Aalborg Universitet

Life Cycle Management

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Publication date:
2007

Document Version
Publisher's PDF, also known as Version of record

[Link to publication from Aalborg University](#)

Citation for published version (APA):
Remmen, A., Jensen, A. A., & Frydendal, J. (2007). *Life Cycle Management: A Business Guide to Sustainability.* UNEP and Danish Standards.

LIFE CYCLE MANAGEMENT

A Business Guide to Sustainability

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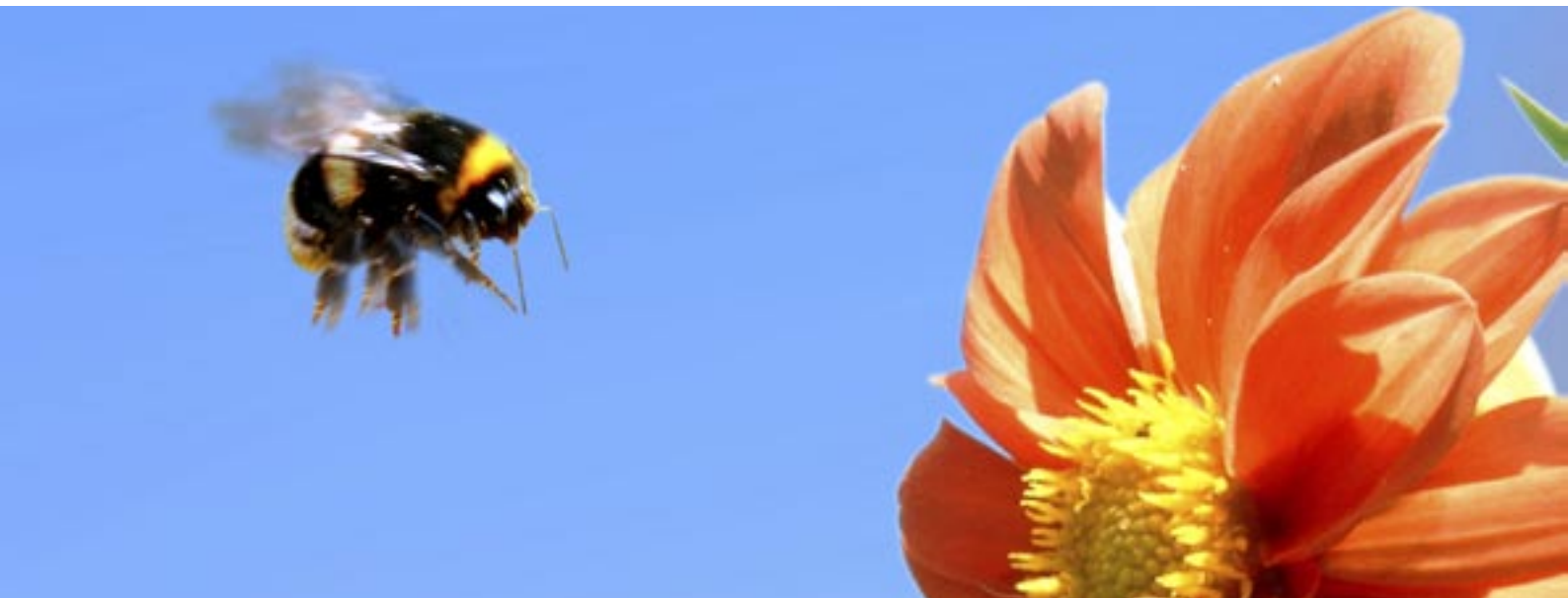
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Life Cycle Management
A Business Guide to Sustainability

Acknowledgements

Executive Summary

The journey towards sustainability requires that businesses should find innovative ways to be profitable and at the same time expand the traditional frontiers of business to include the environmental and social dimensions, in other words take account of "the Triple Bottom Line", and to introduce "Life Cycle Thinking".

Life Cycle Management (LCM) aims to minimize the environmental and socio-economic burdens associated with product or product portfolio throughout its entire life cycle and value chain. LCM makes life cycle thinking and product sustainability operational for businesses through continuous improvements of product systems, as well as, supporting business assimilation of, for example, integrated product policies.

LCM is for organizations, which have expressed a wish to produce or trade products, which are as sustainable as feasible, to improve their public image, visibility, general relations with stakeholders, and increase their shareholder value, as well as, awareness of and preparedness for changing regulatory contexts.

LCM is not a single tool or methodology but a management system collecting, structuring and disseminating product-related information from various programs, concepts and tools. It incorporates environmental, economic, and social aspects of products, which are applied throughout a product's life cycle. The organization must 'go beyond its facility boundaries' and be willing to expand its scope of collaboration and communication to all stakeholders in the value chain.

LCM can be specifically adapted and gradually introduced, in any organization, including SMEs. Organizations may begin with small goals and objectives according to their resources and then get progressively more ambitious over time. To be successful it needs a commitment from top management and the active participation of key employees from relevant departments in the organization.

LCM is a dynamic and voluntary process which is best implemented through a step by step process. Special attention should be given to activities that can secure continuous improvement. Finally, the Plan-Do-

Check-Act cycle, in line with international management systems for organizations, such as ISO 9001 and ISO 14001, is recommended.

This Guide contains twenty one examples, selected by the authors based on relevance, which illustrate how businesses are putting life cycle thinking into practice all over the world. In an effort to be concise there is limited detail in this document. For more information on any aspect covered here the reader should visit the source/ website address.

Résumé Exécutif

Le parcours vers un développement durable exige que les entreprises recherchent de nouvelles façons de faire des profits et en même temps, d'élargir les frontières traditionnelles du business pour inclure les dimensions sociales et environnementales de leurs activités. En d'autres termes, elles doivent adopter le concept du « triple bilan » (« triple bottom line » en anglais) et introduire une réflexion sur le cycle de vie des produits (« Life Cycle Thinking » en anglais).

La gestion du cycle de vie (GCV) a pour objectif de minimiser les impacts environnementaux et socioéconomiques associés à un produit ou une gamme de produits pendant son cycle de vie entier et pour toute sa chaîne de valeur. La gestion du cycle de vie concrétise le concept du cycle de vie et du développement durable pour l'entreprise, à travers des améliorations continues des systèmes de production et aussi le développement de politiques intégrées pour les produits.

La GCV s'adresse aux entreprises qui cherchent à fabriquer ou vendre des produits plus durables, afin d'améliorer leur image publique et leur visibilité et de construire des relations plus étroites avec leurs parties prenantes ; ainsi, elles créent de la valeur pour les actionnaires et facilitent la prise en compte du contexte règlementaire en permanente évolution.

La GCV n'est pas un outil ou une méthode isolée, mais un système pour structurer la collecte et la diffusion des informations sur les produits à partir de différents programmes, concepts et outils. Il prend en compte les aspects environnementaux, économiques et sociaux des produits, qui sont analysés tout au long de leur cycle de vie. L'entreprise doit aller au-delà des limites de ses usines et étendre ses partenariats, sa collaboration et sa communication à toutes les parties prenantes de sa chaîne de valeur.

La GCV peut être adaptée individuellement à l'entreprise et introduite de manière progressive quelque soit sa taille, multinationale ou PME. Selon ses ressources, l'entreprise peut se fixer des objectifs d'abord plus faciles à atteindre qui deviendront ensuite plus ambitieux au fil du temps. Pour réussir, l'engagement de l'équipe dirigeante est aussi nécessaire que la participation active des employés clés dans les différents départements de l'entreprise.

La GCV est un processus dynamique et volontaire. Sa mise en œuvre se fait idéalement à travers un processus en plusieurs étapes. Par conséquent, il est particulièrement important de diriger son attention vers l'amélioration continue, ce qui est possible à travers l'adoption du cycle « Planifier, faire, vérifier, agir » en combinaison avec des systèmes de gestion internationalement reconnus tels que ISO 9001 et ISO 14000.

Ce guide contient vingt-et-un exemples sélectionnés par les auteurs selon leur pertinence pour illustrer la mise en œuvre par les entreprises du concept du cycle de vie dans le monde entier. Pour rester le plus concis possible, nous avons limité le niveau de détail pour chacun d'entre eux. Pour plus d'informations sur les sujets abordés dans ce livre, le lecteur est invité à consulter les sites Internet indiqués.

Resumen ejecutivo

El viaje hacia la sostenibilidad requiere que las empresas encuentren maneras innovadoras para ser rentables y al mismo tiempo extender las fronteras tradicionales de su negocio para abarcar las dimensiones ambientales y sociales, lo que en otras palabras es tomar en cuenta "la Línea de Triple Base", y para introducir el "Pensamiento de Ciclo de Vida de Producto".

La Gestión de Ciclo de Vida (GCV) busca minimizar las cargas ambientales y socio económicas asociadas con el producto o portafolio de productos durante todo su ciclo de vida y cadena de valor. La GCV hace operacional en los negocios el pensamiento de ciclo de vida y la sostenibilidad del producto a través de mejora continua de los sistemas de productos, así como también, apoyando la incorporación de, por ejemplo, políticas integradas de producto.

La GCV es para organizaciones que han expresado su deseo de producir o comercializar productos tan sostenibles como sea posible para mejorar su imagen pública, incrementar la visibilidad y sus relaciones generales con partes interesadas y afectadas, aumentar el valor ante sus accionistas y estar mejor informados y preparados ante contextos legislativos cambiantes.

La GCV no es una herramienta única ni una metodología, sino un sistema de gestión que recolecta, estructura y disemina información relacionada al producto de diversos programas, conceptos y herramientas. Éste incorpora aspectos económicos, ambientales y sociales de los productos, los cuales son aplicados en cada una de las etapas del ciclo de vida de ellos. La organización debe ir más allá de los límites de sus instalaciones y tener la voluntad de extender su alcance de colaboración y comunicación a todas las partes interesadas y afectadas en la cadena de valor.

La GCV puede ser específicamente adaptado y gradualmente introducido en cualquier organización, incluyendo a las PyMEs. Las organizaciones deben empezar con metas y objetivos pequeños de acuerdo a los recursos que poseen y volverse progresivamente más ambiciosos a lo largo del tiempo. Para ser exitosos se necesita un compromiso la Alta Dirección y una participación activa de empleados clave de los departamentos relevantes en la organización.

La GCV es un proceso dinámico y voluntario, y la mejor manera de implementarlo es paso a paso. Se debe dar especial atención a las actividades que puedan asegurar la mejora continua. Finalmente, el ciclo Planear-Hacer-Verificar-Actuar es recomendado, en línea con los sistemas de gestión internacional como ISO 9001 e ISO 14001.

Los autores seccionaron para esta Guía veintiún ejemplos, cuya selección se basó en su relevancia. Estos ejemplos ilustran cómo las organizaciones empresariales están poniendo en práctica el pensamiento de ciclo de vida alrededor del mundo. Debido a una necesidad de sistematización, los detalles son limitados en este documento. Para mayor información acerca de cualquier aspecto cubierto en esta guía el lector deberá visitar las fuentes o direcciones de los sitios Web.

Contents

Foreword by UNEP

The desire to realise our vision is driven by human nature.

The collective vision and desire of the UNEP/SETAC Life Cycle Initiative network is the broad-based application of Life Cycle Thinking; making this a reality requires transferring the vision and desire to the key groups that could facilitate a worldwide implementation of Life Cycle Approaches: consumers; small and medium sized enterprises; key growth sectors in emerging economies; natural resource extraction sectors; civil society in developing economies; and leading companies, organizations and governments.

This publication, "Life Cycle Management - a business guide to sustainability", is the result of a joint effort of key experts and friends of the UNEP/SETAC Life Cycle Initiative and incorporates almost 20 years of experience in Life Cycle Assessment as well as in other recognized approaches such as ISO 14001, eco-design and ecolabels. This guide provides a series of key definitions and principles related to Life Cycle Management, a description

of the importance and scope of intervention that different areas have in the organizations, and a step-by-step guide, adaptable to enterprises of any size, to support the integration of Life Cycle Management in the management process.

Life Cycle Management is for companies that are ready to expand their traditional focus on the production process by incorporating various management aspects associated with a product over its entire life cycle. This guide will assist in the systematic implementation of Life Cycle Approaches resulting in continual improvements for the organization and a contribution towards sustainable development in society. We invite practitioners to use this guide in their quest for new ways to improve the overall management, long term benefits and sustainability of your businesses.

This publication is a contribution to UNEP's activities to promote more sustainable consumption and production patterns. The growing attention to life cycle issues is a natural outcome of decades of UNEP work on

cleaner production and eco-efficient industrial systems. It is a next step in broadening the horizons of pollution prevention; a process which has gone from a focus on production processes (cleaner production), to products (Design for Sustainability) and then to product-systems (incorporating transport logistics, end-of life collection and component reuse or materials recycling) and to sustainable innovation (new products and product-systems and enterprises designed for win-win solutions for business, the environment and people). It also contributes to the 10-year framework of programmes mandated by the World Summit on Sustainable Development in 2002.

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Foreword by SETAC

During the last couple of decades, society has developed a better understanding of human influence on the environment. As we entered the twenty-first century, the case for improved sustainable performance of products became more compelling and more deeply understood.

More and more companies have now embraced Life Cycle Management (LCM) as a unique and systematic framework of concepts, techniques, and procedures with the goal of creating more sustainable products and businesses.

Members of the Society of Environmental Toxicology and Chemistry (SETAC) have been pioneers in developing the scientific background for LCM. In 1998, the first SETAC Working Group on Life Cycle Management was formed with Konrad Saur as Chairman and Allan Astrup Jensen as Convener. Since then, LCM has been a major topic at SETAC annual conferences in Europe and North America. The SETAC Working Group has convened 8 meetings during the years since its inception, and the report *Life-Cycle Management* was published by SETAC Press in 2004 with David Hunkeler as the lead editor

The work in SETAC was also the basis for the first International Conference on Life Cycle Management LCM2001 held in Copenhagen, Denmark, 27-29 August 2001 and later conferences LCM2005 in Barcelona, Spain, 5-7 September 2005 and the coming LCM2007 in Zürich, Switzerland, 27-29 August 2007.

Therefore, it was clear that LCM should be an important part of the UNEP/SETAC Life Cycle Initiative. A LCM Programme was established with five Task Forces. Several workshops were held, and many working documents were discussed and finalised in the first phase. Especially important was the development of a "Background Report on a LCM Guide" as a major contribution to the present publication.

Life Cycle Management: A Business Guide to Sustainability outlines practical examples of product sustainability and life cycle thinking and describes useful ways to implement LCM. We hope this publication will result in LCM being used to take action and to drive market transformation forward.

I would like to thank all of the LCM Programme participants, the International Life Cycle Panel members, and the Initiative's Executive Committee for their extremely valuable contributions, comments, and suggestions.

SIGNATURE (UNEP provides hq-file)

G. Allen Burton
President. 2006-2007
Society of Environmental Toxicology and Chemistry

The Triple Bottom Line
- the Business Case of Sustainability

"To meet the needs of the present without compromising the ability of future generations to meet their needs" has been the definition of sustainable development since the publication of the Brundtland Report in 1987. Sustainable development should ideally improve the quality of life for every individual without expending the earth's resources beyond its capacity. The journey towards sustainable development requires that businesses, governments and individuals take action, i.e., changing consumption and production behaviours, setting policies and changing practices. Businesses have to find innovative ways to be profitable and at the same time improve the environmental performance of production processes and products.

Sustainability has three dimensions as shown in Figure 1.1: economic, social, and environmental. In the business community the term "the triple bottom line" was coined to explain the importance of achieving sustainability. It implies that industry has to expand the traditional economic focus to include environmental and social dimensions, in order to create a more
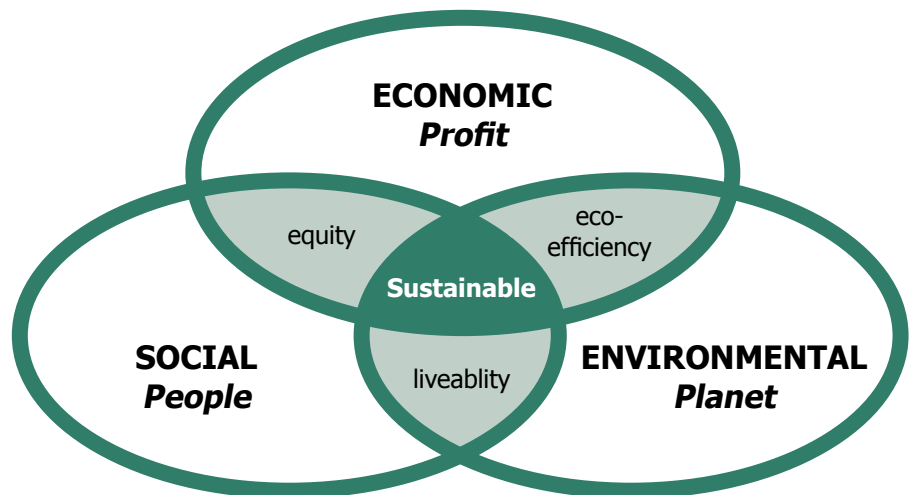
Figure 1.1: Dimensions of Sustainability.

"sustainable" business (Elkington, 1997).

Over the past few decades, organizations have taken more responsibility for the environment and have demonstrated that environmental initiatives and improvements can bring economic benefits. In the 1980s, pollution prevention measures paid off. Implementing cleaner production processes via good housekeeping and the optimization of production

technologies reduced resource use, emissions and waste, as well as, generating significant economic savings for organizations. In the 1990s organizations began to implement environmental management systems (EMS) such as ISO 14001 to secure continuous improvement of their environmental performance. Integrating quality, workplace and environmental management systems created new opportunities for organizations, such as lower resource consumption,

enhanced image recognition, and improved relationships with external stakeholders including local communities, authorities, and NGOs.

Many businesses now embrace the life cycle concept, understanding that products have environmental impacts over their entire product life, i.e., product use, disposal, and distribution changes the environment. Through improvements introduced over the product's life, businesses can potentially find further economic benefits, both in the product (e.g., less material waste, substituted hazardous materials) and in the market (e.g. improved image and competitive advantage).

Already in 1992, before the World Summit in Rio, the World Business Council for Sustainable Development (WBCSD) introduced the concept "eco-efficiency" to highlight the link between environmental improvements and economic benefits, in short, "cre-ating more value with less impact". Briefly outlined, these linkages have been demonstrated in several ways: So far, the social and ethical dimensions of sustainability have not been given the same attention within the business community since the benefits are less tangible. However, examples of positive links exist between environmental improvements and health and safety improvements in the workplace. There now exists a general trend in companies and in governmental policies towards Integrated Management Systems, which include health and safety issues, as well as, other social aspects.

Another trend in the business community are companies taking more and more responsibility for their role in society. As large consumers and producers, businesses have obligations to society and should be accountable for their activities.

- **Cleaner production processes → Resource savings/Margins**

- **Environmental management → Continual improvements/Reputation**

- **Clean and sustainable products → Competitive advantage/Revenues**

Sustainability-Driven Innovation

Perceived business value

Do you believe there is potential for Sustainable Innovation to deliver business value?

(pie chart: Probably Not, Maybe, Probably Yes, Definately Yes)
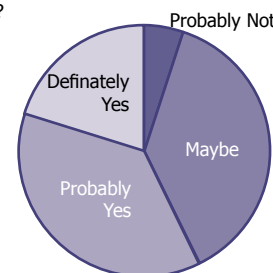
Business benefits seen to date

Reputation	2.4
Brand value	2.2
Market access	1.9
Consumer response	1.9
Market share	1.8
Revenue	1.7
Margins	1.5

1 — No Benefit   2 — Some Benefit   3 — Significant Benefit
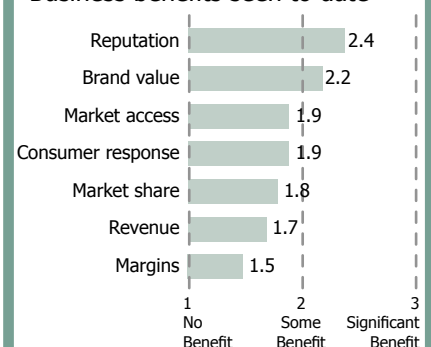
Source: Arthur D. Little Innovation Excellence Study of 40 world leading technology companies, 2005

Introduction to Life Cycle Thinking

Life cycle thinking is essential to sustainable development. It is about going beyond the traditional focus on production site and manufacturing processes so to include the environmental, social, and economic impact of a product over its entire life cycle. Extended Producer Responsibility and Integrated Product Policies mean that the producers can be held responsible for their products from cradle to grave and therefore, should develop products, which have improved performance in all stages of the product life cycle as shown in Figure 1.2.

The main goals of life cycle thinking are to reduce a product's resource use and emissions to the environment as well as improve its socio-economic performance throughout its life cycle. This may facilitate links between the economic, social and environmental dimensions within an organization and throughout its entire value chain.

Natural Resources

Incineration and Landfilling

Recovery

Extraction of Raw Materials

Recycling of Materials and Components

Design and Production

Disposal

Reuse

Packaging and Distribution

Use and Maintenance
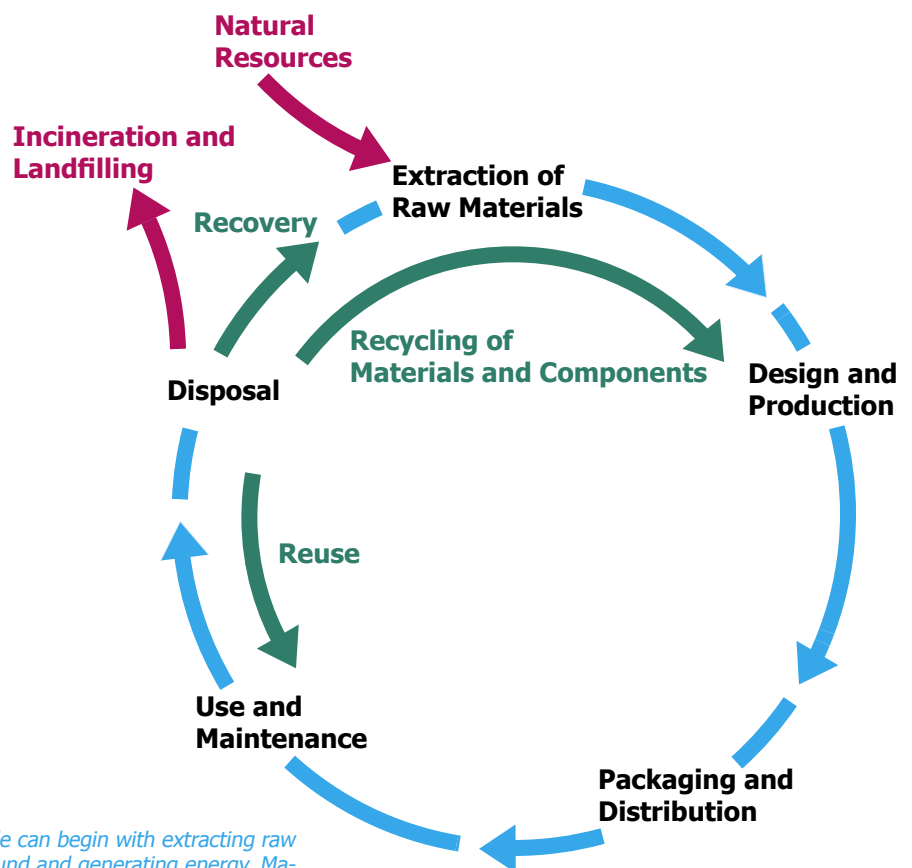
Figure 1.2: A product system, or life cycle can begin with extracting raw materials from natural resources in the ground and generating energy. Materials and energy are then part of production, packaging, distribution, use, maintenance, and eventually recycling, reuse, recovery or final disposal.

Life cycle thinking expands the established concept of cleaner production to include the complete product life cycle and its sustainability. Source reduction in a product life cycle perspective is then equivalent to design for sustainability principles, and what is called the "6 RE philosophy" as shown below:

In each life cycle stage there is the potential to reduce resource consumption and improve the performance of products. In order to succeed every department in the organization and all of the important stakeholders in the product chain have to be involved as will be discussed later in this guide.

- **RE-think the product and its functions. For example, the product may be used more efficiently**

- **RE-pair. Make the product easy to repair e.g. via modules that can easily be changed**

- **RE-place harmful substances with safer alternatives**

- **RE-use. Design the product for disassembly so parts can be reused**

- **RE-duce energy, material consumption and socio-economic impacts throughout a product's life cycle**

- **RE-cycle. Select materials that can be recycled**

SCA Sustainability Policy

"SCA assesses the environmental impact of its products during their various life cycle stages and includes suppliers and subcontractors in this process"

SCA Environmental and Social Report 2005

SCA

www.sca.com

Stora Enso Sustainability Policy

"To minimise our impact on the environment, we consider a life cycle approach and use applicable control technologies".

Stora Enso Sustainability Report, 2007

STORAENSO

www.storaenso.com

Photo by Monika Flückiger

Along the Product Chain
- Going beyond the Organization Boundaries

The organization should expand its facility-focused environmental management system to an integrated management system that incorporates product life cycle thinking as well as interaction with internal and external stakeholders of the organization. Communication and cooperation be-tween the partners involved will build connections between the supply chain and the value chain. This is illustrated in Figure 1.3.

Waste Managers

Recyclers

Raw Material Suppliers

Component Suppliers

Consumers

Producers

Retailers

Transporters

—— *Communication and Collaboration*

—— *Materials and Energy*

—— *Money and Information*
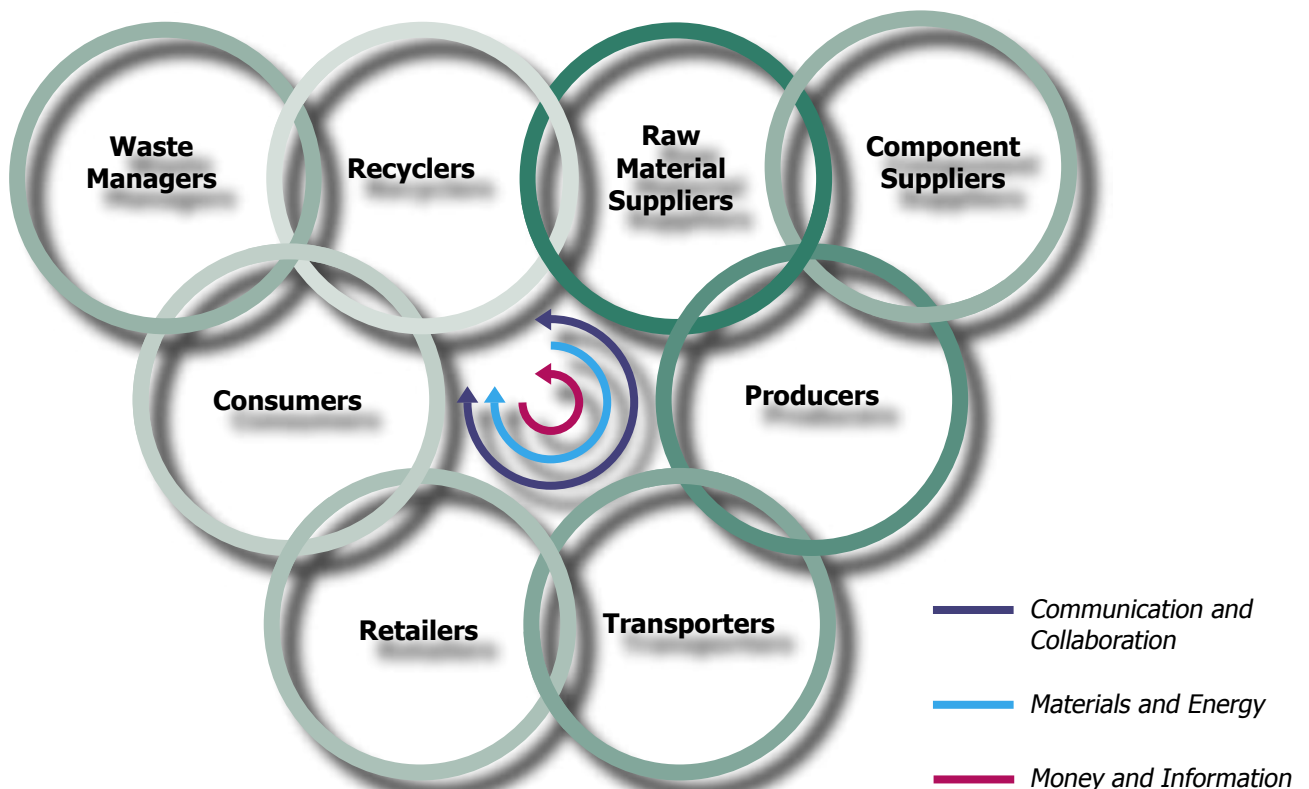
Figure 1.3. Collaboration in the Product Chain.

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For enterprises, a challenge is to make linkages in the product chain in such a way that there is focus on both the environmental optimisation of the material flow in the supply chain; and on the customer's expectations regarding environmental and social issues in the value chain.

An organization's procurement policies and procedures are a common and effective gate by which life cycle management can enter into the firm. Working with suppliers and supply chain issues is rapidly increasing as an important strategic consideration. Traditionally, enterprises manage suppliers in order to optimize the supply chain, track flows of information, materials and funds, manage the logistics of supply and distribution, minimize cycle times and costs and to integrate processes and functions along the supply chain. A Life Cycle Management system is for continuous improvement based on a life cycle perspective; thus, supply chain management practices can be effective entry gates for life cycle management.

Most importantly, existing supply chain management practices will be clearly enhanced by such an approach. Firms are increasingly requesting information from suppliers on materials used in production and the systems they are using to track and manage their environmental impacts. As supplier firms receive these requests, they in turn pass them along their supply chain. An organization that is unsure of how or where to begin can use an effective procurement policy to learn and benefit from the efforts of other firms in the chain. Alternatively, firms who are leading can improve the performance of up- and downstream suppliers by collaborating on programs, tools and efforts. Thus, the understanding of environmental impacts through the supply chain can extend into other parts of the organization leading to a more comprehensive and integrated life cycle management approach.

This comprehensive approach might also serve to align the improvements in the chains and ensure the exchange of useful information. Producers often decrease the number of suppliers they deal with establishing closer and more collaborative relationships and improve risk sharing amongst them. This is particularly true in established industries such as the automotive and aerospace sectors, where a contraction in the number of manufacturers has been observed over the past two decades. The complexity of the product chain is likely to decrease as this trend progresses. Despite decreasing complexity, firms are out-sourcing the assembly and design of components, to full systems more as a rule than an exception.

Present trends in management approaches indicate more focus on a problem-oriented and project-organized cooperation; the later often referred to as 'the matrix organization'. Expanding the organization to encompass suppliers and customers, as well as other actors in the product chain, will contribute to the harvesting of potential benefits of life cycle cooperation.

Responsibility in the Life Cycle

A CSR strategy can be used to advance life cycle thinking. As part of their ongoing CSR strategies which are aimed at advancing integration and inclusion, many companies link environmental and social responsibilities to address a range of issues associated with the product life cycle, including child labour, discrimination, abuse of union rights, as well as, to make positive contributions to the families of employees and the local community.

The UN Global Compact is an example of a set of principles that can be used by businesses to endorse Corporate Environmental and Social Responsibility. UNEP is responsible for environment related activities under the Global Compact

Eskom Cooperates with Consumers to Reduce Peak Consumption

Over the last century Eskom has established itself as a leading electricity supply company, providing over 95% of South Africa's electricity needs and over 50% of Africa's.

Eskom, as a signatory to the *United Nations Global Compact*, has integrated it's principles into their operation. As an example of integration of the environmental principles, in this instance through improved energy efficiency, Eskom is promoting its FLEXICON - Flexible Hot Water Load Management Control - system.

The FLEXICON system forms part of Eskom's *Demand Side Management* (DSM) programme, an initiative coordinated by the DSM Department at Eskom's headquarters in Johannesburg. The main objective of the DSM Department is to find ways of reducing the demand for power during peak periods of electricity consumption. FLEXICON is a really ingenious way for Eskom to reduce load during peak times and shift the load to standard and off peak times. Due to water storage capabilities of a Hot Water Cylinder, the households are not inconvenienced during the load shift duration.

Eskom www.eskom.co.za

The principles of the UN Global Compact can be used throughout the life cycle to promote Corporate Environmental and Social Responsibility

The UN Global Compact was launched in 2000. It is a purely voluntary initiative for the business community to help promote *sustainable development* through the power of collective action. The Global Compact seeks to promote *responsible corporate citizenship* so that business can be part of the solution to the challenges of *globalization*. Today, many hundreds of companies from all regions of the world, and international labour and civil society organizations are engaged in the Global Compact, working to advance ten universal principles in the areas of human rights, labour standards, the environment and anti-corruption.

THE GLOBAL COMPACT

www.unglobalcompact.org

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Sustainability Management of Supply Chains

Inversiones Mineras del Sur S.A. (INMINSUR) is one of the ten subsidaries of Compañia de Minas Buenaventura - a Peruvian mining company that ranks among the top 10 gold producers worldwide. INMINSUR extracts gold from its mine called Antapite, located in the southern Andes of Peru, in the poorest region of Peru with 95.4% of its population under the "poverty line". Antapite provides work to more than 1,200 people; where 85.2% of them comes from 10 supplier companies. Antapite has a certified *environmental management* acc. to ISO 14001, which has extended its application to also cover health and security aspects ,as well as, its scope to also cover its suppliers. The suppliers provide services previous to the extraction stage as shown in the figure below.
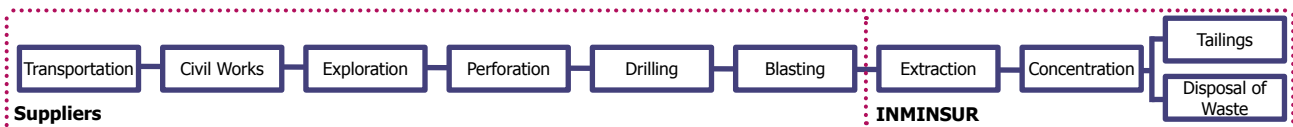
Antapite has supported the implementation of *environmental management systems* (EMS) by its 10 *suppliers* and furthermore it has a "supplier assessment policy", which requires compliance with at least the following criteria: compliance with the law, attention to health and security aspects of employees or sub-contractors, positive impacts on the neighborhood, and minimum pollution of water courses. The implementation of an extended EMS in Antapite (INMINSUR) and its 10 suppliers, has lead to the following results along the Life Cycle:

- Less utilization and consumption of: explosives (then less air and dust emissions), water, and consumption and fuel for the workers transportation (then less air emissions and waiting times)
- Less generation of construction wastes (e.g. rests of cement)
- Non use of toxics in the exploration stage
- Controlled disposal of sludge from exploration processes
- Fewer accidents in the mine site

Logo deleted because of low quality
(UNEP provides hq-file)

www.buenaventura.com

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What is Life Cycle Management?

Life Cycle Management (LCM) is a product management system aiming to minimize environmental and socio-economic burdens associated with an organization's product or product portfolio during its entire life cycle and value chain. LCM is making life cycle thinking and product sustainability operational for businesses through the continuous improvements of product systems, and LCM supports the business assimilation of policies such as integrated product policies.

Organizations use LCM to support their goals of providing products or services which are as sustainable as possible. Many organizations have seen this strategy lead to improvements in their image, stakeholder relations, shareholder value, as well as, awareness of and preparedness for changes to their regulatory contexts.

LCM is not a single tool or methodology but a management system collecting, structuring and disseminating product-related information from the various programs, concepts and tools incorporating environmental, economic, and social aspects of products, across their life cycle. The organization must 'go beyond its facility boundaries' and be willing to expand its scope of collaboration and communication to all stakeholders in its value chain.

SEEbalance® - an LCM tool

In the 1990s BASF developed the *"Eco-Efficiency Analysis"* as a standard tool for a comprehensive assessment of its products and processes; by August 2005 more than 240 analyses had been carried out. Recently, this tool has been amended to include a *social dimension*, "Socio-Eco-Efficiency Analysis" (SEEbalance®).

The products are analyzed from the angle of the end *customer, with environmental, economic* and *social aspects* given equal weight in the assessments. Within the tool it is possible to evaluate future scenarios and effects of various options on a product's performance. The short timeframe (2 month) and low costs for the analysis (<30,000 €) are further advantages. The tool results in a simple and impressive illustration of the quantitative assessment's results. These are illustrated with SEECube®, which is used for:

- Strategic decisions on investments, products and markets.
- Comparison of production sites and markets.
- Prioritization of research and product development.
- Discussion with opinion makers in political decisions.
- Marketing, support to external customers and social acceptance of product.
- For communication issues e.g. corporate sustainability reports.

An Eco-Efficiency Analysis project with a coating customer resulted in an additional business of approximately 400,000 € per year.
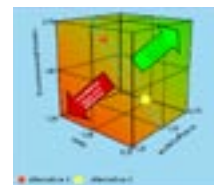
□ ▪ BASF
The Chemical Company

www.oekoeffizienzanalyse.de

3M - a pioneer in LCM

"Life Cycle Management was a commitment we must embrace to maintain our environmental leadership and to strengthen our competitive position."
L. D. DeSimone, 3M President and CEO (1991-2001)

Life Cycle Management (LCM) is a formal part of 3M's product introduction process worldwide. Cross-functional, new product introduction teams use an LCM scheme to systematically and holistically address the environmental, health and safety opportunities and issues from each stage of their product's life.

Inherent to 3M's Life Cycle Management Process is the characterization and management both of a product's risks and opportunities. Risk reflects the potential for exposure and the hazards of the materials associated with the product over its life cycle, as well as, the degree of uncertainty and feasibility of controlling exposure. Opportunity addresses finding solutions to these issues.

LCM was applied to the Adhesive HOT MELT BR-7065A manufactured at 3M Brazil for the local market. It is mainly used to close cardboard boxes, and it is applied using an electrical melting pot. As a consequence of an LCM matrix analysis, op-

Life Cycle Management Process					
Life Cycle Stage ⟍ Impact	Material Acquisition	R&D Operations	Manufacturing Operations	Customer Needs	
				Use	Disposal
Environment					
Energy/ Resources					
Health					
Safety					

portunities were identified for process stage, use stage and disposal stage taking into consideration the change from stick shapes to pellet shapes. According to a technical service representative there were complaints about the length of time needed for product melting, product loses in the wall of the equipment (residuals in the melting pot) and skin burning due to adhesive splashing during the melting pot loading process. In order to save energy (melting time), to minimize risk of burning and product losses, a new design for the product was proposed - pellets. The process line was optimized and instead long cooling water hopper the matrix of the extruder is cooled. This change is also a benefit in terms of maintenance and cleaning. The adhesive product was analyzed and classified according to Brazilian norms as not dangerous and inert for waste disposals after use.

Source: Lienne Pires – 3M Brazil

www.mmm.com

19

Communication and Life Cycle Management

External business communications of life cycle information are an important part of LCM. It makes a business more visible, may improve image and may increase market penetration. Life cycle information may be included in:

- Communication to shareholders and stakeholders in general by, for example, green accounting and annual environmental or sustain-ability Reports.
- Communication with customers through such items as life cycle based environmental product declarations, LCA data, product environmental performance indica-tors, or product profiles.
- Communication with public au-thorities via product information schemes and green public procure-ment guidelines.
- Communication with the public, consumers and retailers using product brochures and various ecolabeling systems and informa-tion campaigns.
- Communication with suppliers, including SMEs, using company codes or manuals of conduct, audit or supplier evaluation systems.

Larger companies often combine supplier communication with offering training exercises.

Figure 2.1. Examples of green/sustainable public procurement guidelines that can also be used by private organizations.

Ecolabels in India

In order to increase consumer awareness, the Govern-ment of India launched the 'Ecomark' scheeme in 1991 for easy identification of environment-friendly products.

The criteria follows a cradle-to-grave approach, i.e. from raw material extraction, to manufacturing, to disposal. The 'Ecomark' label is awarded to consumer goods which meet the specified environmental criteria and the quality require-ments of Indian Standards.

An earthern pot has been chosen as the logo for the Ecomark scheme in India.

www.envfor.nic.in/cpcb/ecomark/ecomark.html

Helpful Tools for Life Cycle Management

In relation to the daily operations of organizations, there are different opportunities as illustrated in Figure 2.2. Strategies, which include long-term plans of actions, should first be established to support the overall management of business.

These actions could be supported by introducing concepts, systems and processes, which systematically help the organization to manage its business operations in ensuring that it fulfils the tasks required to achieve its objectives. The organization can also initiate different programs to meet specific challenges or to promote a specific focus, for instance, consumer demands or design options.

Finally, the organization can use different models, methods and tools to produce valuable knowledge about the consequences of business operations, for instance, analytical tools such as LCA or procedural tools such as audits and benchmarks. Based on this knowledge

the organization can decide to proceed as usual, or to change aspects of its activities to better meet its goals and objectives. Valuable inputs can be provided by different types of information and data.

Business Case for Sustainability

Life Cycle Thinking

Corporate Environmental and Social Responsibility

Tools and Techniques, such as
- Life Cycle Assessment (LCA)
- Life Cycle Costing (LCC)
- Cost Benefit Analysis (CBA)
- Material and Substance Flow Analysis (MFA/ SFA)
- Input-Output Analysis (IOA)
- Material Input Per Unit of Service (MIPS)
- Cumulative Energy Requirements Analysis (CEPA)
- Cleaner Production Assessment (CPA)
- Risk Assessment (RA)
- Audits

Life Cycle Management

Systems and Procedures, such as
- Communication
- Stakeholder Engagement/ Product Panel
- Eco-labelling
- Certification
- Sustainable Procurement
- (Product-Oriented) Environmental Management Systems
- Design for Sustainability
- Dematerialisation
- Environmental Impact Assessment

Data, Information and Models, such as
- Databases
- Best Practice, e.g.
  - Benchmarks,
  - Standards
  - Weighting Schemes
- Models, e.g.
  - Dose-Response
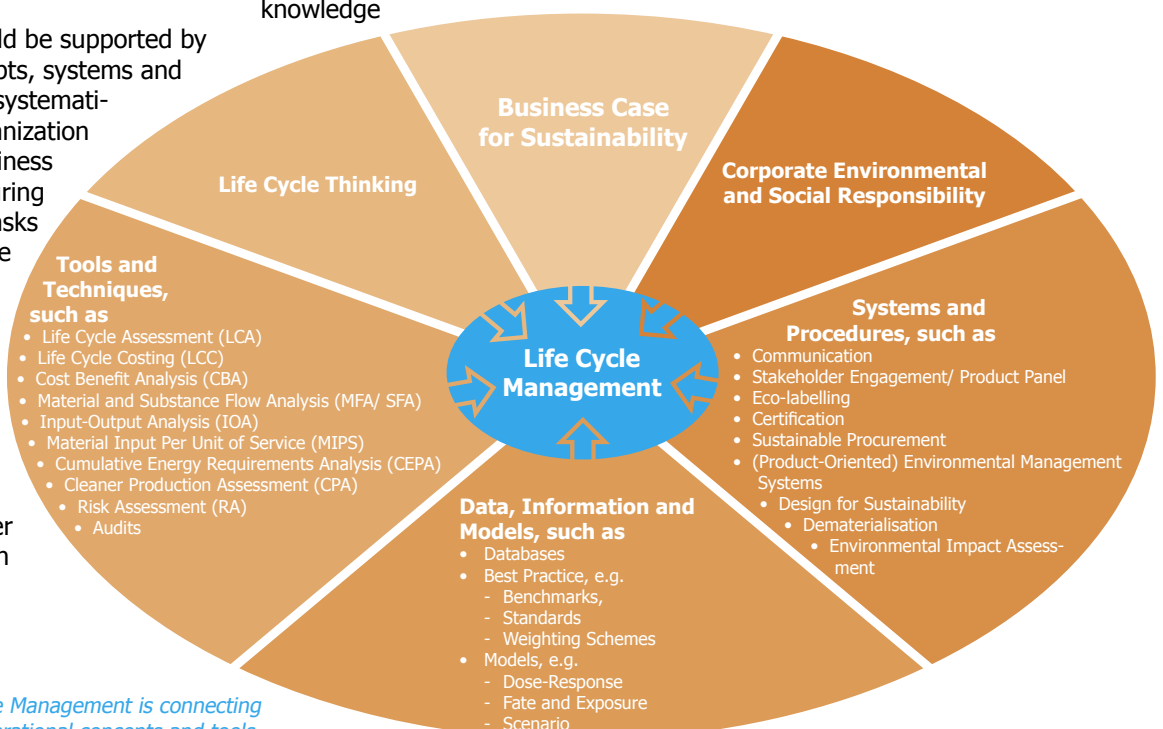 - Fate and Exposure
  - Scenario

Figure 2.2. Life Cycle Management is connecting various operational concepts and tools.
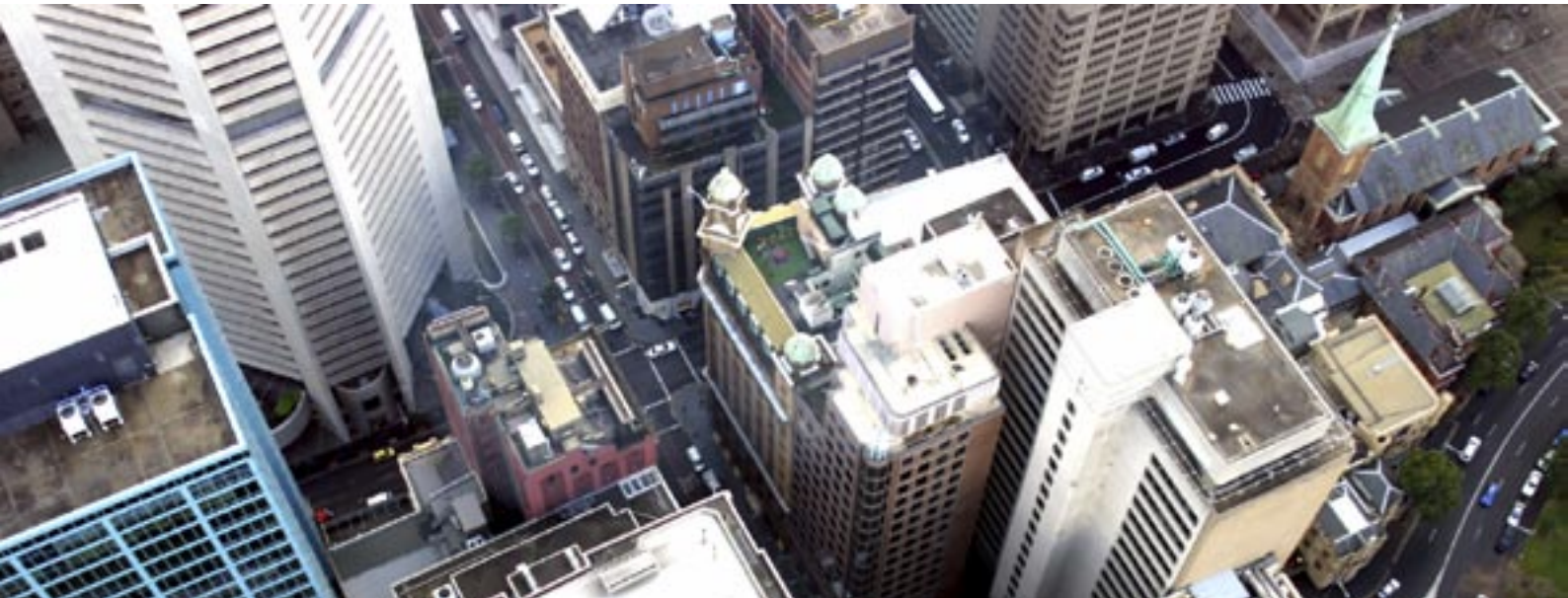
Any Organization can implement LCM

Introducing LCM into an organization should be a policy decision which comes from senior management and is integral to the organization's policies and strategy. Continued support from senior management during its implementation is also needed.

Full support means in practice that senior management ensures that:
- Sufficient resources are set aside for the LCM initiative including time and educational resources;
- Management of the organization actively participates in setting up the strategic goals;
- Explicit communication throughout the organization regarding the aims is effective and clear; and
- deas and suggestions of the employees involved are taken seriously.

LCM can be implemented in a simple manner. Life Cycle Assessment (LCA) can be valuable tool in analysing the environmental impact of a product throughout its life cycle and typically provides information as to which stages of the product's life cycle are most important. Hence an organization can prioritise work and focus on

the relevant stages of the life cycle using the results of this analysis.

However, conducting an LCA of a product or using other advanced tools in your organization is not a prerequisite for implementing LCM. LCM is a dynamic process; organizations may start with small goals, using the resources that are available, and get more ambitious over time. A good start is to advance step by step and focus on concrete opportunities to reduce the environmental impact as part of this iterative process, especially within a small or medium sized organization.

Participation of a range of employees ensures that the LCM initiatives will be deeply rooted in the organization and that the focus will be on concrete improvements to a product's sustainability profile, rather than mere talk and data collection. Furthermore, broad participation ensures that the LCM program does not 'die', if a key employee involved leaves the organization.

An LCM initiative may impact all departments of an enterprise, thus all

relevant functions within the company must participate positively. Communication and exchange of ideas within and across the relevant functions of an organization is a key to success. Communication and interaction also helps to push ideas into realization.

Key Drivers for implementing LCM

Many external and internal factors can influence an organization to consider improvements towards sustainability, and to develop policies, implement tools and structure programs that integrate LCM into the core operations of their business. Key drivers for implementing an LCM approach are business strategy, market requirements and requirements from the finance sector, national legislations, regional regulations and international agreements.

Internally, a business striving for increased operational and resource efficiency may see a strategy for product sustainability as an opportunity to achieve these goals and reduce costs. Leading companies will undertake initiatives to increase market share

Photo by Monika Flückiger

and enhance the potential for product innovation as can be seen in the 3M case. More conservatively, intrinsic factors will include reduced penalties and risks.

Several organizations seek to gain competitive advantage through innovation, brand value enhancement and strategic positioning in the market. Taking a life cycle approach can help identify important opportunities, and risks. Often organizations implement LCM systems to improve their public image and stakeholder relations, map their product chains and develop criteria for product enhancement and value creation.

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.

An integrated management system – covering quality, environment and health & safety – with policies, goals,

performance measures and a strategic plan that supports continuous improvements will be a driver for integration of sustainable performance concerns.

Life Cycle Management offers a framework that allows management to organize and align the various applied concepts and tools in such a way as to exploit the synergies and interrelations between them.

VESTAS, wind turbines and LCA

For the wind turbine manufacturer Vestas, LCA has been used to identify that the main burdens of a wind turbine is a result from the consumption of materials, mainly metals, when constructing the wind turbine. As a result of that, the main focus in the product design at Vestas is to reduce the material consumption per kWh of wind energy produced.

Furthermore, VESTAS has used LCA to get rid of an old myth saying that a wind turbine takes more energy to manufacture than it generates throughout its life cycle. With the results of the LCA's published, Vestas has communicated that for a modern wind turbine it takes only about half a year of operation to generate the same amount of energy that is needed throughout the lifecycle to extract raw material, manufacture, establish, run and dispose of a wind turbine. With an estimated life time of a wind turbine of more than 20 years - wind turbines are clearly net energy producers over their life cycle.

Vestas

www.vestas.com

Life Cycle Management in Different Departments

Engineers in an environmental department can take care of the impacts from a production facility. However, Life Cycle Management initiatives regarding the improvement of a product's environmental and socio-economic performance throughout the product life cycle and value chain may affect most of the departments and functions of an organization. For example, an innovation that changes the material composition of a product not only affects its quality, price and environmental profile, but also raises questions regarding procurement of new material, potential new markets, consequences to the production process, new logistical demands, etc.

A life cycle perspective requires that all departments or functions work together, including product development, purchasing, production, logistics as well as marketing. All functions (illustrated in the following as departments) must therefore participate with ideas for initiatives and solutions, based on their particular expertise.

Each department within an enterprise operates to some degree inside "its own universe" – with its own projects, interests and priorities. A challenge for management is to highlight life-cycle-based environmental and socio-economic initiatives in every department. This can be done by establishing a cross-organizational group in order to provide the different departments and functions with inspiration, simple tools, etc. - and even more importantly to coordinate the different initiatives.

For an SME the number of departments might be limited. Here LCM might involve fewer people as they each cover more functions. For such an organization the description of the role of the different departments should be interpreted as the role of the different functions.

Anchoring Life Cycle Management in the every day practice of a company is crucial for success. That is also why building up the needed capacity in-house of a company often leads to a better and more rooted result compared to using external competences to handle the process.

The challenge of interdepartmental communication

Beware not to presume a shared view of the life cycle concept. A study of two large enterprises of the Swedish forest product industry revealed considerable differences in interpretation of the life cycle concept both within and between departments, in spite of many years of life cycle activities. Life cycle thinking was often mistaken as a synonym to carrying out LCA studies. Other interpretations include that the product had to be recycled or made out of renewable raw material. Due to these different interpretations, many of the employees failed to see any link between the life cycle ambition of the company and their own every day tasks and responsibilities.

Emma Rex,
Chalmers University of Technology, 2006

CHALMERS
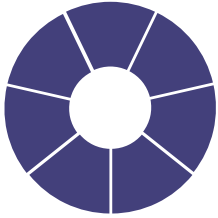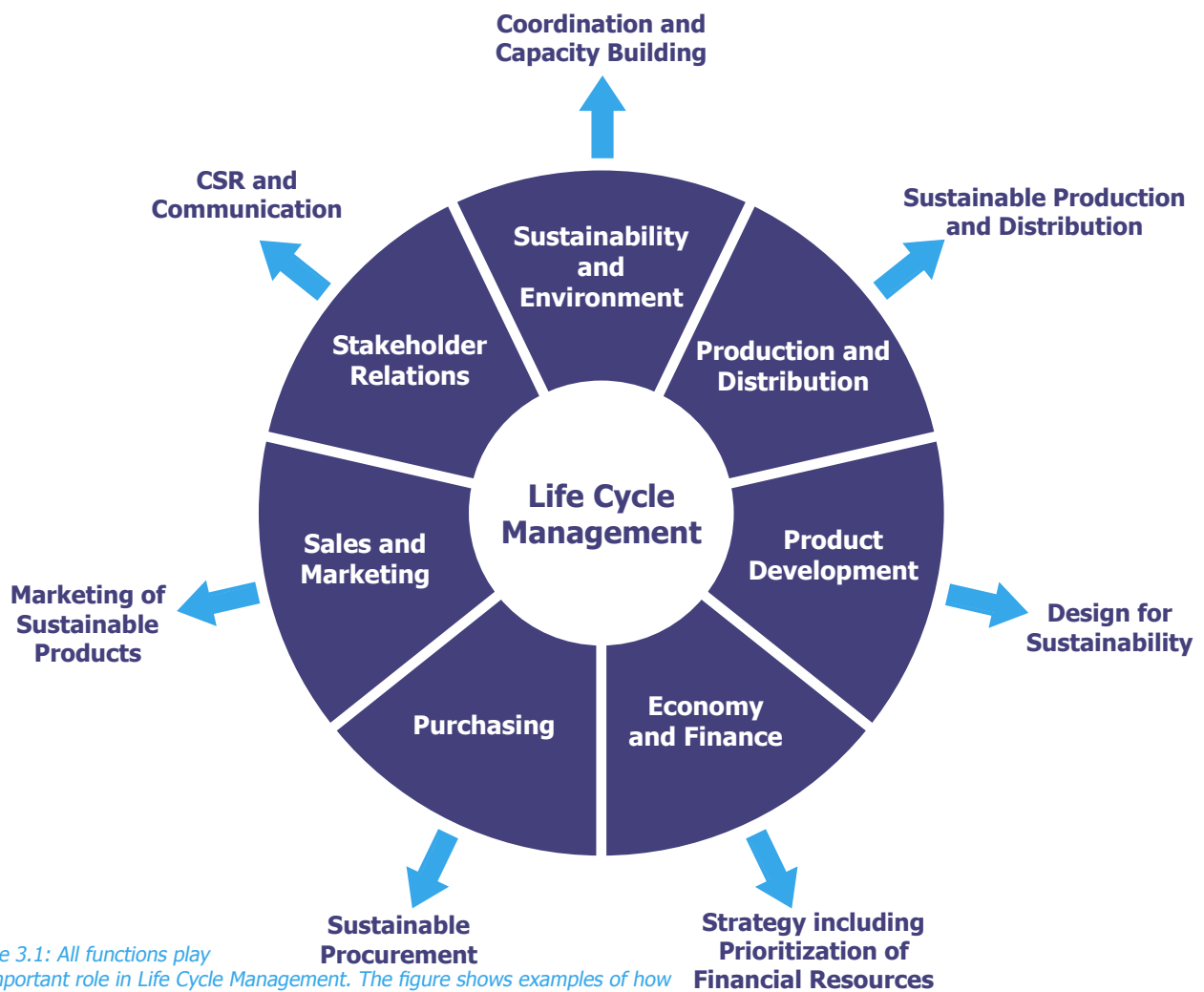
Figure 3.1: All functions play an important role in Life Cycle Management. The figure shows examples of how different departments in an organization can contribute to an LCM program.
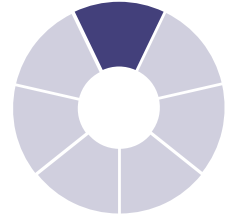
Sustainability and Environment
- How to build LCM in an organization

Companies with a department for sustainability, environmental and social responsibility can use it to coordinate the implementation and maintenance of a Life Cycle Management System.

Such departments are typically responsible for reporting developments within environmental and sustainable policy and they can provide valuable inputs through training of employees in the other departments. However, it is crucial that the whole company is motivated and speaks 'the same language'.

Most small and medium-sized enterprises (SMEs) do not have a sustainability department nor an environmental or quality department to take care of the necessary coordination of an LCM initiative. In this case a cross-organizational or cross-functional team with a representative from each relevant function can act as coordinator and at the same time make sure that everybody has the necessary tools and materials to inspire and carry out the initiative.

Green Management at SONY

The electronics giant SONY has developed a comprehensive system to integrate environmental responsibility into its business strategy and product design. A Group Environmental Vision sets out the company's long-term aspirations, and the "Green Management" group's environmental action plan defines the mid-term targets required of each business division.

Divisions must establish and implement annual business plans which incorporate environmental considerations. Explicit targets have been established such as to reduce product weight and to increase their recycled material content.

Reduction of the environmental impacts of products requires life cycle assessment from manufacture of parts and products, to transport, to use by customers, and to final disposal. SONY has developed a system to clarify the environmental impacts of products throughout their life cycle. This draws on data relating to product information, parts configurations, product transport conditions and other factors. Product design divisions can estimate CO_2 emissions at each stage of the life cycle. This enables SONY to identify products and stages with high environmental impacts, clarify improvement priorities and prepare targets. A product environmental data collection system gathers this data and allows SONY to monitor their product's environmental impacts.

SONY

www.sony.net

© 2007 Berendsen Textil Service A/S

Production and Distribution

Employees in a production department have a role to play in addressing the impacts associated with production processes and thus may actively contribute to reducing resource consumption and social and environmental impacts.

Production employees may contribute good ideas for concrete product and process improvements, as well as, finding and supplying data which specifically relate to a particular product. In addition, production employees have practical experience and insight regarding what is possible in the production process, which can help in identifying practical opportunities for improvements. A possible tool to be used is material flow cost accounting (MFCA), which split the production costs (materials, energy etc.) into a flow to products and a flow to wastes and grasp both the amount of materials and money in each process. It is used extensively in Japan, where about 100 companies use it.

Distribution is the link between all stages of a product's life cycle. Energy consumption is connected to transport of raw materials, as well as, finished products, and is generally a minor part of an enterprise's total energy consumption. Similarly, distribution of a consumer product such as a t-shirt is seldom identified as one of the significant areas of environmental impact in a life cycle assessment.

Nevertheless, a number of conditions within an enterprise may support transport-related initiatives. These may include a desire to influence the transport companies, to undertake more extensive environmental initiatives. Furthermore, as all products are distributed, transportation becomes important from the social perspective. Despite their relatively small impact transport related issues continue to grow and should be given appropriate consideration.

Laundering With Clean Conscience at Berendsen

At Berendsen Textil Service A/S, a Danish textile service provider, they know that they have a social responsibility to the communities where their laundries are located. Therefore, Berendsen is working to integrate people that are often considered socially vulnerable. This includes hiring people of non-Danish ethnic or cultural backgrounds, as well as, accommodating individuals who face challenges finding regular employment.

Life Cycle Assessments carried out by Berendsen have shown that laundering throughout the use phase of textiles has the greatest environmental impact of all of its life cycle stages. This is the basis for having the main environmental focus on the "production" at Berendsens own laundries. Since 1995 the company has had a benchmark system at the laundries called WECO. The WECO programme is still running and has lead to major environmental and cost savings at Berendsen due to reduced consumption of water, electricity, chemicals and oil/gas - in other words through cleaner production.
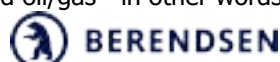
BERENDSEN   www.berendsen.com
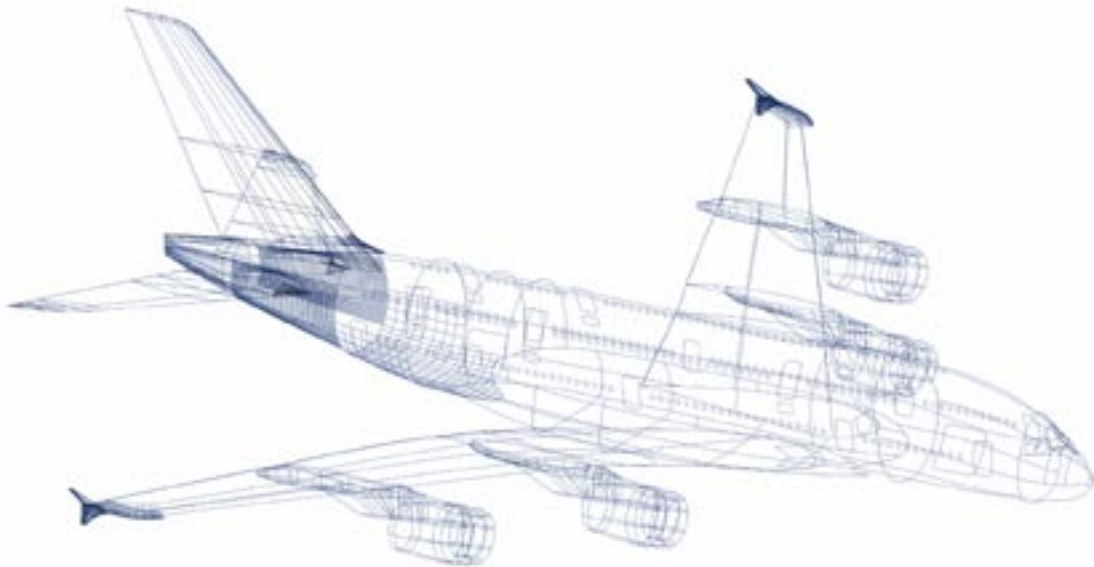
Product Development and Design

Integrating environmental and socio-economic concerns into product development and design is expected to reduce costs and promote innovation.

Design for Sustainability (Crul & Diehl, 2006) aims to introduce social and environmental aspects into products and modifies and inspires the classical product development process through the introduction of new concepts, ideas and activities. It is most effective, when integrated into established design and development processes, and when its objectives are aligned with the overall business strategy. Sustainable design is not a one-size-fits-all concept, but must be adapted based on the life cycle profile of the specific product, the business strategy, and the culture and capabilities of the organization. Further, it can be applied to both goods and services.

■ **New environmental profile – goals for product development**

■ **Environmental profile – existing product**

7) Optimisation of end-of-life system
Recycling of the product
Better collection and sorting
Reuse of materials
Cleaner waste incineration

0) New concept development
Dematerialising
Common use of the product
Integration of functions
From product to service

1) Selection of environmentally friendly materials
Fewer environmentally harmful materials
Renewable materials
Materials with a low energy content
Recycled materials
Recyclable materials

2) Less consumption of materials
Reduction of weight
Reduction of transport (volume)

3) Optimisation of the production technology
Use of cleaner technology
Fewer production processes
Lower energy consumption
Low waste generation
Fewer/cleaner secondary materials

4) Efficient distribution systems
Less packaging and more environmentally friendly packaging
Energy efficient forms of transport
Energy efficient logistics

5) Reduction of environmental impacts associated with product use
Low energy consumption
Cleaner energy source
Few necessary secondary materials in the product
Use / consumption
No use of energy / secondary materials

6) Optimisation of product life
Reliability and durability
Easy maintenance and repairs
Product with a module structure
Classic design
User takes good care of the product

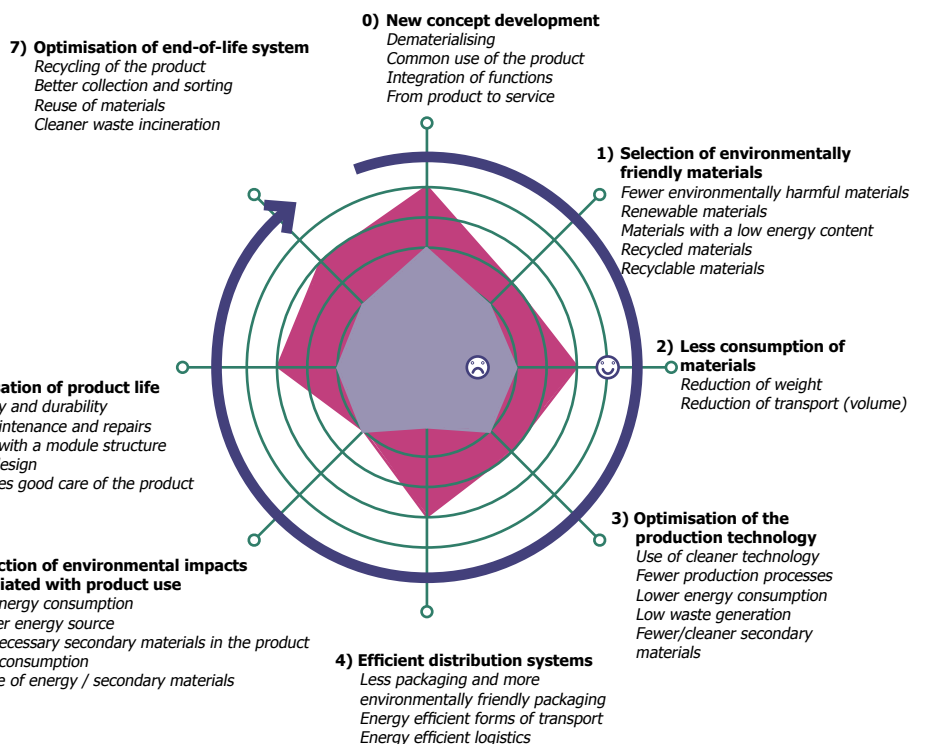*Figure 3.2: A product's environmental profile (adapted from Brezet & van Hemel, 1997)*

© 2005 Airbus S.A.S. - photo by exm company / H. Goussé

The premise of design for sustainability is that the function of the product is identified and the opportunities for improvement of environmental and social performance along with other criteria are identified, as well. Technical aspects, economy, design, quality, etc. are still crucial to the development of a product, but these aspects may be combined so that environmental and social considerations are given more weight, for example:

- **Move environmental and social considerations higher up on the design criteria list.**

- **Develop a new product with the starting point of social, ethical and environmental considerations - for example a new clothes collection based on organic cotton and fair trade.**

- **Make the existing product more sustainable, for example by replacing an environmentally harmful substance with a less harmful substance.**

- **Shift from producing a product to supplying a service - the sale of answering machines shifts to an electronic answering service delivered by the phone company.**

Based on a definition of the product system, the environmental and socio-economic aspects of a product are assessed from two different angles:

- **A product life cycle perspective with assessment of the environmental and socio-economic impacts of a product system with tools such as Life Cycle Assessment (LCA) or Life Cycle Costing (LCC).**

- **A stakeholder perspective with assessment of impacts based on the stakeholders' view such as legal requirements, market demands, and competitors' products. Quality Function Deployment (QFD), interviews, etc. are commonly applied tools.**

The radar plot (Figure 3.2) is an example of an overview of ideas for improvement within the different life cycle stages with special attention to environmental impacts.

A380 Designed to Reduce Fuel Consumption

In 1991 Airbus presented a vision for the future - an aircraft that would meet the demands of the 21st century with an ultra high passenger capacity.

Today the vision has become reality. In 2007 the first super jumbo aircrafts with a capacity of 555 passengers will start to operate.

The high passenger capacity with a 2-deck design and the use of new light weight materials has decreased the energy consumption per passenger dramatically.

A380 is expected to use about 3 litres of fuel per 100 passengers kilometres or about 40% less that the typical aircraft of today.

AIRBUS   www.airbus.com

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Bright Ideas Yields Green Flagships at Phillips

The EcoDesign procedures at Philips deal with all phases of product development. To support the EcoDesign process, Philips has their own EcoVision program which for products focus on the following six Green Focal Areas:

| Energy Consumption | Packaging | Hazardous Substances | Weight | Recycling and Disposal | Lifetime Reliability |

To be considered a Philips Green Flagship, a product must first go through divisional EcoDesign procedures. Next, the product or product family is investigated in at least three of the Green Focal Areas (including energy). Based on this analysis, the product or product family must be proven to offer a better environmental performance of more than 10% in one Green Focal Area with a Life Cycle Score on par (+/-5%), calculated with Philips' EcoScan tool.

During this investigation, a product or product family is compared with its predecessor or closest commercial competitors. When compared with more than one competitor, the results are expressed as an improvement compared to the average of the competitors' performance in the investigated focal areas. So while a product may be 'green', only Philips top EcoDesigned products achieve Green Flagship status.

An example of one of the more than 200 Philips Green Flagships on the market is shown on the picture above. Philips CosmoPolis street lighting systems are twice as efficient to run as older mercury vapor lamps. CosmoPolis systems provide a significantly better quality of light and contain industry leading low levels of mercury.

PHILIPS

www.philips.com/sustainability/report

Economy and Finance

Good financial performance is one major goal for organizations but investors, banks and stock-ranking institutions may also have an impact on driving organizations toward sustainability and Life Cycle Management. Traditionally, investors look for funds with calculated risks and some level of predictability. As the business climate changes, organizations that do not have a comprehensive approach to understanding and managing their environmental and social impacts will be viewed as a high-risk investment. This trend can be seen in the emergence and importance of business indexes such as the Dow Jones Sustainability Index applying economic, social and environmental criteria to assess and rank the sustainability of listed companies.

Insurance companies are also beginning to charge higher fees to customers, which appear to be a greater risk in terms of their environmental and/or social performance, both in their operations and product chains.

The existing regulatory framework acts as an important driver for organizations to consider, especially in regards to the environmental impacts of their operations and products. Liability for exceeding local air quality emissions limits, for example, can result in a bad image, fines and even licensing restrictions and related costs. The threat of retrospective liability makes a clear case for a proactive LCM approach to map all environmental and socio-economic aspects of the organization, its suppliers and customers to ensure life cycle information is available for decision making at all levels at all time.

Life cycle costs avoided at Johnson & Johnson

Johnson & Johnson tracks the life cycle costs avoided as a result of projects implemented by facilities to meet the Next Generation Goals.

Total life cycle costs include the costs of purchasing, transporting, storing, treating and disposing of materials.

By tracking both annual cost reductions and cumulative savings from prior years, Johnson & Johnson has built a strong business case for its environmental goals and programs.

Johnson & Johnson

2003 Environmental Costs & Cost Savings

CATEGORIES	ENVIRONMENTAL COST (MILLION $)	COST AVOIDANCE/SAVINGS (MILLION $)*
Labor	26.3	0.05
Wastewater Management	12.6	0.2
Hazardous NPO Management	21.9	11.6
Non-hazardous NPO Management	14.2	15.7
Toxic NPO Management	0.4	1.4
Air Emission Management	4.6	0.05
Management Systems	1.7	0.04
Regulatory Compliance	4.9	0
Governance	2.0	0
Consultants	4.2	0
Liabilities	6.3	0.04
Equipment	13.6	0.2
TOTAL	$112.7	$29.3
Manufacturing Materials		
Raw Materials	–	84.9
Packaging	–	29.4
Energy	–	11.9
Water	–	1.9
TOTAL	–	$128.1
Capital for Environmental Equipment	$41.4	–

*From implementation of NGG Projects

Source: J&J sustainability report 2003

www.jnj.com

Purchasing

When organizations purchase raw materials, semi-products, goods and services, they may use a supplier evaluation system, asking suppliers to provide specific information such as life cycle data and social responsibility in addition to the documentation of product safety. Those requirements are further imposed on the sub-suppliers in the product chain. Rather than playing 'catch-up' or just reacting to demands, firms have the opportunity to use a proactive life cycle approach to manage their environmental impacts together with more traditional cost-driven supply chain management efforts.

The purchaser has an important role in selecting the optimal raw materials and products for production. Consequently, a buyer requires some tools, which integrate environmental and social considerations together with other factors such as price, quality, and functionality.

Purchasers are able to encourage environmental considerations at their suppliers via questions and demands. A purchaser may request the following information:

- **Overview of the supplier's environmental and social initiatives as well as policies;**

- **Documentation of the impacts from the previous life-cycle stages;**

- **Overview of working conditions at suppliers and sub-suppliers; and/or**

- **Specific environmental and social data regarding raw materials, secondary materials, etc.**

Communication may be broadened to include dialogue and collaboration, where the enterprise contributes ideas and constructive criticism regarding improvements at the supplier's end. The purchaser may take on the role of a critical, environmental and socially conscious customer with numerous demands, or the role of a collaborative partner working together on creating mutual advantages associated with the product's development.

Suppliers of IKEA Must Take the IWAY to Sustainability

IKEA products shall be manufactured under acceptable working conditions by suppliers who take responsibility for the environment. For that reason, in 2000 the company established a code of conduct "The IKEA Way on Purchasing Home Furnishing Products" (IWAY).

IWAY specifies the minimum criteria for the supply chain and what suppliers can expect of IKEA. IKEA

© 2007 LEGO Group

### First with a "Code of Conduct"

The Danish-based company LEGO is the sixth-largest manufactures of toys with production in several countries. LEGO has an annual revenue of about 1 billion € and more than 5,000 employees around the world.

In 2003 LEGO was the first play material manufacturer to join the UN Global Compact Initiative and its principles.

As early as 1997 LEGO introduced a set of guidelines – a Code of Conduct – outlining what ethical, social and environment, health and safety requirements it expected of itself and its supplier companies. This code covers:

- Child labour
- Compensation and working hours
- Discrimination
- Coercion and harassment
- Forced and compulsory labour
- Health and safety
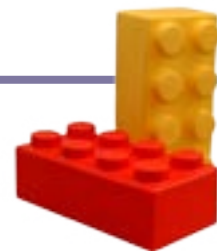
- Freedom of association
- The environment
- Anti-Corruption

The suppliers are audited by independent auditors.

www.lego.com

suppliers are themselves responsible for ensuring that their own suppliers also fulfil IWAY criteria.

There are rules for working conditions, minimum wages, overtime rates, trade union representation rights, waste management, chemical management, and emissions to air and water. IKEA will not tolerate child labour, discrimination or the use of timber from intact natural forests.

IKEA has few factories of its own. Instead production takes place at

around 1,600 suppliers in Europe, Asia and North America, frequently in low-cost countries. By helping suppliers to live up to the IWAY criteria, IKEA also helps to raise standards and increase prosperity in developing countries.

IKEA has specially trained inspectors who visit suppliers all over the world. They continually check that IWAY criteria are met, and help suppliers who are experiencing difficulties. IKEA also employs independent auditors to carry out random checks and verify working methods and results.

IKEA's work with social and environmental issues is an ongoing process. The many small steps forward are an expression of IKEA's aspiration for continuous improvement.

www.IKEA-goup.ikea.com
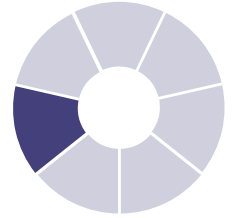
Sales and Marketing

The market is an important driver of Life Cycle Management and mostly in areas with strong competition. Front-runner companies are using LCM to differentiate themselves from their competitors and to benefit from innovation and increased competitiveness. In terms of opportunity, the market offers advantages to organizations that are the first to move on these issues. Thus, the employees responsible for sales and marketing have an important role in a life cycle initiative, ensuring a good flow of information to and from the customers.

Knowledge regarding consumer behaviour and preferences is crucial for developing and marketing sustainable products. Consumer and market surveys provide knowledge regarding consumer preferences and the priority level that they give to environmental and social considerations. However, a dilemma in market surveys is a difference between what consumers say and how they act.

Information sent to customers provides the enterprise with an opportunity to increase the awareness about a product's environmental and social impacts. Sales employees must have enough knowledge on these issues to be able to advise customers regarding a product's eco-friendly use and disposal. An investigation of the consumers' use of a product may reveal inappropriate aspects of its use, thus giving product developers new knowledge and inspiration for future improvements.

Sales and marketing departments or divisions must have enough social and environmental knowledge that they can profile the enterprise's products relative to their competition. This requires that sales employees are familiar with criteria for ecolabelling, green public procurement guidelines, etc.

1200% Increase in Sales

In 1999 the National Consumer Agency in Denmark tested a range of textile detergents and came to the result that Coop's detergent Bluecare with the Nordic Swan ecolabel was the most efficient, most environmentally friendly and among the cheapest of the products.

The results were referred to in almost all of Denmark's media outlets and were an eye opener to consumers that ecolabels like the Nordic Swan consider more than just environmental aspects. The sales of the Bluecare detergents increased by a factor 12 due to the test results, and other ecolabelled products in the Coop Blue Care series increased their sales, as well.

A similar test in 2006 once again showed that the ecolabelled products were efficient and cheap. Coop's textile detergent Änglamark Bluecare once again was the test winner.

www.coop.dk

© 2007 Steelcase Inc.

Life Cycle Thinking at Steelcase

The Steelcase sustainability mission is to create and provide products that advance environmental and human health, social responsibility and economic prosperity. Steelcase also works to further the science and practice of sustainability with customers, business partners, and environmental thought leaders.

In the company's experience, life cycle assessments (LCA) enable continuous improvement throughout each stage of a product's life. They are the foundation for developing life cycle based environmental declarations that provide a technical and transparent evaluation of how a product performs in every stage of its life.

Steelcase is the first contract furniture company to offer Environmental Product Declarations (EPDs) with their award-winning Please chair. Today, Steelcase provides EPDs on every new international product. The LCA studies and EPDs are conducted by external experts and each LCA and EPD is reviewed by an independent third party.

Life cycle assessments and Environmental Product Declarations are important tools in Steelcase's long-standing commitment to innovation, quality, and sustainability.

Steelcase

www.steelcase.com
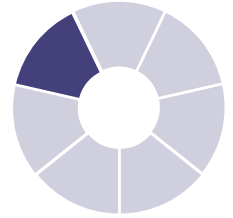
Stakeholder Relations

Companies do not operate alone. Employees as well as suppliers and customers are obvious stakeholders – without whom the enterprise would not exist. In addition, financial institutions and public authorities also have a crucial role to play as primary stakeholders.

Stakeholders are in principle any party that has an interest ("stake") in a company or its products. As illustrated in Figure 3.3 several other secondary stakeholders exist throughout the product life cycle. How important these stakeholders are to a company will depend on the specific case and context.

The reason for the increasing focus on stakeholders is that the global activities of business have various impacts along the product chain. Organizations are held accountable for these impacts by a number of different stakeholders. Therefore, identification and engagement with stakeholders is necessary to anticipate their opinions on the business, products and services and to identify what really matters to them.

Some of the possible benefits and outcomes of stakeholder collaboration and communication are listed in Figure 3.4. However, it is not always easy to measure the benefits of engaging in closer collaboration and communication with stakeholders.

To learn more about " the principles of systematic stakeholder engagement" please consult "The Stakeholder Engagement Manual" of UNEP
www.unep.fr/outreach/home.htm

Figure 3.3: Stakeholdes for a business and it's products.
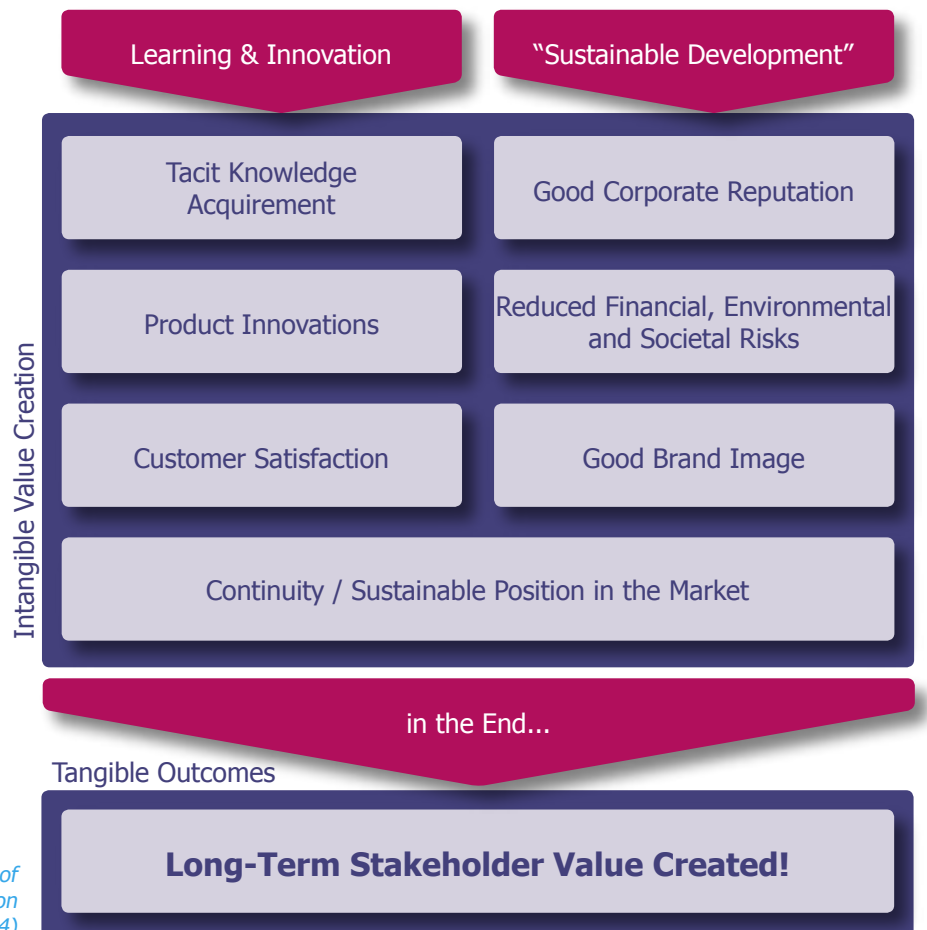
Figure 3.4: Possible benefits and outcomes of stakeholder collaboration and communication (adapted from Wuppertal Institute, 2004)

Implementation of Life Cycle Management - A Step by Step Approach

Based on the ISO management system standards for environment (ISO 14000) and quality (ISO 9000), this section introduces some key terms and recommendations on a systematic approach to life cycle management.

The approach addresses the classical management areas:

- **Policy, objectives and targets**
- **Action plans and programmes**
- **Procedures and instructions**
- **Monitoring and registration systems**
- **Documentation and reporting as well as communication along the product life cycle**

Special attention is given to activities that can secure continuous improvement. For that the "Plan-Do-Check-Act Cycle" is applied as in several management standards. This step-by-step approach helps generate a systematic approach to management along the product life cycle as illustrated in Figure 4.1.

1. Set policies - set goals and determine the ambition level
2. Organize – get engagement and participation
3. Survey – overview of where the organization is and wants to be
4. Set goals – select areas where the efforts will be directed, determine goals and make an action plan
5. Make environmental and social improvements – put the plan into action
6. Report – document the efforts and their results
7. Evaluate and revise – evaluate the experience and revise policies and organizational structures as needed
8. Take it to the next level - Set up new goals and actions, more detailed studies, etc.

PLAN DO CHECK ACT

Figure 4.1: Phases of the step-by-step approach.

Policies

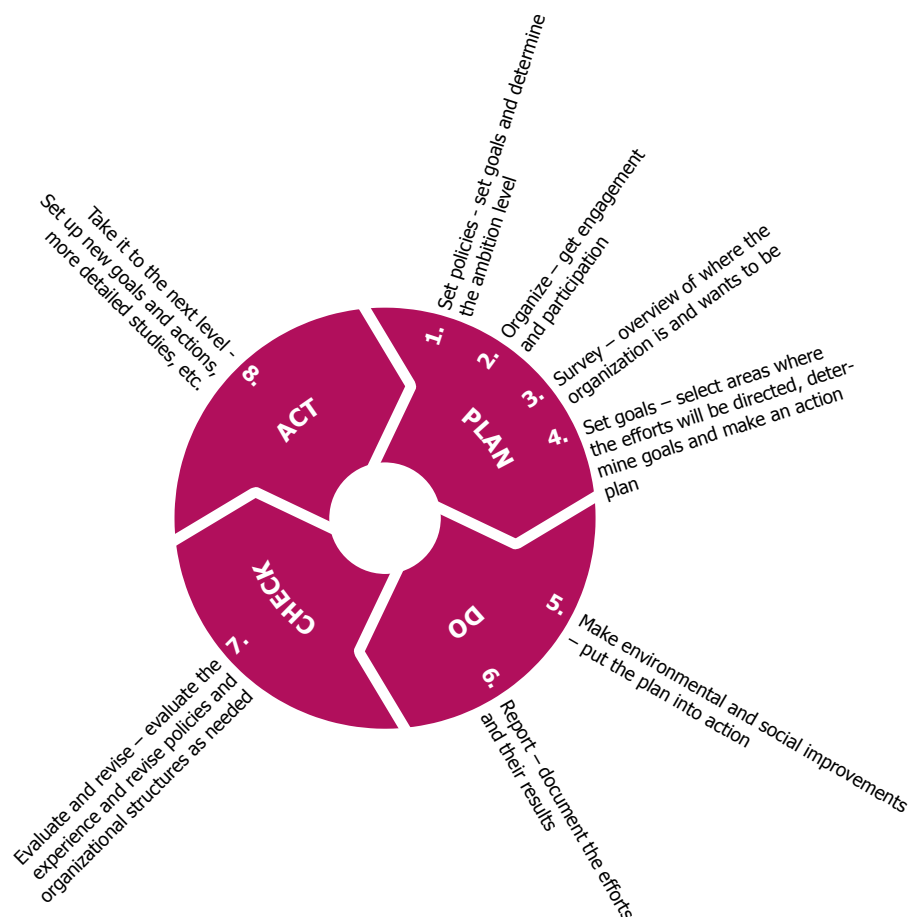Life Cycle Management should become part of an organization's policies so that its importance rings through all levels of the organization. A policy should be visionary with a long-range focus, while also being realistic and concrete, grounded by its ambition level. Setting goals according to the level of ambition ensures conformity between policy and actions.

There are at least three different level of ambition:

- **Internal readiness and commitment to continuous improvements.** This level signifies awareness that environmental and social improvements can be made using management frameworks such as ISO 9001, ISO 14001 and/or corporate social responsibility (CSR), and that a commitment to improvements of product performance is the first step towards LCM.

- **Life cycle improvement of products.** An organization understands the value of addressing its products beyond the manufacturing level, for instances, in materials selection and acquisition, use

of product, distribution and end-of-life – based on a screening of the product's performance.

- **Product profiles to the market.** The environmental and social profile of the product can create competitive advantages. However, these improvements should be supported by proof, such as a life cycle assessment, to avoid 'greenwashing'.

These ambition levels help an organization to understand where to begin. A less experienced organization can easily 'graduate' to higher ambition levels as knowledge and familiarity associated with putting plans into action are achieved.

Furthermore, the policy must provide sound strategies and objectives for improvements in all relevant stages from cradle to grave. The definition of the product profile should take into account legal requirements, an evaluation of the impacts along the life cycle and other interested parties' demands. It should also answer such questions as: Where are we in comparison to our competitors? Do

we have the necessary information on supplied parts and materials? Are environmental quality and social concerns of our customers being fulfilled?

When the policy has been set, the next steps are to organize the effort and set up specific targets.

Quotes from the Environmental Policy of Konica Minolta

"The Konica Minolta Group aims to promote sustainable development and profitable growth. We integrate environmental, economic and social perspectives into our business strategies...
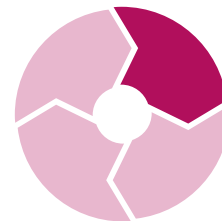
Consideration for the environment throughout the entire life cycle of products and services..."

Konica Minolta Holdings Inc., 2006
President and CEO Yoshikatsu Ota

KONICA MINOLTA

www.konicaminolta.com

Organize
- Commitment and Cross Functional Teams

As noted earlier, top management must be an integral part of the initiative, with different parts of the organization participating in the process.

Responsibility within a coordination group shopuld lie with a team leader, who is responsible for ensuring that the group functions, meetings are arranged, minutes are taken, etc. The members of the coordination group should be selected so that all relevant departments or functions are represented, including top management, product development, production, product distribution, sales, marketing, and purchasing.

Cross functional teams may be established in order to work on specific issues. Some groups are permanent in order to secure continuous improvement of the environmental performance, for example, an energy group involving employees from production and product development. Other groups could be ad hoc in order to implement a specific task, e.g. a supplier evaluation scheme with involvement of people from purchasing, product development and marketing.

For small or medium sized (SMEs) organizations a single but permanent cross functional team might be the best solution, but it depends on the specific structure and culture of the organization.

Implementation in the organization requires the allocation of appropriate resources, assignment of responsibilities for the different tasks, building expertise based on practical experience as well as procedures and instruction to ensure that activities are running properly.

Cross-functional teams

FORD of Europe uses a Product Sustainability Index (PSI) to translate sustainability aspects to the organization of vehicle product development. PSI limits the scope of those key environmental, social and economic characteristics of passenger vehicles that are controllable by the product development organization. PSI considers environmental, economic and social aspects - based on externally reviewed LCA and Cost of Ownership/ Life Cycle Costing (LCC), externally certified aspects (allergy-tested interior) and related aspects such as sustainable materials, safety, mobility capability and noise. The tool is an easy to use spreadsheet which requires only one hour of training before it can be used by engineers. PSI has been integrated into the existing decision-making process. It allows non-experts to manage key environmental, social and economic aspects in the product development. This allows mainstream functions to take ownership of sustainability and assigns accountability to those who can really decide on changes affecting the vehicle's sustainability performance.

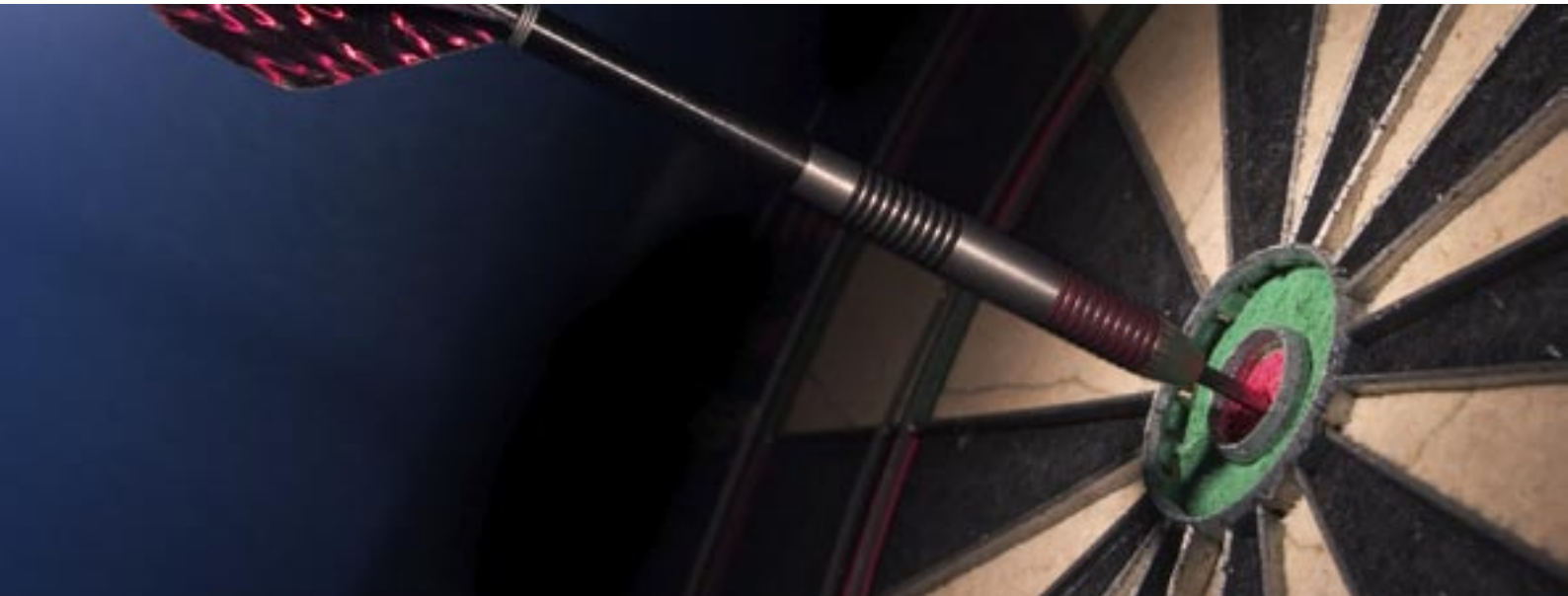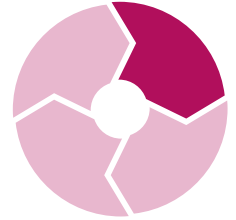Source: Wulf-Peter Schmidt, FORD

www.ford.com

Survey/Review
- Overview of Status

An initial review of an organization's products or services is a good way to identify where and how it will initiate the LCM process. The review should cover information pertaining to a particular product as well as the knowledge related to the market and external stakeholders, including pressure groups. Extending this to cover suppliers, business associations, authorities, retailers, research institutions, etc. ensures that important aspects are not missed.

Furthermore, a standard like ISO 14031 on environmental performance evaluations can assist companies in evaluating performance against their policy, objectives, targets and other criteria in relation to their products. The recommendations of ISO 14031 can also be applied to address other management aspects e.g. quality or health and safety; and from a sustainability perspective economic and social aspects, as well.

ENVIRONMENTAL & SOCIAL IMPACTS

- Life cycle stages – where are the most important environmental and social impacts?
- Technology – is there a new technology available or being developed that can reduce the impacts?
- Do the competitors have the same impacts - and how do they address them?

STAKEHOLDERS

- Product chain actors – are suppliers, retailers, or others interested in collaboration on environmental and social initiatives?
- Authorities – what are the demands of authorities?
- Within sector – what are competitors doing? Codes of conduct within the trade?
- Which is the main pressure group - and what are their main concerns and prorities?
- What are the main concerns and demands of consumers in export markets?

MARKET/COMMERCIAL CONDITIONS

- Supply – what are the product profile's characteristics?
- Demand – how important is the social and environmental awareness of consumers and customers?
- Value – what advantages are achieved by adding positive environmental and social characteristics as an extra product quality?

Figure 4.2: Aspects of a survey.

Set Objectives and Targets

Responses to the questions listed in Figure 3.2 provide a basis for selecting areas, where product improvements are worth pursuing. In some cases the social and environmental problems identified by an organization may be solved by another's efforts, for example, the invention of a new technology or a supplier phasing out harmful substances due to pressure from other stakeholders.

Based on the current situation and knowledge, an enterprise must decide which areas will be prioritized regarding LCM initiatives. This decision may be made based on:

- **Relevance**
  Where are the most significant problems in the product's life cycle?

- **Potential**
  Where is it possible to achieve environmental and social improvements?

- **Influence**
  Where can the organization make a real difference?

- **Economic Feasibility**
  Is the initiative economically feasible?

High relevance and high influence yield high potential for real improvements.

An enterprise may have several opportunities for improvements, so it should choose several initiative areas to involve as many of the departments as possible – for example, procurement and logistics as well as product development.

Dialogue with stakeholders is part of getting an overview of legal and other requirements including environmental and social concerns. Furthermore, dialogue is also important when setting up objectives and targets. Targets for improvement of a product's characteristics will also have an impact on customers' expectations and responses.

Concrete goals and an action plan must be defined for each initiative. An action plan is a means of explicitly stating the goals, delegating responsibility and setting the time frames, so the plans and initiatives are clear for both management and employees.

Targets for sustainability at ABB

ABB is a global leader in power and automation technologies. Sustainability is integrated into all daily business decisions, and ABB aims to contribute to economic growth, environmental stewardship and societal development through its businesses. To ensure continues improvements new objectives and targets are defined every year. Some examples of previous targets from ABB are shown below.

"Introduce water-borne paint for robots to reduce emission of solvents"

"Conduct training courses for relevant groups of employees on human rights issues"

"Establish and formalize system for the sustainability assessment of customer projects"

"Establish action plan to compensate for ABB's own emissions of greenhouse gases"

www.abb.com

42

Put the Plan into Practice

Planning is important, but practical implementation is vital, as practical results create credibility, enthusiasm, and active support for a product initiative. Focusing on the entire life cycle of a product will identify numerous possibilities for obvious improvements – the "low-hanging fruit" or "easy rewards" which will improve a product's profile. Focussing on a concrete problem will generate ideas for improvements.

Aside from the easy improvements, an organization can choose new challenges to tackle, which might include addressing new or potential issues. For example, what if regulations change and companies are required to take back all of their products at the end of life? Such a demand would, of course, be added to an enterprise's list of initiative goals and an action plan. The company could implement life cycle thinking to engage a re-design of the product to meet the requirements of the legislation, including easier recycling, simple disassembly, new materials selection, etc.

In order to secure continuous improvements of the product, written

procedures or instructions should be established. They can define methods of operation to be followed and guarantee continuity when people change jobs or new staff are hired. It does not imply the development of a handbook or instructions for every action - but rather only for key activities.

Existing practices and the view of key persons have to be taken into account, in order to make the procedures work and to be part of the daily practice. The procedures should be established to support activities that are agreed to as 'standard' in the organization.

Nokia's effort to fit life cycle knowledge into practice

Nokia has been involved with LCAs and developing them since mid 1990s. This firm uses LCAs as a strategic tool to assess the environmental impacts of its products and conducts periodic LCAs whenever there is a major technology shift like from 2G mobile phones to 3G mobile phones. This organization also has an IPP (Integrated Product Policy) approach to "reduce the environment impacts from products through their life-cycle, harnessing, where possible, a market-driven approach, within which competitiveness concerns are integrated". The company is working on developing suitable methods for environmental assessments of electronic products, an example of this being the Key Environmental Performance Indicators (KEPIs). KEPI consists of a small number of product environmental performance indicators validated as representative of the most important environmental impacts of an electronic product life cycle, and may provide a good and simple assessment tool for use in the electronics industry. Nokia also applies other tools such as the Ecological Footprint Analysis (EFA) and MIPS (Material Input per Service Unit).

"Successful business requires a solid product life cycle based environmental performance"
Environmental Report of Nokia Corporation, 2004

NOKIA

www.nokia.com

Report
- Document Efforts and Results

With regard to the commitment of management and employees, it is crucial that the results of the LCM efforts are documented, and that they are made publicly available. Such documentation gives credibility when answering inquiries from customers, suppliers, etc. The form of documentation is completely dependent upon the ambition level in the organization. It is advantageous for organizations to have some insight into the kind of environmental and social impacts that the stakeholders prioritise, so that communication can be tailored to meet these demands. Some ideas can be adopted from the Sustainability Reporting Framework established by the Global Reporting Initiative (GRI). This could include using performance indicators to report progress, such as those found in the GRI Guidelines or to have some guidance on how to deal with boundary of responsibility issues, as addressed in the GRI Boundaries Protocol. See: www.globalreporting.org

Corporate accounts and environmental reports, which already contain details of an enterprise's social and environmental initiatives, may be redirected to be more product-oriented, thus providing a good forum to document results and make them visible to the public. Product-oriented environmental reporting may address some of the following:

- **To what degree has the energy consumption of the product through the entire life cycle stages been reduced?**

- **How much of the product can be recycled?**

- **To what degree and how has distribution and transport been optimized?**

- **Which social improvements have been carried out affecting relevant stages of the life cycle?**

- **Etc.**

Results may also be made visible by calculating some key figures, for example energy consumption during the production of the product. The key figures and the practical results of the initiatives can be made public via for instance a leaflet, an eco-label, or an environmental product declaration.

Internal as well as external communication is a necessary precondition for achieving the benefits of LCM initiatives.

Figure 4.3: Many companies report on sustainability to their stakeholders.

Evaluate and Revise

After completing the first round of improvements to the life cycle profile of a product, a good idea is to "take a deep breath" and evaluate the experience:

- **What went well? And what did not?**
- **Which risks were identified?**
- **What preventive actions should be taken?**
- **Were the goals met?**
- **How can the effort be improved?**
- **Should more employees be involved in the initiative?**
- **Should the efforts be focused in a different direction?**
- **Were the appropriate means and methods used?**
- **What was the influence on sales and customer demands?**
- **Should more stakeholders be involved?**
- **Should the level of ambition be raised?**

Such an evaluation, conducted at least once a year, makes an excellent forum for adjusting an organization's policy so that it is consistent with the actual efforts. After such an evaluation an organization may decide to continue at the same ambition level until the internal commitment and readiness to undertake initiatives are well established or until stakeholders voice demands regarding more extensive environmental and social commitment, and thus a higher ambition level.

Remember that the idea behind a step-by-step approach is ensuring the interaction between developing knowledge of a product's environmental and social impacts, market demands, etc. and the implementation of concrete product-oriented improvements.

Checking also involves the measurement, monitoring and evaluation of activities, products and services as well as of the management system, itself. Important elements are:

- **Monitoring** the performance of the processes and products in view of the defined objectives and targets, with the support of indicators.

- **Feedback and criticism** from customers and other parties are an important information source for organizations to improve products, as well as the product development process;

- **Establishment of preventive and corrective actions** for potential and actual non-conformities with requirements

- **Conducting internal audits** to determine and provide information to management on whether LCM conforms to plans, has been properly implemented, as well as, to identify improvement options.

Take it to the Next Level

The annual cycle "ends" or "begins" with a 'review and set directions phase'. The top management review, which addresses the possible need for changes to policy, objectives and other elements of the system in the light of audits, evaluations, changing circumstances provides management with the opportunity to continuously improve the organization and their products' performance.

Through the experience from the first round of improvements, an enterprise has likely identified areas for further investigations or initiatives.

If an organization's customers request documentation on the impacts of a product then a simple environmental assessment is appropriate. If it becomes evident that there are significant environmental impacts in the use stage of a product, then an investigation of consumers' desires and demands would be an obvious starting point of further consideration. If an enterprise uses chemicals or materials, which are on the list of undesirable substances, it would be sensible to begin phasing them out.

On the basis of experience, the initial area and goal(s) are redefined and a new round of efforts begins with plans, improvements, etc. Focus should remain on achieving specific environmental and social improvements to the product profile, while realizing results achieved throughout the improvement process.

During this and subsequent stages, the organization can begin (or continue) to broaden its relationship in the product chain – it is much easier to develop a base of knowledge if there is cooperation and an atmosphere of trust among producers, suppliers, retail store owners, disposal facilities and other stakeholders in the product chain.
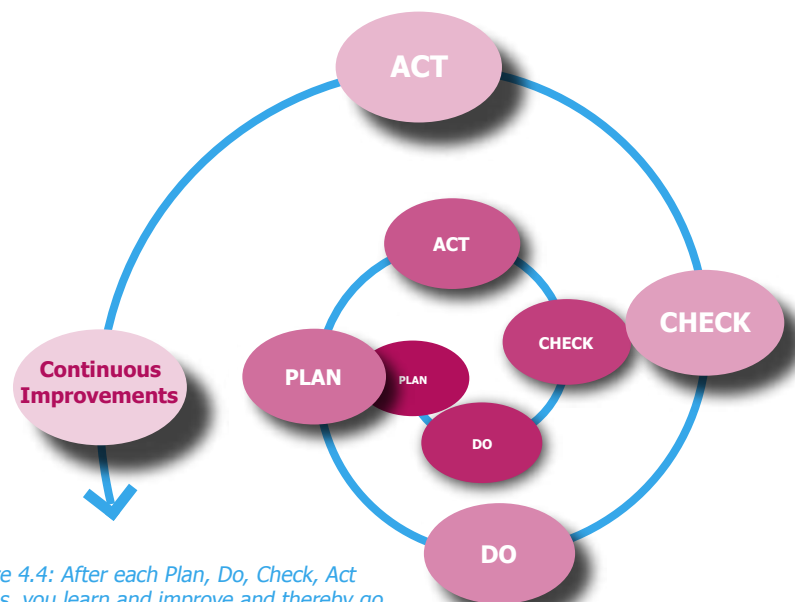
Figure 4.4: After each Plan, Do, Check, Act cyclus, you learn and improve and thereby go to "the next level".

Further Reading and References

Life Cycle Management

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Other

> **ISO 14040:2006, Environmental management – Life cycle assessment – Principles and framework.** International Organization for Standardization.

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> **The Innovation High Ground: How Leading Companies are Using Sustainability-Driven Innovation to Win Tomorrow's Customers.** Arthur D. Little Global Management Consulting, 2005.

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> Elkington J (1997): **Cannibals With Forks: The Triple Bottom Line of 21st Century Business.** Capstone, New Society.

Glossary (of concepts and tools mentioned but not explained in the text)

Cleaner Production Assessment (CPA): Cleaner Production Assessment is structured methodology to systemically identify and evaluate Cleaner Production opportunities and facilitate their implementation.

Cost of Ownership: A financial estimate designed to help consumers and enterprise managers assess direct and indirect costs related to the purchase of any capital investment.

Cost Benefit Analysis (CBA): Estimates and totals up the equivalent money value of the benefits and costs to the community of projects to establish whether they are worthwhile.

Cumulative Energy Requirements Analysis (CEPA): Quantify the primary energy requirement for products and services in a life-cycle perspective.

Eco-efficiency Analysis: Eco-efficiency can be defined as maximizing the economic efficiency while minimizing the impact on the environment.

Environmental Impact Assessment (EIA): The process of identifying and evaluating the consequences of one economic activity on the environment and, when appropriate, mitigating those consequences. EIA is used as an aid to public decision making on larger projects.

Environmental Product Declaration (EPD): Declaration of a product's performance with regard to different environmental parameters during the products life cycle either cradle-to-grave or cradle-to-gate.

Environmental Risk Assessment (ERA) is the examination of risks resulting from technology that threaten ecosystems, animals and people.

Green (or Sustainable) Procurement: "A concept for reducing the environmental burden by buying products with a reduced environmental impact compared to similar products.

Input-Output Analysis: An economic tool used to measure impacts of an existing, proposed, or anticipated business operation, decision, or event on the economy.

Life Cycle Assessment (LCA): "Compilation and evaluation of the inputs, outputs and the potential Environmental Impacts of a Product System throughout its life cycle".

Life Cycle Costing (LCC): "All costs associated with the system as applied to the defined life cycle".

Material and Substance Flow Analysis (MFA/SFA): "Mapping of the total use, recycling and disposal of a specific material or substance in a defined region."

Material Input per Unit Service (MIPS): A measure of the Environmental Impact potential of goods defined as the weighted cradle-to-grave material inputs per units of services obtainable.

Product environmental performance indicators: Describe products impacts on living and non-living natural systems, including ecosystems, land, air and water.

Product-Oriented Environmental Management Systems (POEMS): Environmental management system focusing on the life cycle of the products and intermediates that passes through the company's operations.

Product Stewardship: A product-centered approach to environmental protection that calls on those in the product life cycle (manufacturers, retailers, users, and disposers) to share responsibility for reducing the environmental impacts of products.

Quality Function Deployment (QFD): A method for the systematic analysis of "the voice of the customers" and relationships between these quality requirements and the product structure.

Supply Chain Management: An information management tool, which integrate procurement, operations, and logistics from raw materials acquisition to customer satisfaction.

About the UNEP/SETAC Life Cycle Initiative

The Global Life Cycle Initiative was established by UNEP and SETAC. Among other things, the Life Cycle Initiative builds upon and provides support to the ongoing work of UNEP on sustainable consumption and production, such as Industry Outreach, Industrial Pollution Management, Sustainable Consumption, Cleaner and Safer Production, Global Reporting Initiative (GRI), Global Compact, UN Consumer Guidelines, Tourism, Advertising, Eco-design and Product Service Systems.

The Initiative's efforts are complemented by SETAC's international infrastructure and its publishing efforts in support of the LCA community.

The Life Cycle Initiative is a response to the call from governments for a life cycle economy in the Malmö Declaration (2000). It contributes to the 10-year framework of programmes to promote sustainable consumption and production patterns, as requested at the World Summit on Sustainable Development (WSSD) in Johannesburg (2002).

Our mission is to develop and disseminate practical tools for evaluating the opportunities, risks, and trade-offs associated with products and services over their entire life cycle to achieve sustainable development.

The programme's aim is to put life cycle thinking into practice and improve the supporting tools through better data and indicators, by hosting and facilitating expert groups, and disseminating their work through webbased information systems.

> The Life Cycle Management (LCM) programme creates awareness and improves the skills of decision-makers by producing information materials, establishing forums for sharing of best practices, and carrying out training programmes around the world.
> The Life Cycle Impact Assessment (LCIA) programme increases the quality and global reach of life cycle indicators by promoting the exchange of views among experts whose work results in a set of widely accepted recommendations.
> The Life Cycle Inventory (LCI) programme improves global access to transparent, high-quality life cycle data.

For more information, see
www.uneptie.org/pc/sustain/lcinitiative

Sponsors of the UNEP/SETAC Life Cycle Initiative

> **Government of Germany**
> **Sustainability Victoria**
> **Association of Plastics Manufacturers in Europe**
> **American Plastics Council**
> **Plastic Waste Management Institute**
> **International Council on Mining and Metals (ICMM)**

About SETAC

The Society of Environmental Toxicology and Chemistry (SETAC) is a professional society, in the form of a not-for-profit association, established to promote the use of a multidisciplinary approach to solving problems of the impact of chemicals and technology on the environment. Environmental problems often require a combination of expertise from chemistry, toxicology, and a range of other disciplines to develop effective solutions. SETAC provides a neutral meeting ground for scientists working in universities, governments, and industry who meet, as private persons not bound to defend positions, but simply to use the best science available.

Among other things, SETAC has taken a leading role in the development of Life Cycle Management (LCM) and the methodology of Life Cycle Assessment (LCA). The organisation is often quoted as a reference on LCA matters.

For more information,
see **www.setac.org**

About the UNEP Division of Technology, Industry and Economics

The UNEP Division of Technology, Industry and Economics (DTIE) helps governments, local authorities and decision-makers in business and industry to develop and implement policies and practices focusing on sustainable development.

The Division works to promote:
> sustainable consumption and production,
> the efficient use of renewable energy,
> adequate management of chemicals,
> the integration of environmental costs in development policies.

The Office of the Director, located in Paris, coordinates activities through:

> **The International Environmental Technology Centre** - IETC (Osaka, Shiga), which implements integrated waste, water and disaster management programmes, focusing in particular on Asia.

> **Sustainable Consumption and Production** (Paris), which promotes sustainable consumption and production patterns as a contribution to human development through global markets.

> **Chemicals** (Geneva), which catalyzes global actions to bring about the sound management of chemicals and the improvement of chemical safety worldwide.

> **Energy** (Paris), which fosters energy and transport policies for sustainable development and encourages investment in renewable energy and energy efficiency.

> **OzonAction** (Paris), which supports the phase-out of ozone depleting substances in developing countries and countries with economies in transition to ensure implementation of the Montreal Protocol.

> **Economics and Trade** (Geneva), which helps countries to integrate environmental considerations into economic and trade policies, and works with the finance sector to incorporate sustainable development policies.

UNEP DTIE activities focus on raising awareness, improving the transfer of knowledge and information, fostering technological cooperation and partnerships, and implementing international conventions and agreements.

For more information,
see **www.unep.fr**

The journey towards sustainability requires that companies must find innovative ways to make profits and at the same time extend the traditional boundaries of business to include the environmental and social dimensions, a process known as "the Triple Bottom Line", which introduces the process of "Life Cycle Thinking" .

LCM is not a single tool or methodology but a management system that collects, structures and disseminates product-related information from various programs, concepts and tools. It incorporates environmental, economic, and social aspects of products, and is applied in every part of the product's life cycle. The organization must 'go beyond its facility boundaries' and be willing to expand its scope of collaboration and communication to all stakeholders in the value chain.

LCM can be specifically adapted and gradually introduced into any organization, including SMEs.

This Guide contains many examples illustrating how business organizations are putting life cycle thinking into practice all over the world.

The cover illustrates the life cycle of a basketball. Rows represents the three dimensions of sustainability - people, planet and profit and the columns depict the stages of the life cycle - raw material extraction, research & development, manufacturing, transportation, use and disposal.