stakeholder interest, resulting from the user needs survey, the workshops and communication with interested parties, five priority themes have been identified for immediate work. These are described below.

- Topic Area 1—**Life Cycle based product development:** Innovation of products and services: the role of Life Cycle thinking in product development, innovation, including approaches such as Design for Environment (DfE), product to service, product service systems, etc.;
- Topic Area 2—**Communication of Life Cycle information**: labeling, product declarations, reporting, certifications;
- Topic Area 3—**Management along the Life Cycle:** Product-oriented environmental management systems (POEMS), supply chain management, material data sheets and restrictions, procurement;
- Topic Area 4 —**Stakeholder responsibility along the Life Cycle:** stakeholder analysis, product stewardship, extended producer responsibility programs;
- Topic Area 5—**Capacity building** for developing countries and small to medium sized enterprises.

Two additional themes were identified as being of key importance in the near future:

- Integration of economic aspects, tools and interfaces with LCM
- Integration of social aspects in LCM

Annex B describes these priority areas of interest in greater detail. The description of the theme includes typical drivers and challenges, provides insights into promising approaches and gives an overview on needs for related stakeholders.

4. Work Plan

The LCM Definition Study identified the need for six Task Forces under the LCM Program. All task forces support the overall objectives of the LC Initiative and have particular relevance for the aims set forth for the LCM Program in particular. The six suggested Task Forces are:

- LCM TF 1: LCM Handbook
- LCM TF 2: Life cycle based product development
- LCM TF 3: Communication of life cycle information
- LCM TF 4: Management along the life cycle
- LCM TF 5: Stakeholder engagement along the life cycle
- LCM TF 6: Development of Training materials on LCM

The general and specific needs for Life Cycle Thinking and Life Cycle Management will be a core element of the LCM Handbook, where motivations, success factors and drivers will be discussed in greater detail. Specific needs for a life cycle perspective will also arise in the task forces on product development and managerial approaches along the life cycle. In the same way, the handbook will discuss and position possible applications of LCM with the larger toolbox, as laid out in the LCM definition study. Finally the handbook will provide important input into developing training material and contribute to capacity building.

Task forces 2, 3 and 4 will, opposite to task force 1, 5 and 6, be more focused on developing analytical input into the development of the LCM framework. Task force 5 is more of educational and dissemination nature. Task force 6 will focus on the development and dissemination of training materials it is related to LCM.

All task forces are closely linked. Information exchange and mutual input is critical. Task Force 1 requires input from task forces 2, 3, 4 and 5 in order to achieve the objectives. In the same way, task force 6 requires input from all other task forces, be if on a conceptual level, case studies of references. Since training will build on the other LCM task forces, all aims play a decisive role in assembling deliverables. The task forces are not stand alone efforts, but require a high degree of coordination and planning. The overarching elements for all task forces is the LCM framework. All efforts centre around the framework and position tools and approaches within.

It is therefore suggested to assemble a steering committee for the LCM program, consisting of the task force leadership and the LCM program leadership. An external advisory board may complement and guide these efforts.

4.1 LCM Task Force 1: Life Cycle Management Handbook

LCM is a rather new concept, but product oriented policies and corporate strategies have already successfully been used to meet emerging challenges and explore opportunities towards more sustainable patterns of production and consumption. LCM offers a promising platform for linking existing strategies, concepts, programs and tools to meet broader stakeholder, market and societal needs. The handbook will describe the links within the different tools and discuss how they can become mutually reinforcing. The handbook will also discuss success factors and provide insights in paths forward to implement life cycle thinking within organizations, both private and public.

The task force will become effective in 2003, and will conclude with the presentation of the final draft handbook, ready for publication.

By beginning of 2004, a draft outline of the handbook will be presented to the program and initiative leadership. Herein included are contributions for other task forces, that supply state-of-the art descriptions of their respective fields. The draft handbook will be completed by June 2004.

4.2 LCM Task Force 2: Life cycle based product development

The integration of environmental and life cycle related information in the product development process is being viewed as one of the most promising approaches to change products and service systems towards improved environmental performance. The predominant emphasis is on the continuous improvement mode, opposite to step-change improvements through system change. This theme is dealt with separately under the UNEP Eco-Design manual effort. It is however important to provide explore linkages between both activities.

The task force will become effective in 2003. The term of the task force is foreseen to be active for two years. Depending on user needs, the term may be extended.

The task force will become effective December 2003, at least in an inaugural state. Addition members will be added over time. The first major work package is the development of a respective input into the LCM Handbook.

- By October December 2003 provide a first draft chapter in the LCM Handbook covering the following issues:
    - Drivers: Why, for whom?
    - Actors: Champions, content shepherds, roll-out
    - Definitions, existing standards and references
    - Role of different market actors and stakeholders; what is difference between actors and market actors; put them together
    - Critical success factors: incentives, organizational challenges, knowledge barriers, Capabilities required
    - Concepts and tools used; e.g.: level of improvement
    - Clarification of different approaches: DfE, Ecodesign, Step-change improvements vs. continuous improvement.
    - Positioning in an organization, organizational issues Data and information needs
    - Benefits, business case
    - Illustrative examples
- By April 2004 provide content support, organizational support and a report from the tentative DfE workshop with ABB on DfE to be held in Sweden 4th quarter 2003 or 1st quarter 2004
- By the 3rd or 4th quarter 2004 organize, support and document a further workshop

Foreseen deliverables beyond 2004:

- Report on recommended practice on the integration of environmental aspects into product development
- Monitoring possible international standardization efforts in the field
- Organize further workshops for information collection and outreach in different regions

4.3 LCM Task Force 3: Communication of life cycle information

The task force will position the existing tools and identify the best options to initiate changes of consumption and production patterns. In particular the task force will examine the mutual reinforcement amongst the tools and within the larger LCM framework, specifically within management systems, with other tools.

Communication of life cycle information is one of the key approaches discussed in industry and in the public sector to promote sustainable patterns of production and consumption. Communicating to the different stakeholders, including the value chain actors, regulators, opinion leaders, consumers, NGOs, is a critical success factor to stimulate the supply and demand for innovative products and services. Different approaches have been developed and introduced successfully, including environmental labels (ISO type I labels), environmental claims (ISO type II labels), product declarations (ISO type III labels such as EPDs) and environmental certifications (such as FSC, MSC).

The task force will become effective in September 2003. The term of the task force is foreseen to be active for two years. Depending on user needs, the term may be extended.

The task force will concentrate its activities around two major themes of interest:

- Role and abilities of communication tools?
- Target audiences and respective needs
- Links of communication with other processes
- Role of tools

Deliverables

- By October December 2003 provide a first draft chapter in the LCM Handbook covering the following issues:
  - Drivers: Why, for whom?
  - Definitions, existing standards and references
  - Positioning of the different tools
  - Role of different market actors and stakeholders; I think it is important to may a clear distinction between business-to-business information; information to retailers; and information to consumers;
  - Critical success factors: incentives, organizational challenges, knowledge barriers, capabilities required;
  - Concepts, Tools used, description of the toolbox
  - Positioning in organizations and in public policy
  - Benefits, business case

    - Illustrative examples
- By October 2003 provide content support and a report from the Type III workshop in Sweden
- By the 3rd quarter 2004 organize, support and document a further workshop

Foreseen deliverables beyond 2004:

- Report on recommended practice on the communication of life cycle information
- Monitoring possible international standardization efforts in the field
- Organize further workshops for information collection and outreach in different regions
- Reach out to public and private sector initiatives

4.4 LCM Task Force 4: Management along the life cycle

Management along the life cycle is to approach and apply Life Cycle Thinking from the management system point of view i.e. using 14001 and 14004 but also other standards if appropriate e.g. ISO 14031 on indicators together with GRI indicators (for environmental reporting!) which are presently being discussed in conjunction with Global Compact, can be seen as check lists of potential environmental and other sustainability aspects to be included in a life cycle oriented management system (sometimes referred as Product-Oriented Environmental Management System); and from the life cycle perspective especially EMAS II with the unique (in many ways) list of indirect aspects should also be included. Another approach for the TF 3 will be the integrated management systems approach combining quality, environment, OHS, social accountability and other issues in the same management system and also integrated with the business and strategy circles of the organization.

In particular for the private sector, management systems and business processes are key elements to achieve business goals, objectives and targets. Integrating environmental aspects together with elements of quality or more recently social issues has successfully been guided by implementation of international or national standards for environmental and quality management systems, such as ISO 14000 and ISO 9001, in many industries. In Europe, similarly EMAS is playing a key role and especially by adding indisputable legal compliance, employee involvement and public outreach by the verified environmental statement.

Presently, the number of industries using certified environmental management is below 1% and the application of the standards (e.g. ISO 14001 and EMAS) do not exceed 5% of the industries. Using a life cycle approach and integrating product-oriented management might turn out to be a framework to

related and motivate more companies and other organizations in product and value chains to embrace environmental and other sustainability aspects.

The task force will become effective in October December 2003. The term of the task force is foreseen to be active for two years. Depending on user needs, the term may be extended.

The task force will become effective December 2003, at least in an inaugural state. Addition members will be added over time. The first major work package is the development of a respective input into the LCM Handbook. Further on the task force will look into the following:

- Organization and moderation support for a workshop to be held in the second or third quarter 2004.
- Planning of a further workshop needs
- Development of a report on the state of the art

The task force will close link its activities with the leadership of the LCM program and align its activities with the other task forces. The leadership of the task force will represent the theme in a LCM program steering committee.

Deliverables

- By December 2003 provide a chapter in the LCM Handbook on the management system options and barriers to Life Cycle Management; preliminary list of content elements:
  - Drivers: Why? Places to intervene with the systems?
  - Actors: Champions, content shepherds, roll-out
  - Definitions, existing standards and references
  - Critical success factors: incentives, organizational challenges, knowledge barriers, capabilities required
  - Discussion of existing approaches
  - Positioning in an organization, organizational issues
  - Benefits and barriers for business and society
  - Illustrative and practical examples
- By July 2004 provide content support, organizational support and a report for a tentative theme workshop

Foreseen deliverables beyond 2004:

- Organization and documentation of a second thematic workshop
- Report on recommended practice
- Monitoring possible international standardization efforts in the field
- Organize further workshops for information collection and outreach in different regions

- Reach out to public and private sector initiatives

4.5 LCM Task Force 5: Stakeholder engagement along the life cycle

Three elements relating to stakeholder responsibility along the life cycle of products therefore need to be explored – the roles and expectations of different stakeholders; their information requirements and the processes and tools by which this information is gathered and transmitted or communicated.

Life cycle thinking in practice requires the involvement of multiple market actors and related stakeholders. One of the most important challenges has been the management of product life cycle impact along the value chain. Consistency and alignment of information flows, overall environmental objectives and a fair distribution of collectively achieved economic advantages characterize one of the fundamental challenges for applying Life Cycle Management. On top of this, seeking and finding alignment with other market actors, including particular consumers; e.g. retailers, but also regulators is critical to achieve business benefits and remove barriers. In order to optimize our present systems of production and consumption, the management of product life cycle impact is critical.

The task force will become effective in September 2003. The term of the task force is foreseen to be active for two years. Depending on user needs, the term may be extended. The task force will work closely with Task Forces 2 and 3 where appropriate.

Work program and work process:

The overall nature of this task force is the provision of illustrative cases and success factors. The task force will primarily look into opportunities for gathering success stories and develop adequate meeting and information gathering. Workshops, study missions, and interviews may become preferred routes.

Expected 03 / 04 deliverables:

- In September 2003 support and help organize a workshop on LCM in association with the INLCM Conference in Seattle;
- Organize and document a study mission by End 2003 to assemble practical solutions and identify fruitful approaches to demonstrate stakeholder responsibility along the life cycle;
- By October 2003 provide a draft in the LCM Handbook/Guidance covering the following issues mentioned above;
- By the 3rd or 4th quarter 2004 organize, support and document a further workshop.

Foreseen deliverables beyond 2004:

- Report on recommended practice
- Communicating to relevant public sector bodies
- Reach out to public and private sector initiatives

4.6 LCM Task Force 6: Life cycle training material

LCM and life cycle thinking seem to be very adequate approaches to support the promotion of more sustainable patterns of production and consumption. A critical capacity need is the overall understanding of the life cycle perspective and the development of a respective capacity on a global basis. Capacity building refers to large and small and medium sized companies in all parts of the world. It also refers to capacity building in academia, governments and non-governmental organizations.

The task force will start as soon as funding becomes available and the other task forces have provided sufficient input, so that a work program can be developed.

As of today, no detailed work plan exists. Activities have to be planned including the following considerations:

- To whom to communicate?
- In which form?
- Capacity building efforts include:
    - Workshops
    - Case studies
    - Reference materials
    - Train-the trainers events

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Glossary

Activity based costing (ABC)—A cost accounting methodology that breaks down the activities (ie functions) that go into producing an organization's output and then allocates the costs that are not directly variable with output volume according to the activities.

Corporate social responsibility (CSR)—Corporate social responsibility is the commitment of business to contribute to sustainable economic development, working with employees, their families, the local community and society at large to improve their quality of life (WBCSD).

Cost-benefit analysis (CBA)—Cost-benefit analysis is a macro-economic tool for determining whether or not the benefits of an investment or a policy outweigh its costs. The tool has a very broad scope and aims at expressing all positive and negative effects of an activity in a common unit, namely money, from a social, as opposed to a firm's point of view. Usually whole production and consumption systems are examined. Thus, in a world of perfect markets, costs and benefits would indicate to any decision maker every relevant information for economic welfare. Economic and environmental elements are likewise expressed in monetary values – as far as possible and depending on the level of detail. In terms of methodological steps CBA involves first of all a determination which costs and benefits are examined, then tries to identify these costs and benefits and finally weighs them against each other. Latest developments point out that CBA is more and more used as appraisal methodology for overall public regulation.

Cumulated energy demand —see CERA

Cumulative energy requirements analysis (CERA)—Cumulative energy requirements analysis (CERA) states the entire demand valued as primary energy which arises in connection with the production, use and disposal of an economic good (product or service) or which may be attributed respectively to it in a causal relation. This energy demand represents the sum of the *Cumulative Energy Requirements* for the production CERA), for the use (CERA) and for the disposal (CERA) of the economic good.

Disability adjusted life years (DALYS)—The summation of healthy life years lost due to disability and mortality. Life years lost due to disability are computed by adjusting age-specific life expectancy for loss of healthy life due to disability. The value of a year of life at each age is weighted, as are decrements to health from disability from specific diseases and injuries and future life years are discounted (Gold, etal, 1996).

Design for environment (DfE)—In DfE, all environmental considerations in the whole Life Cycle of the product are taken into account. Design for the environment can be defined as: *systematic consideration of design performance with respect to environmental, health, and safety objectives over the full product and process Life Cycle* (Fiksel, 1996). Sustainable product design (SPD) is sometimes referred to as

going one step beyond DfE. While DfE focuses on the redesign of existing products SPD also investigates the possibilities of function and system innovation.

Duales System Deutschland (DSD)—Also known as the German "Green Dot" system, this is an extended producer responsibility program that makes producers and distributors of packaging responsible for establishing and maintaining a system to take back wastes associated with their products.

Eco-efficiency—The term eco-efficiency was introduced by the Business Council for Sustainable Development (BCSD, 1993), now World Business Council for Sustainable Development (WBCSD). It is defined as follows: "Eco-efficiency is the delivery of competitively-priced goods and services, that satisfy human needs and bring quality of life, whilst progressively reducing ecological impacts and resource intensity throughout the lifecycle, to a level in line with the Earth's estimated carrying capacity". Eco-efficiency has become a synonym for management philosophy towards sustainability, in short eco-efficiency means producing more from less. Eco-efficiency as a concept can be applied as a practical approach, and quantified performance indicators for production and consumption processes can be calculated according to the general formula: *Eco-efficiency = Environmental impact/Costs*.

Environmental audit—In the 1980s, the first environmental auditing programmes began on a voluntary basis, adapted from the well-established auditing procedures in quality audits. Environmental audit has become part of the ISO 14.000 series and can be seen as a checking of the environmental management systems (EMS). ISO 14010 sets out the principles and rules for an internal or external auditing of an EMS, including qualification criteria for the auditors.

Environmental accounting—(1) National accounting: physical and monetary accounts of environmental assets and the costs of their depletion and degradation. (2) Systematic, documented verification process of objectively obtaining and evaluation audit evidence to determine whether specified environmental activities, events, conditions, management systems, or information about these matters conform with audit criteria, and communicating the results of this process to the client [ISO 14001].

Environmental impact assessment (EIA)—A technique used for identifying the environmental effects of development projects. An EIA requires a scoping study to be undertaken in order to focus the assessment. This can be carried out in the field or as a desk study depending on the nature/scale of the project.

Environmental labeling—The environmental labeling tool, provides guidelines for the use of environmental labels and declaration. These provide communication of information on environmental aspects of products and services, to encourage the demand and supply of those products and services that cause less stress on the environment and is especially relevant for the needs of consumers. ISO provides standards for three different types of labels: Type II environmental claims (ISO 14021) and the Type I and Type III environmental labeling scheme. Type I labels are based on a multiple criteria-based

third-party environmental labeling programme aiming at yes/no decisions whether products will get a label or not; Type III labeling aims at more detailed information on a number of criteria attached to a product, without a yes/no decision regarding the provision of a label.

Eco-Management and Audit Scheme (EMAS) - The EU Eco-Management and Audit Scheme (EMAS) is a management tool for companies and other organizations to evaluate, report and improve their environmental performance. The scheme has been available for participation by companies since 1995 (Council Regulation (EEC) No 1836/93 of 29 June 1993) and was originally restricted to companies in industrial sectors. Since 2001 EMAS has been open to all economic sectors including public and private services (Regulation (EC) No 761/2001 of the European Parliament and of the Council of 19 March 2001). In addition, EMAS was strengthened by the integration of EN/ISO 14001 as the environmental management system required by EMAS; by adopting an attractive EMAS logo to signal EMAS registration to the outside world; and by considering more strongly indirect effects such as those related to financial services or administrative and planning decisions.

Participation is voluntary and extends to public or private organizations operating in the European Union and the European Economic Area (EEA) — Iceland, Liechtenstein, and Norway. An increasing number of candidate countries are also implementing the scheme in preparation for their accession to the EU.

Environmental management system (EMS)—An environmental management system specifies how an organisation can formulate an environmental policy and objectives taking legislative requirements and information about significant environmental impacts into account. The overall objective is a continual environmental improvement of the organisation. The EMS according to ISO 14001 makes a distinction between 5 different decision steps: environmental policy, planning, implementation and operation, checking and corrective action and management review

Environmental performance indicators—A specific expression that provides information about an organization's environmental performance (definition from ISO 14031).

Environmental product declaration (EPD)—A declaration of a product's environmental impact during its Life Cycle, gives prospective customers information that allows them to compare the performance of competing products. (See environmental labeling, Type III labels).

Environmental risk assessment (ERA)—Environmental risk assessment is the examination of risk resulting from technology that threaten ecosystems, animals and people. An approach to estimate the risks related to substances, processes and technology is either quantitative or qualitative. Risk assessments vary widely in scope and application. In broad terms risk assessments are carried out to examine the effects on humans (health risk assessment) and ecosystems (ecological risk assessment). The focus on the present description concerns risk assessments of substances in ecosystems.

Extended producer responsibility (EPR)—The Organization for Economic Cooperation and Development (OECD) defines extended producer responsibility as "an environmental policy approach in

which a producer's responsibility for a product is extended to the post-consumer stage of a product's Life Cycle. There are two related aspects of EPR policy: 1) the shifting of responsibility (physically and / or economically; fully or partially) upstream toward the producer and away from municipalities; and, (2) to provide incentives to producers to incorporate environmental considerations in the design of their products. While other policy instruments tend to target a single point in the chain, EPR seeks to integrate signals related to the environmental characteristics of products and production processes throughout the product chain. (OECD 2001).

Environmental supply chain management (ESCM)—Environmental supply chain management is the organization of activities to address the environmental performance of materials, components, goods and services that an organization buys and uses.

Full cost accounting—A tool to identify, quantify and allocate the direct and indirect environmental costs of ongoing company operations. Full cost accounting helps identify and qualify the following four types of costs for an organisation, process or project: direct costs, hidden costs, contingent liability costs, and less tangible costs.

Green procurement—Green procurement means buying products or services with a reduced environmental impact. This can be achieved in a number of ways and may mean looking at product characteristics such as energy efficiency, durability, packaging and/or the environmental impacts in a Life Cycle perspective. A number of third party organisations have developed standards and guidelines for green products and services. One form of guidelines is set up by Environment Canada (1996). It provides a checklist focusing on the four Rs: Reduce, Reuse, Recycle and Recover in each phase of the materiel Life Cycle. This approach differs from the EU eco-labelling scheme, which issues environmental labels to products.

Input / output analysis— Input-output analysis (IOA) was founded by Wassily Leontief in the 1930s, focusing on how industries trade with each other, and how such inter-industry trading influenced the overall demand for labour and capital within an economy. The basic distinction that is made in input-output analysis is between the output of goods and services sold to 'final demand' (households, governments, exports, investment), and the 'total output' of the various sectors, comprising final demand, plus the output that is used as inputs into other sectors (intermediate demand).

Industrial ecology (IE)—Industrial ecology is the multidisciplinary study of industrial systems and economic activities, and their link to fundamental natural systems (Allenby, 1999). It is concerned with the evolution of technology and economic systems such that human activities mimic mature biological systems as regards being self-contained in their material and resource use (Allenby, 1994). Thus it emphasises the need to search for greater synergism between industrial processes, emphasising the potential for reduction in environmental impacts by linking different manufacturing processes via their waste streams and encouraging cyclic flows of materials (Graedel *et al.*, 1993).

Integrated product policy (IPP)—Integrated product policy is public policy that seeks to *reduce the Life Cycle environmental impacts of products* from the mining of raw materials to production, distribution, use, and waste management. It is not, as its name might suggest, a single policy instrument, but rather a framework for integrating a number of product-focused concepts, tools and policy instruments (e.g., eco-labelling, extended producer responsibility, green procurement, etc). It is seen as a means by which governments and authorities can encourage, facilitate and coordinate the actions of stakeholders along the product Life Cycle to improve the environmental performance of products, whether this involves greening their design and development, production, distribution, use, recycling or disposal.

Life Cycle - Consecutive and interlinked stages of a product system, from raw material acquisition, through manufacturing, use and final disposal.

Life Cycle Assessment (LCA) - Compilation and evaluation of the inputs and outputs and the potential environmental impacts of a product or process system throughout its Life Cycle.

Life Cycle costing (LCC) - Life Cycle Costing is an "assessment of all costs associated with the life cycle of a product that are directly covered by the any one or more of the actors in the product life cycle (supplier, producer, user/consumer, end-of-life-actor), with complimentary inclusion of externalities that are anticipated to be internalized in the decision-relevant future." (Rebitzer and Hunkeler 2003)

Life Cycle thinking—Life Cycle thinking considers the cradle-to-grave implications of any action. It reflects the acceptance that key societal actors cannot strictly limit their responsibilities to those phases of the Life Cycle of a product, process or activity in which they are directly involved. It expands the scope of their responsibility to include environmental implications along the entire Life Cycle of the product, process or activity.

Material flow accounting—Material flow accounting aims at specifying the pathways of materials in, out and through the economy of a nation, a region, a community, a business sector, a company or a household. Two main complementary approaches exist: 1) the flows of bulk materials, e.g., steel, wood, total mass, are analysed to study the industrial metabolism *(b-MFA = bulk material flow analysis)*; the results can be used to set priorities for policy measures towards increased resource efficiency and sustainable supply and waste management systems; and, 2) the flows of a single substance or a group of substances are studied which are associated with specific environmental effects *(SFA = substance flow analysis)*; this allows for an effective cause-effect modelling, linking the actual industrial metabolism to specific environmental issues in a quantitative manner.

Material flow analysis (MFA)— A mapping of the total use, recycling and disposal of a specific material in a defined region. The mapping reveals for which purposes the material is used. The mapping quantifies use, recycling and disposal of the material for the different purposes.

Product stewardship— Product Stewardship is a principle that directs all actors in the Life Cycle of a product to minimize the impacts of that product on the environment, as well as on health and safety aspects (Rebitzer and Buxmann 2003). What is unique about product stewardship is its emphasis on the entire product system in achieving sustainable development. Product stewardship emphasizes making the entire product system sustainable. All participants in the product Life Cycle - designers, suppliers, manufacturers, distributors, retailers, consumers, recyclers and disposers - share responsibility for the environmental effects of products.

Product-oriented environmental management system (POEMS)— Product Oriented Environmental Management (POEMS) is environmental management that does not only focus on plants or production sites of a firm but takes the Life Cycle of the products and intermediates into account that pass through the company's operations.

Responsible Care - Responsible Care is a program created in 1988 by the Chemical Manufacturers Association (CMA), now called International Council of Chemicals Association (ICCA). It is a program adopted by ICCA's members to foster environmentally responsible management of chemicals. Guiding principles and codes of management practices have been established.

Simplified Life Cycle assessments (SLCA)— (synonymous: Streamlined LCA): An LCA obtained through a procedure that reduces the complexity of an LCA and therefore cost, time and effort involved in the study. "This may involve exclusion of certain life cycle stages, system inputs or outputs, or impact categories, or may involve the use of generic data modules rather than specific data for the system under study". (Christiansen 1997)

Social accounting—Social accounting is a way of demonstrating the extent to which an organization is meeting its stated social or ethical goals. Whilst independently verified, the organization itself owns the process of data collection and analysis and the process is driven by indicators the organization sets in consultation with stakeholders, as opposed to being based on standards or criteria determined externally.

Stakeholder—An individual or organization with an interest in a product, system or organization.

Substance flow accounting (SFA) - A mapping of the total use, recycling and disposal of a specific substance in a defined region. The mapping reveals which materials the substance is a part of. The mapping quantifies use, recycling and disposal of the substance for the different purposes. Part of Material Flow Analysis.

Substance flow analysis (SFA)—See material flow accounting.

Total cost accounting (TCA)— Total cost accounting describes the long-term, comprehensive analysis of the full range of internal costs and savings resulting from pollution prevention projects and other environmental projects undertaken by a firm. As such, TCA encompasses conventional companies and less tangible, hidden, indirect company costs, and is a subset of Life Cycle costs. It is a dynamic subset,

however, subject to change and redefinition as the boundary between internal and external costs shifts with changing regulations and company policies.

Voluntary agreements—Voluntary agreements (VAs) are commitments undertaken by firms or by industrial organisations to deal with environmental problems. The agreements are made with public authorities or recognised by the authorities. They may comprise individual firms and/or groups of firms within an industry. VAs have been in existence in European Union states for some years already. The site of the concerted action CAVA (1998) provides bibliographical references on VA.