4 Implementing Ecodesign

4.1 The First Steps

4.1.1 Steps to Introduce of Ecodesign

Ecodesign is still at an embryonic stage and until now has been undeveloped in several countries in the European Union, and even more so in the rest of Europe. The vast majority of industrial enterprises continue to manufacture products without taking environmental issues into account. Nevertheless, in recent years some environmental improvement has been noted in many products, mainly in the use of recycled materials, the incorporation of available technological advances at the production stage, and the reduction of the weight and volume of packaging used in distribution.

In many cases, these improvements are the outcome of a strategy for increasing financial rather than environmental benefits. They typically include *costs reduction* through energy or material saving and reduction of the cost for treatment of emissions. In other cases the cause has been the search for a *distinctive feature*, such as labelling (paints, lacquers, water-saving system). In yet other cases, the improvement has been in *response to legal regulations*, in particular directives on packaging, obsolete vehicles, electrical and electronic products, etc., or to circumstantial pressures.

Example of changes of the kind mentioned are the total or partial use of recycled material in urban furnishing sectors, industrial packaging of household goods, which is now a reality, and improvements in environmental management by SMEs (Small and Medium-size Enterprises) in response to demands from the major multinationals. The latter typically require environmental improvements, often certification, for the components that they acquire from their suppliers.

The introduction of ecodesign in enterprises is not a question of fashion or impulse, but rather a consequence of the fact that the companies and the society in which it operates gradually achieve a certain degree of environmental and financial maturity. It is no coincidence that German, Danish and Dutch enterprises are leaders in the application of ecodesign.

4.1.2 Tools to Help the Process

A growing number and variety of tools have been developed as a response to the challenges and pressures to do more business in environmentally friendly products. These tools include among others the following:

Management systems. These typically cover quality, environment, health and safety. They invest in people, as well as social and ethical issues. There are national and international standards for management systems, e.g. ISO 14001, EMAS, ISO 9000, AA 1000, SA 8000 and BS 8800.

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Key performance indicators. Indicators have often been developed in national environmental policy goals, e.g. as sustainable development indicators, they are found in the ISO 14031 EPI standards, and in the eco-efficiency indicators developed by the World Business Council for Sustainable Development;

Product management. Standards for product stewardship and consumer information have been developed in the ISO 14021 standards and in national and international Green Labelling schemes.

Environmental reporting. Environmental reporting is increasingly often included together with economic reporting from companies, municipalities and even on the national level. Standards typically include greenhouse gas emissions, waste, and water consumption. Examples include indicators and the Global Reporting Initiative, GRI.

4.1.3 Some Principal Approaches

When the management of a company or organisation wants to introduce environmental management and ecodesign as part of a policy change, some practical guidance is needed. The following concrete steps may be part of such a process:

Introduce management systems. Make a commitment to manage and improve your impacts – resources, energy and water, waste, transport, emissions, etc. – using appropriate management systems.

Use environmental auditing. Explore the scope for greater resource efficiency and benchmarking performance, e.g. by joining a governmental programme or a programme in an industrial association. Embrace the principles of producer responsibility by taking into account the different aspects from "cradle-to-cradle" in supplying products and services, working towards greater recycling and recyclability. Consider all the implications and opportunities at the design stage.

Introduce corporate responsibility. Tend to social responsibilities through: 1. good employer practices by, for example, encouraging fairness at work and helping staff to develop their skills; 2. being a good neighbour, responsive to the local community; 3. being an ethical trader.

Communicate with stakeholders. Report on environmental performance towards meaningful targets, using relevant certification schemes and making product declarations that are legal, decent, honest and truthful.

Cooperate in the supply chain and the sector. Work with others either through the supply chain, specifying what you want and helping others to comply, or as part of concerted sectoral action to help improve overall performance, safeguarding yours as well as theirs.

4.2 Management

4.2.1 The Importance of Knowledge Management

Ecodesign is a knowledge-intensive activity. Everything revolves around knowledge, not only knowledge of ecodesign itself, but also knowledge about how to acquire information, knowledge of the learning process of people, the expertise of teachers, and, not the least, knowledge of how to organise, operate and maintain an educational and applied research organisation.

In a knowledge-based society, the acquisition of knowledge and the practice of using knowledge will be the deciding competitive factors. Knowledge about the company's products, services and internal processing is combined with knowledge about the customer. The goal is to make ecodesign deliver new services, as well as complete solutions to customers.

Knowledge should be put to systematic use in order to determine what knowledge an organisation needs to achieve its aim. Nonaka and Takeuchi [1995] take this a step further by claiming that for a KIO (Knowledge Intensive Organisation) the creation of knowledge is the key to a lasting competitive advantage. Nonaka and Takeuchi express this as "in an economy where the only certainty is uncertainty, the sure source of lasting competitive advantage is knowledge."

Thus in order to preserve the competitive advantage companies must continue to learn and innovate continually, and often radically. Few companies, however, have much time to allocate to this process. If the innovation process focuses on minimising the operational costs, mostly by optimal utilisation of new technological possibilities, time is created for education and innovation.

It is obvious that training will be an important component for companies in a knowledge-based society, and experts will play an important role here both in the public and private sector. This training should concern a core-competence of ecodesign, but also about the competence-development process itself. This investing in knowledge makes several traditional economic concepts difficult to apply. A company or organisation cannot "own" a person in the same way as a machine, and thus investing in a person is very different from investing in equipment, buildings etc. Rules for protecting intellectual property exist (patent rules) but do not suffice here. The company has every reason to create a working place that makes their personnel want to stay and contribute.

4.2.2 Managerial Changes

Small companies are facing increasing pressure from environmental inspection and control, and contractors to improve their environmental performance. However, pressures associated with limited time, resources and competence often push the en-

vironment far down on their agenda. Few small companies have investigated the inherent business benefits of operating an effective Environmental Management System, EMS, in this case ecodesign. They are not aware that EMS and ecodesign could help them avoid inefficiency and enhance legal compliance.

Inertia within such small firms is extremely difficult to overcome. The obstacles and barriers associated with implementation, include:

- Perceived lack of time.
- Lack of policy and documents.
- Lack of understanding of EMS (ecodesign) requirements.
- Lack of sufficient regulatory and legal knowledge.
- Economic constraints.
- Difficulty in defining economic benefits.

In order to improve or to change the management system, a functional approach is needed. The functional approach in turn asks for an integration of management, much in the same way that "quality" pressures have provided for an integrated approach of marketing and selling of products and services. Here management of design, development, production, selling and after-sales activities is integrated, and these activities cannot be divorced from each other. Their importance and interdependence far outweigh the justification for ignoring and reducing the importance of any function.

In today's almost global economy, where there are increasing pressures of competition within many industries and commercial sectors, the application of the *five functions of management* (Figure 4.1) [James, 1996] has never been more necessary or decisive. Their effective application to quality management is imperative. The activities involved in each function are in summary:

Planning. This is the determination of targets and goals that need to be achieved, and using plans, procedures and strategies to achieve them.

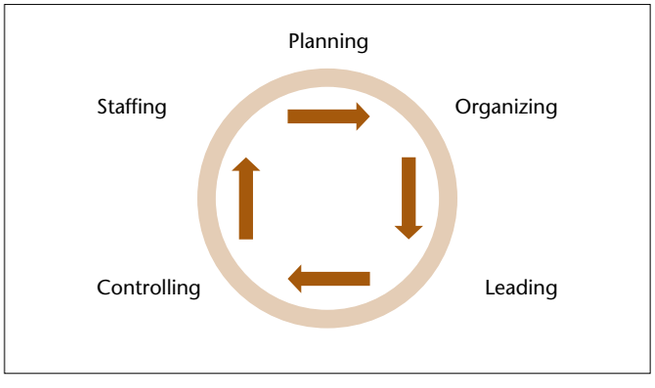

Figure 4.1 *Management function cycle [James, 1996].*

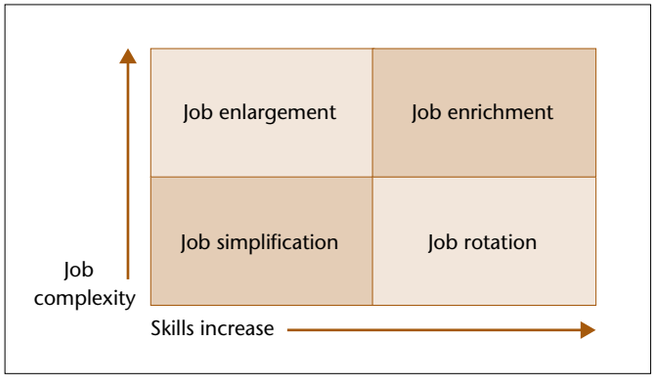

Figure 4.2 *Job design method [James, 1996].*

Organising. Determining the right task to perform and ensuring it is distributed efficiently and effectively. It can be applied to individuals, groups, departments or whole organisations.

Leading. Giving direction to others and getting others to do the task given. It means motivating subordinates and maintaining morale.

Controlling. Determining appropriate standards, applying them and ensuring that they are achieved and taking corrective action when necessary.

Staffing. Deciding the type of people to be employed and training them to do the jobs allocated.

4.2.3 Job Design

The process from product development to product innovation contains a series of activities derived from many sides of the company, from company and marketing strategy to the whole product collection. In the development and innovation processes everybody is involved, from designer to engineer, but also the general management, marketing and sales, the quality and maintenance officer, production staff and so on. Implementing ecodesign will thus lead to an increased complexity of the work conducted, and therefore to new specialisations and new skills. It has a major influence on job design.

Job design (Figure 4.2) [James, 1996] is an important aspect of a quality-oriented organisation. It is not sufficient to give people extended job specifications – they must be trained and educated, and they must be motivated sufficiently to carry out that job.

Job design provides the greatest influence on organisational structure. The larger the organisation, the greater the likelihood that specialisation will be needed. This occurs because there is a limit to the amount of work – physical or mental – that an individual can perform. Consequently, as an organisation grows, so does the need and pressures for specialisation. Fredrick Taylor (1856-1915) used specialisation as the basis for his methods

of working. Different work requires different skills, attitudes and aptitudes. Specialisation therefore allows individuals to develop more focused skills and competencies in order to carry out their tasks and job responsibilities more effectively.

The four areas in Job design, concerning the complexity and personal skills, are;

Job simplification. The process of narrowing the specialising of a job, so that the job-holder has fewer activities to perform.

Job enlargement. The development of job specifications that increases the variety of activities that an individual carries out. It is more challenging and there is room for increased mental stimulation through increased innovation and risk-taking. It also provides improvements in operator skills and competencies through increased skills development, training and education.

Job rotation. The rotation of individuals through different job sets and a planned order. Job rotation increases skills and releases workers from the effects of boredom related to job simplification and job enlargement.

Job enrichment. The process of developing job content that increases job skills, the potential for individual growth through education and training, achievement, recognition and responsibility.

Table 4.1 *Barriers and opportunities to implementation of ecodesign and manufacture of ecodesign [Rieradevall, 2002].*

Group	Barriers	Opportunities
Designers and technicians	Considering the product in isolation, and applying the concept of recycling. Lack of awareness of ecodesign. No use of tools for environmental improvement and processes. Intuitive approach to environmental improvement. Environmental improvement of products only in the use of recycled materials.	Innovation. Concept of life cycle. Integration of environmental aspects in financial and social projects. Product system.
Enterprises	Priority for treatment and recycling. Lack of awareness of ecodesign. Few environmental inventories. Lack of awareness of overall impact of their products' life cycles. Make environmental improvements to products only to obtain cost savings.	Identification of stages with greatest impact. Financial efficiency thanks to cost reductions in production, transportation, use and end-management of waste. Differentiation from competitors. Advance on regulation: IPP, ecodesign regulations, directives on end-management of products. Improvement of image, marketing and communication. Greater safety and reduction of insurance costs. Movement towards sustainable enterprises.
Consumers	Environmental responsibility for product beyond consumers' control. Preferential choice of ecoproducts not widespread. Lack of awareness of eco-labels. Little importance seen in environmental considerations in the home. Very little awareness of the environmental implications of products.	Green purchasing. Financial savings from reduced consumption of energy and materials during use. Improvement of end-management of products. Enhanced quality of life. More environmentally friendly lifestyles.
Governments	Green purchasing by governments only beginning and of minor importance. Few resources dedicated to research and development on new ecoproducts. Little promotion of eco-labels. Priority for end-process strategies (treatment and recycling).	Contribution to definition of new environmental policies. Image of environmentally friendly institution. Resources savings. Reduction of overall environmental impact. Greater participation by all players. Commencement of programmes for sustainable development.

4.3 Challenges, Difficulties and Opportunities

4.3.1 Challenges

The Badalona Declaration, adopted by the International Forum City, Company and Environment held in the city of Badalona, Catalonia, Spain, in the framework of the Sesame Network Cities, (see Internet Resources) says:

One of the future objectives for companies must be to adapt industry and other production activities in order to progress towards sustainability. Progress must be made towards environmental improvement and protection in order to ensure further and better growth: the environment is an opportunity for innovation rather than an obstacle to business development.

And later regarding consumers:

The environmental crisis is giving rise to the appearance of a new profile of consumer, who shows greater awareness of the ecology and greater solidarity, plays a proactive role in providing solutions, and acts as a responsible consumer.

We may translate the conclusions from the Badalona Declaration into challenges for ecodesigners. In summary they are:

Ecodesign means that the effect a product has on the environment should be considered and reduced at all stages along the product life cycle. These stages include the development of a product, its manufacturing, its marketing and distribution, its use and finally, its disposal.

Ecodesign products should be "flexible, reliable, durable, adaptable, modular and dematerialised". In addition to being environmentally adapted, the products should be economically and socially justifiable.

Ecodesign has emerged from a series of improvements in environmental protection. This development started with end-of-pipe solutions, continued with prevention to avoid waste and toxic substances in production (cleaner production), and led to efforts to minimise the environmental impact of a product, applied to the entire life cycle, from raw material extraction to the ultimate disposal of a product (cleaner products). Today the aim is to optimise the entire socio-economic system of the product as well as that of its use to meet the criteria of sustainable development for the future.

Ecodesign aims at advancing prosperity while reducing "environment spending".

Box 4.1 Case study: Implementing Ecodesign in Small and Medium-sized Companies

In a study by Delft University in the Netherlands (C.G. van Hemel, 1997) 73 small and medium-sized companies were interviewed about an ecodesign project which had been initiated by the university. Best represented were companies working with metal products, machinery, wood and furniture, electronics, and rubber and synthetics.

Three quarters of the companies had no earlier experience of ecodesign. They nevertheless saw ecodesign as an opportunity rather than a threat, and as an investment that would be paid back. The main reasons to start ecodesign included a wish to increase the quality of a product, anticipating future developments, and product innovation. But reasons also included personal responsibility towards the environment, and supply chain pressure.

A total of 602 individual ecodesign improvements were suggested (mostly based on the ecodesign strategy wheel). 30% of the improvement options were completed after 10-16 months, and after 3 years a total of 247 (41%) were completed. The dominating strategies were selecting low impact material, lower product weight, and recycling. Lower on the list were cleaner production, more efficient packaging, low energy consumption in the use phase, and the use of recycled materials in the product.

Ecodesign had been applied to 39 products. They were as follows:

- 1 new product
- 21 products which were thoroughly redesigned
- 13 products which were slightly improved
- 4 packagings of products were improved

The experiences of the companies were overwhelmingly positive. Most companies said that they were now able to apply ecodesign themselves, and 90% said that they would recommend ecodesign to others. 71% said that they would continue with ecodesign, and 30% had already started ecodesign projects with other products, and even more had initiated research on products. 25% were going to integrate environmental concerns in their quality requirements, and another 25% included product related issues in their EMS.

A majority of the companies expected the ecodesign to promote their business. 67% expected their products to increase market shares, and 56% expected to enter new markets. 25% expected a profit to be made within two years.

It was clear that internal stimuli to make ecodesign were more important than external stimuli. It was also clear that in many cases ecodesign worked together with business interests, cost reduction, image improvements, and new market opportunities. However, external stimuli were also relevant, especially if larger investments were needed.

4.3.2 Difficulties

When proposing that a company should apply ecodesign, one is regularly met by a series of questions and objections. The two most common – with short answers – are:

Why should business care about its impact on society? Because the introduction of practices and technologies that favour the reduction of waste and pollutant emissions and the saving of energy will be increasingly necessary in order to improve the profitability and competitiveness of companies.

Shouldn't a business only take action if there is a business case? That is true, but another reason is that one needs to meet regulations. Environmental criteria are today incorporated in all phases of a product, from conception, design, manufacture, distribution, use and wasting. The whole life cycle should therefore be redesigned from the new viewpoint of the Integrated Product Policy (IPP) of the European Commission. Ecodesign falls within this new vision of products and makes them feasible.

Other questions related to business difficulties are:

Should business care:

- if young people don't have the skills that business needs?
- if the climate is changing and it is getting hotter or colder?
- if customers care about the business impact on the environment?
- if customers cannot pay their bills?
- if customers have extra needs?
- if regulators, government and stakeholders demand action?
- if business affects public health and safety?
- if business is missing the opportunity to improve its reputation or gain a competitive edge?

We can't ask these questions and then conclude that business shouldn't care. Every business has an impact on the society in which it operates. Actively managing that impact is just common sense. It is not an original, nor indeed an entirely creative thought, but it is true. The best programmes in this area to date embrace good management disciplines, passionate personal commitment from people across the business, and a readiness to account openly for their impact.

Table 4.1 shows the barriers encountered by the main players in connection with implementing ecodesign, and production, purchasing and end management of ecoproducts.

4.3.3 Opportunities

In spite of the barriers and difficulties, the implementation of ecodesign and the manufacture of ecoproducts offer advantages for all players involved. Table 4.1 is a summary of these advantages and opportunities.

4.4 Examples of Implementation of Ecodesign

4.4.1 17 Examples of Ecodesign

Example 1: Using Recycled Resources. Recycled non-chlorine bleached coated paper. France

The French paper producing company Matussière & Forest has taken the technology of environmentally adapted paper one step further. Already in the 1980s non-chlorine bleached paper became common (after consumer pressure) and in the 1990s the techniques for producing good quality paper from recycled paper developed dramatically. With the new product it is now possible to coat paper produced from 100% recycled paper. For this new product development the Matussière & Forest was awarded the European Business Award for the Environment 2004. The paper is of equally high quality as ordinary paper and does not require more energy in its production. Paper production is typically in the early stages of a supply chain, and the new paper has the potential to improve many products.

www.matussiere-forest.fr
www.eu-environment-awards.org/html/winners_2004.htm

Example 2: New Concept Development. Shared use of cars. The Netherlands

Selling the use instead of the ownership of products is a speciality of the Dutch company Greenwheels. Greenwheels is one of the companies that have developed an innovative system to enable people to share the use of cars. When cars are shared by multiple users, there are environmental benefits. First, the cars are maintained and repaired regularly by the operator, which increases their reliability, performance and energy efficiency. Secondly, the cars are used more intensively and need to be replaced more often than traditionally-owned cars. Energy-efficient innovations can therefore be launched on the market earlier than when cars are owned individually. Thirdly, customers sharing a car tend to use it more sparingly, and cover short distances using public transport or bicycles. In the Netherlands, half the numbers of trips by car are made over distances of less than five kilometres!

The idea looks like ordinary car rental but has features that make it more appealing. The cars are placed in parking lots or garages near customers, to make access easy. Parking places are reserved by Greenwheels, which is important, especially in crowded cities. The cars may be used also for short periods of time, such as one hour, which keeps costs down. Reservations are made by phone 24 hours a day. The customers pay a yearly subscription fee in addition to the fee per kilometre and hour.

www.greenwheels.nl

A number of other companies have taken up the same idea. Carplus in the UK can be found on *www.carplus.org.uk*. See also *www.carplus.org.uk/carclubs/case-studies.htm*. Similar clubs are available in Germany (Cambio Car), Italy (ICS), Switzerland (Mobility), Finland and Sweden (City Car Club, *www.citycarclub.se*). The Stockholm club has 13 Ford Flexifuel models, which run on ethanol or petrol. The Uppsala association (*www.bilpoolarna.se*) has at present (March 2005) 51 members, of which 48 are households and 3 are organisations.

Example 3: Integration of Functions. A solar collector balcony. Germany

The German company Viessmann has developed the Solar-TubuSol, a vacuum tubular collector which can be used in place of large solar panels. One application is the so-called solar balcony balustrade. This heat-providing balcony balustrade is constructed from tubes of thick borosilicate glass. A durable vacuum-sealed glass/metal collector ensures safety and a long service life. Thanks to this innovation, no separate attachments for the balcony balustrade and the solar collectors are required. This saves materials and energy. Furthermore, the vacuum tubular collector out-performs flat-bed collectors by about 30 percent, given diffuse sunlight. This works partly because the individual tubes can be directed optimally toward the sun. The system also encourages the use of solar energy of solar panels in architectural design. The design was selected for the Top Ten in the 1996 Industry Forum Design Competition.

Figure 4.3 A solar collector balcony *(Example 3). This balustrade is used both as a solar panel and as a balcony balustrade. The Vitosol 200 model is found in the City of tomorrow (Bo01 exhibit in 2001) in Malmö. Photo: Viessmann Werke GmbH & Co KG.*

300 m^2 of the solar Collector Balcony was used in Malmö´s City of Tomorrow large architectural and urban planning exhibit in 2001, and received the Saxonian environmental award that year.

www.viessmann.com

Example 4: New Concept Development. The SMART car. Switzerland

A combined development by Mercedes-Benz and Swatch MH, the Smart is an example of re-orientation of the function a product actually fulfils. The Smart was introduced in 1998 as a super-compact, city-compatible vehicle by a new company MC Micro Compact Car AG, located in Biel, Switzerland. The two-seater has a reduced fuel consumption (some 4 litres/100 km) and is only 2.50 metres long. With different drive modes – petrol and diesel – and with both sedan and convertible models available, the Smart can be tailored to meet the wishes of most purchasers. Emissions are low.

The car also offers various options for linking with other means of transportation: “Only by combining public transport concepts with car sharing and pooling plans can future demands for mobility be fulfilled” (Smart press release). Tests are going on in the field of pool leasing and car sharing. Access to a large car pool with various models and rental arrangements will be possible for Smart drivers. A substantial market potential is expected in the multiple-car utilisation field.

www.smart.com

Example 5: Energy Optimization. The green light traffic signal. Denmark

Technical Traffic Solution (TTS) in Denmark developed a new, innovative traffic light using light-emitting diodes. This offers

Figure 4.4 The Smart car *(Example 4). This car for city traffic is small (2.5 m) easy to park and uses little fuel (about 4 litres/100 km). It contributes to a reduced resource flow.*

many advantages over traditional traffic lights, including energy conservation, the use of environmentally-sound material (aluminium), less or almost no operation and maintenance costs, increased safety, and elegant design.

Rapid developments in semiconductor technology have made it possible to produce a light-emitting diode (LED) with the internationally required standard specifications. Light-emitting diodes have many advantages compared to traditional bulbs. The production processes and materials used are environmentally good. The LED uses considerably less energy than traditional bulbs. They have a lifetime which is typically over 10 years, while traditional bulbs with short lifetime of (typically 11 months with a burning time factor of 60%) need to be changed about once a year. In addition, the new lenses of the traffic lights do not need to be regularly cleaned which, combined with the LED, make the new lights practically maintenance free. TTS received the Danish Design Award and in 2002 the Danish EU environmental award for their product Green light based on the LED technique.

www.tts.dk

www.eu-environment-awards.org/html/winners_2002.htm

Example 6: Resource Saving. The green furniture project. Denmark

The Green Furniture Project is a Danish initiative to design and produce furniture with a careful choice of materials and techniques. The project originated in a research project at Aarhus School of Architecture in Denmark and was further developed by the organization 'Det Grønne Møbel'. By 1996, a collection of 11 products had been developed through the cooperative efforts of industrial designers, experienced carpenters and other craftsmen from small workshops in the area. The furniture, produced with the cleanest production techniques possible, is now being made and sold from local workshops. At least 80 percent of the raw materials used in production must be renewable local materials such as wood, ecologically-grown flax and waste wool. Seaweed collected at the nearby coast substitutes for freon-inflated foams, and the use of other low impact materials such as traditional bone-based glue is combined with new products such as natural paints. The furniture basically consists of wood from elms that have died as a result of Dutch elm disease.

www.dgm.dk

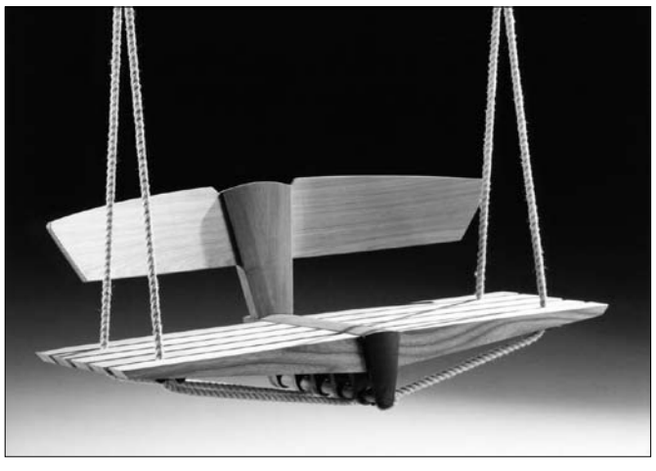

Figure 4.5 The green furniture project *(Example 6). The furniture in this project are built from local clean resources, and wood from trees killed by Dutch elm disease.*

Example 7: Using Recycled Resources. Patagonia fleece-jacket. USA

Recycled plastics can be used for many purposes. In 1993 the Patagonia Company developed a polyester fleece made of recycled soda bottles to make sports clothing. The first product was a fleece jacket. This PCR® (Post-consumer recycled) fleece has diverted over 86 million bottles from landfills to date. The PCR® filament yarn contains 30-50% post-consumer feed stock – soda bottles, polyester uniforms, tents and garment – and 50-70% (the rest) post-industrial feed stock, mostly from yarn and polymer factory waste. This material offers the same performance characteristics as virgin yarn at a competitive price with less environmental harm.

The Patagonia Company has profiled itself as an environmentally concerned company. In 1984, they began pledging at least 1% of sales (or 10% of pre-tax profits, whichever is greater) to the protection and restoration of the natural environment. In 1993 Patagonia began to incorporate environmental ethics into the product line. In 1995 the company switched

Figure 4.6 The Patagonia fleece-jacket *(Example 7). This jacket is made from plastics from consumer waste, such as soda bottles, and industrial waste from polymer factories.*

to 100% organically grown cotton in all sportswear. In 2004 the company gave away 2.1 million dollars for the environment. To date they have donated over 20 million dollars. They continue their work on reducing the environmental harm in all of their products and processes.

www.patagonia.com

Example 8: Energy and Resource Efficiency. SCOOLER, an electric scooter. France

The Scooler is an electric scooter developed by the French company ALEL. It was launched in 1996 and then received the first prize in the 1996 Ecoproduct Competition organized by the French Chamber of Commerce and the Ministry of Environment. The Scooter offers a driving distance of 95 km (at 45 km/h) before the batteries have to be recharged. The scooter is built to have a long life (80 000 km instead of 20 000 km for a conventional scooter) during which the batteries do not need to be replaced. The company guarantees the take-back and recycling of the nickel-cadmium batteries. Since transmission uses a leather belt instead of a gear box, no transmission oil is required. Energy costs for the Scooter are 25 Euro cents for 100 km instead of 4.5 Euro for a conventional scooter with a combustion motor.

www.alel.biz

Figure 4.7 Electric scooter *(Example 8). This scooter (the Scooler) runs on battery for 95 km on 45 km/h. Costs is about 10% of running a traditional gasoline motor scooter.*

Example 9: Dematerialisation. SoftAir air furniture. Sweden

The manufacture of a SoftAir inflatable sofa, and other SoftAir furniture, requires only about 15% of the materials, energy and resources needed to make a traditional sofa. Costs of transportation and storage of inflatable furniture are of course also very low. Life cycle assessment shows a decrease of about 85% of the total amount of energy that is consumed when making a traditional sofa. The material used in SoftAir products is polyolefin, which is 100% recyclable. The basic material pure air is of course also eco-friendly. The designer Jan Dranger won the IF Ecology Design award 1999 for the SoftAir concept.

www.softair-furniture.com

Example 10: Reduced Toxicity and Improved Energy Efficiency. CFC-free refrigerator. Germany and Turkey

Refrigerators and freezers have been manufactured and designed without ozone-depleting substances (freons, Chloro Fluoro Carbon, CFC) for some ten years. The German-Turkish company Arçelik began manufacturing CFC-free refrigerators (using R-600a and R-134a refrigerants) in 1994, although the Turkish market is allowed to use CFC until 2010 according to the Montreal Protocol. c-Pentane/iso-Pentane are used as blowing agents inside the polyurethane insulation.

In addition the refrigerators are very energy-efficient. In 2004 Arçelik received the Energy+ award from the European Commission for the outstanding performance of its Blomberg CT 1300A model refrigerator. This 288 l refrigerator uses 0.375 kWh per 24h (equivalent to 16 W). Its energy efficiency index of 19.8 is the lowest so far in Europe.

www.arcelik.com.tr

www.energy-plus.org:1001/english/awards/

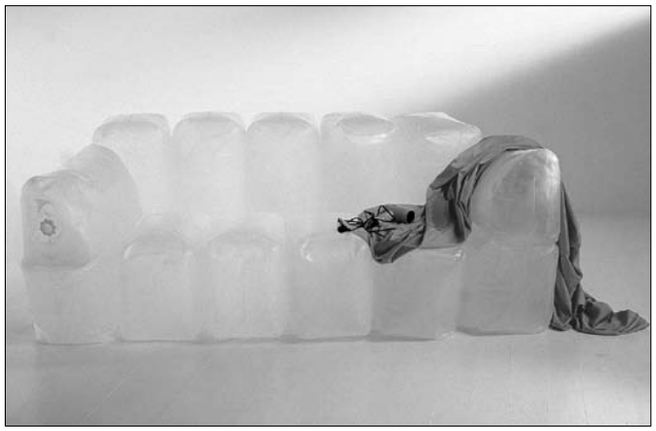

Figure 4.8 Inflatable furniture *(Example 9). The SoftAir inflatable sofa only requires some 15% of the resources needed for a conventional sofa. It consists mostly of air. Of course the sofa may also have a textile cover.*

Example 11: Improved Energy Efficiency. Wind-up radio, flashlight etc. UK

The FREEPLAY radio is an example of a product which is much more environment-friendly when used than its competitors, thanks to its remarkable energy source. The Englishman Trevor Baylis wanted to develop a radio to enable communication by radio in countries where an electric power supply through direct current or batteries was little available. He developed the wind-up radio FREEPLAY, which uses no power but functions through a winding mechanism consisting of a carbon steel spring, which drives a generator. The spring can be wound up in only 20 seconds, and gives 40 minutes of radio play. The radio is also available with a DC input jack as a supplement to the winding mechanism. The original BayGen wind-up radio has now been improved with a built-in flashlight. The rechargeable battery pack can store excess power with its built in solar panel as well as ordinary AC.

The wind-up technology has also been developed by several other companies including large enterprises like Grundig and Philips as well as small but more specialized companies like Freeplay Energy plc in the UK. Freeplay Energy in partnership with Motorola also makes a small wind-up combined flashlight & generator which can charge mobile phones. After winding less than a minute the user can generate 5 minutes of talking time.

www.freeplayenergy.com

Example 12: Multiple Improvements. Green consumer electronics. The Netherlands

Philips has developed a framework to measure environmental performance of its consumer electronics products using structured benchmarking process addressing weight, hazardous substances, energy efficiency, packaging, recycling and disposal. The procedures were developed at Philips Consumer Electronics Environmental Competence Centre in cooperation with the Technical University of Delft in the Netherlands. The products had the requirement that they should be 10% more energy efficient than other comparable products on the market.

The result of this work is the marketing of a product line called Green Flagships including about 100 different products from LCD-monitors and TV-sets to small digital audio players. At present (2005) about eight new Green Flagships products are produced each year.

www.misc.ce.philips.com/greenflagship/

Example 13: Long Life. Tripp-trapp chair. Denmark

The Tripp-Trapp chair from the Danish manufacturer Stokke has been on the market for nearly 20 years and is a classic example of a product which combines multi functionality with elegant simplicity. The chair can be modified and adjusted to fit the growing child. Since it is built of wood it lasts for years and years and its lifetime continues in the second-hand market.

www.stokke.com

Figure 4.9 Wind-up radio *(Example 11). The Freeplay Radio offers the latest in self-sufficient technology: a choice of wind-up, solar and rechargeable batteries. Also available for flashlights mobile phones etc.*

Figure 4.10 Tripp-trapp children's chair *(Example 13). This is a classic in good design. It can be adjusted to the growing size of a child, is robust and mostly wooden.*

Example 14: Recycling and Good Waste Management. The think chair. Germany

The Think Chair was developed by the company Steelcase Inc. in close collaboration between researchers, manufacturers and designers. The design-company McDonough Braungart Design Chemistry, famous for its ”cradle-to-cradle” product concept (C2C), worked with the manufacturer Steelcase, while the Institute for Product Development in Denmark did a life cycle assessment. The chair is ergonomically perfected but it also has ecological benefits. The material of the chair is all environmentally safe and consists to 41% of recycled lightweight materials. When wasted it is very easy to disassemble and 99% is recyclable.

The Environmental Product Declaration (EPD) of Think Chair, created according to ISO 14025 LCA, accounts for resource depletion, waste, global warming potential, as well as smog. The chair has won a number of internationally well-recognised design awards and the work to improve it still continues. Steelcase Inc. has incorporated the C2C-concept in the development of other products. The “Think” of the chair, as Steelcase put it, stands not only for the intelligent brain but also for concern for the environment.

www.steelcase.com
www.mbdc.com

Figure 4.11 The Think Chair *(Example 14). This chair was developed using an LC impact assessment of all materials. It is made from 41% recycled material and is 99% recyclable. Photo: Steelcase Inc.*

Example 15: New Concept Development. Technology equipped clothing. USA

Perhaps many would associate Technology Enabled Clothing as something from the science fiction world but TEC is a company that has developed a system to conceal conduits inside garments which can be connected to USB-compatible devices such as hands-free headsets for cell phones and MP3-players. They call it Personal Area Network (PAN). No more loose wires. From an environmental point of view one notice that the garments have built-in solar cells. The cell phone or mp3-player charges as you take a walk in the sun.

www.technologyenabledclothing.com

Example 16: Increased Energy Efficiency. Dye-sensitized solar cells. Netherlands

The dye-sensitized solar cell replicates the most important principles of its prototype, photosynthesis. Due to its simple construction it offers the hope of a significant reduction in the cost of solar electricity. “Their manufacture is relatively simple on laboratory scale.” In fact, according to ECN-researcher Jan Kroon, “you can practically make this solar cell in your kitchen with TiO_2 (commonly used in toothpaste) and raspberry juice”. “The present state of this technology has resulted in working prototypes of cells and small modules, but these are not available on the market yet. We expect that within five

Figure 4.12 Technology Enabled Clothing *(Example 15). The jacket provides a “Personal Area Network”, in which you may recharge batteries by photovoltaics, connect mobile phones or use a MP3-player. Photo: Scottevest Inc.*

years these solar cells will appear on the market for low-power applications either on glass or flexible substrates (i.e. calculators, watches, price labels). Hopefully, this will function as a stepping stone for the introduction of high power applications, which are mainly intended for outdoor use." Their efficiency is only 5-10% on small areas, which is much less than conventional silicon solar cells, but the promise of low manufacturing costs and versatility, make practical applications of these photovoltaic devices feasible in the future.

www.ecn.nl

Example 17: Dematerialisation. The Mac minicomputer and MP3-player. USA

Apple computers have from the outset been quite compact and thus dematerialised. Apple Ipod, a combined hard disk and MP3-player, with disk space of 60 GB, has the size 10x6x2 cm. The Mac mini computer H4 with frequency of 1.42 GHz and 80 GB hard disk and 1 GB RAM memory, equipped with CD player and DVD burner has the dimensions 5x16.5x16.5 cm. Although the computers have to be equipped with key-boards and monitors, the Mac mini computer constitutes a considerable dematerialisation.

www.apple.com

4.4.2 Comments on the Survey of 17 Cases

Table 4.2 gives an overview of 17 cases of ecodesign, which are described in more detail further on. The cases are collected from all over the world, with some slight over-representation of German, Dutch and Danish cases. The table features all kinds of products and services, from small household products, such as boilers, chairs and TV sets, to larger products, e.g. cars, and finally services, although the service amounts to the use of a product. They are reviewed according to which stage in the product life cycle environmental benefits are most important, separated as production, use and wasting phases.

Figure 4.13 Mini MP3-player and computer *(Example 17). The Apple iPod and Mac mini computer illustrate a dramatic case of dematerialisation. Despite their compact design, they are equipped with large hard disks and many other functions*

12 products out of the 17 feature improvements in the production phase. Most typically the production uses renewable or recycled material. In several cases care has been taken to avoid toxic material. Many of these products are very much dematerialised, in some cases by a factor of close to 10.

Many products, 11 out of 17, offer environmental gains during their use phase. Most typically, products are very or extremely energy efficient due to ecodesign. Secondly, products are more repairable, since parts can be exchanged easily, and therefore have an extended lifetime. Some products have been designed not to have any toxic material, and others, such as the scooter and the SMART car, are zero-emission vehicles and thus are in the same category of non-toxic products.

Finally 9 out of the 17 descriptions specifically mention environmental benefits during the wasting phase. Recycling of the materials, easy end-of-life disassembly of the product are included, as well as the absence of toxic material, or – for the batteries for the scooter – the producer will take back and recycle the product.

In several cases it is specifically mentioned how environmental benefits, resulting from ecodesign, also have economic benefits, both for the producer and the customer, user, when less energy and material is used. In other cases there are social benefits (less toxic).

4.4.3 Companies which have Implemented Ecodesign

Many large multinational manufacturing companies have established ecodesign for many years. These include Apple computers and Philips electronics. IKEA has for several years an environmental strategy including education of all personnel, review of all providers and ecodesign of all products, based on the Natural Step principles. Similar strategies are used by e.g. Skanska and hotel chains such as Scandic hotels (member of the Hilton family).

But there are also several smaller companies, mostly those in which ecodesign is part of their business concept. The AXIS water boiling kettle, the FREEPLAY wind-up radio, and the Viessmann solar balcony are interesting examples. They prove that it is not always necessary to have the resources of a large company to achieve success. A good idea may stand on its own feet.

Some of the companies explicitly refer to the need for an extensive development effort to reach the product they wish to produce. Examples include the Bryant & May matches (without toxic phsophorous) for the environment and of course the larger companies such as Apple and Hitachi. In some cases, again, a good idea may be enough. Greenwheels shared use of cars is in this category.

Table 4.2 *Review of 17 examples of ecodesign.*

No	Product	Production phase	Use phase	Wasting phase
1	*Matussière & Forest.* Recycled non-chlorine bleached coated paper.	Using recycled paper as resource.		Recyclable.
2	*Greenwheels.* Shared use of cars.		Increased efficiency: Cars maintained better and used more often.	Cars replaced sooner after more mileage.
3	*Viessmann.* Solar collector balcony.	Multi-functionality: saves materials and energy.	Increased energy efficiency: heat-providing balcony balustrade.	
4	*SMART.* Super-compact car.	Dematerialisation.	Low weight, reduced fuel consumption, zero emissions.	
5	*Technical Traffic Solution (TTS).* Traffic light using light-emitting diodes.	Dematerialisation.	Increased energy efficiency; much decreased maintenance costs.	Dramatically increased life span.
6	*Det Grønne Møbel.* Furniture with a careful choice of materials and techniques.	Renewable local materials; very clean production techniques.		Material recyclable or burnt as biomass.
7	*Patagonia.* Polyester fleece jacket made of recycled soda bottles.	Using recycled plastics as resource.		Material recyclable.
8	*ALEL.* Electric scooter.		Energy efficient; no fossil fuels, not even transmission oil; cheaper to drive.	Long life; Company takes back and recycles the nickel-cadmium batteries.
9	*SoftAir.* Inflatable furniture.	Dematerialisation: Requires only 15 % of resources of conventional furniture.		All material (polyolefin) is recyclable.
10	*Arçelik.* CFC-free refrigerators.	No use of ozone-destroying CFC.	Energy efficient.	
11	*FREEPLAY.* Wind-up radio, as well as flashlight and mobile phone.		Functions through a winding mechanism to charge radio, mobile or flashlight; no energy	
12	*Philips Consumer Electronics Environmental Competence Center.* Green Electronics.		Products use 10% or less energy than conventional consumer electronics.	
13	*Stokke.* Tripp-Trapp chair.	Using wood as material.	Can be adapted to the age of the growing child.	Long life; attractive on the second hand market; recyclable wood.
14	*Steelcase.* The Think Chair.	Resource is environmentally safe and 41% recycled material.	Ergonomically perfected chair.	Easy to disassembly; 99% recyclable material; The C2C concept.
15	*Technology Enabled Clothing.* Technology equipped clothing.		Multifunctional; Equipped with solar cells to recharge equipment.	
16	*Energy research Centre of the Netherlands (ECN).* Dye-sensitized solar cells.	Simple material such as TiO_2; easily manufactured: still in development stage.		
17	*Apple.* Mac minicomputer and MP3 player.	Dematerialisation.		

Study Questions

1. What kinds of profits are gained by implementing Eco-design other than Environmental ones?
2. Make a short list of ideas, subjects and/or findings for the design of an Ecodesign implementation plan.
3. Select one of the many examples and discuss its pros and cons
4. Visit one of the links and select one more interesting example.

Abbreviations

C2C	Cradle-to-Cradle.
EPD	Environmental Product Declaration.
EPI	Environmental Performance Indicator
EPM	Environmental friendly Product Development.
HVLP	High Volume Low Pressure.
IPP	Integrated Product Policy.
KIO	Knowledge Intensive Organisation.
KM	Knowledge Management.
PAN	Personal Area Network.
PBIT	Profit Before Interest and Taxation.
RPD	Renewing Product Development.
SME	Small and Medium-sized Enterprise.
TEC	Technology Enabled Clothing.

Internet Resources

BADALONA International Business Centre

www.bcin.org

Beispiele für ökointelligente Produkte und Dienstleistungen Ökodesign - Eine Initiative für nachhaltige ökointelligente Produkte, Wien, Österreich

http://www.ecodesign-beispiele.at/

PRé Consultants: life cycle tools to improve environmental performance & sustainability

http://www.pre.nl/ecodesign/default.htm

UNEP Sustainable consumption site

http://www.uneptie.org/pc/sustain/design/design-subpage.htm

EnviroWindows. Environmental Information for Business and Local Authorities

http://www.ewindows.eu.org/ManagementConcepts/Ecodesign

Eco Smart Design, a product-oriented design program by ESS (Environmental Systems & Solutions), Craigavon Northern Ireland and Product Ecology Pty Ltd, Melbourne Australia

http://www.ecosmartdesign.co.uk/abouttheprogramme/index.asp

Industrial Designers of America (IDSA) ecodesign section

http://www.idsa.org/whatsnew/sections/ecosection/

Eco-Gallery SDN BHD, Johor, Malaysia

http://www.eco-gallery.com/

Ecco design company

http://www.eccodesign.net/eco_design.htm

Design school HTL-Hallein, Hallein/Salzburg, Österreich

http://www.htbl-hallein.salzburg.at/eco.design/ecoziel.htm

The Centre for Sustainable Design, Surrey Institute of Art & Design, University College, UK

http://www.cfd.rmit.edu.au/programs/sustainable_products/ecodesign_guidelines_dia

BioThinking, Edwin Datschefski, London

http://www.biothinking.com/pd.htm