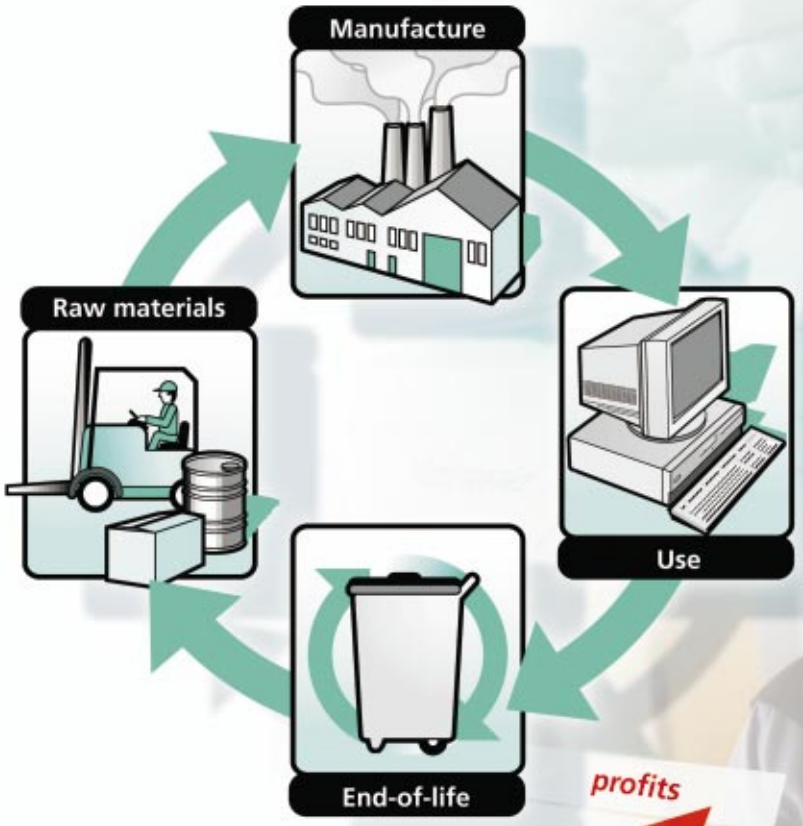
GG295

Cleaner product design: examples from industry



Cleaner product design: examples from industry

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Prepared with assistance from:

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Summary

This Good Practice Guide describes the different ways in which nine well-known companies have adopted cleaner design. Many of the issues and considerations are similar, but the cleaner design methods vary.

Cleaner product design (cleaner design) involves identifying how a product gives rise to environmental impacts during its life-cycle (raw materials, manufacture, distribution, use and end-of-life) and then reducing these impacts through design. The aims of cleaner design include reduced raw material use, elimination of hazardous materials, reduced use of energy and water, less pollution and waste, increased service life and greater potential for recycling. Different projects involve some or all of these to a greater or a lesser extent.

Some of the Industry Examples in this Guide involve the redesign of an existing product or the development of new products. Various Industry Examples explain how companies:

- researched their products;
- developed a cleaner design strategy;
- implemented cleaner design;
- worked with their suppliers.

The Industry Examples demonstrate the various benefits of cleaner design including:

- lower production costs;
- improved product function and quality;
- increased market share;
- improved environmental performance;
- improved relationships with customers and suppliers;
- continued compliance with legislation;
- easier disassembly and increased potential for recycling;
- longer product design life.

A companion Good Practice Guide (GG294) *Cleaner Product Design: An Introduction for Industry* explains in more detail what cleaner design is, the benefits of cleaner design and what it involves.

Contents

Introduction

Cleaner product design (cleaner design) is the design of a product to minimise its environmental impacts over its entire lifetime and to satisfy customer requirements. Companies often refer to cleaner design as 'Eco-design' or 'Design for the Environment'. It involves identifying how a product gives rise to environmental impacts during its life-cycle (raw materials, manufacture, distribution, use and end-of life) and then reducing these impacts through design. A product's environmental impacts can be reduced by addressing key environmental considerations covering each stage of its life-cycle.

The potential benefits of cleaner design include:

- lower production costs;
- improved product function and quality;
- increased market share;
- improved environmental performance;
- improved customer/supplier relationship;
- continued compliance with legislation;
- easier disassembly and increased potential for recycling;
- longer product design life.

There is no one correct 'cleaner design method'. Different companies will face different issues and find different solutions. These include raw material selection, reduced raw material use, lightweighting, reduced consumption of resources during distribution and use, improved recyclability and reduced end-of-life impacts. Different projects will involve some or all of these considerations to a greater or lesser extent.

This Good Practice Guide is one of a set of two Guides that aim to introduce directors and managers to cleaner design. The Industry Examples in this Guide describe how nine well-known companies have chosen to approach cleaner design. Although these examples all feature large companies, the thought processes and steps are the same for all sizes of company. Table 1 shows the particular aspect of cleaner design highlighted by each example.

A companion Good Practice Guide (GG294) *Cleaner Product Design: An Introduction for Industry* explains in more detail what cleaner design is, the benefits of cleaner design and what it involves. The elements of the cleaner design cycle are described and checklists are provided to help companies plan and implement their own cleaner design programme. GG294 is available, free of charge, through the Environment and Energy Helpline on freephone 0800 585794 (or via the Envirowise web site at www.envirowise.gov.uk).

Cleaner design helps to reduce operating costs, increase market share and improve environmental performance.

Table 1 Aspects of cleaner design described in the Industry Examples

Industry Example		Aspect of cleaner design			
Company	**Cleaner design project**	**Researching the product**	**Developing a cleaner design strategy**	**Implementing cleaner design**	**Working with suppliers**
1 The Ericsson Corporation	Finding out about material content	✓			✓
2 RMC Group plc	Finding out about environmental impacts	✓			
3 Black & Decker Corporation	Introducing a cleaner design programme		✓		
4 Coca-Cola Enterprises Ltd	De-materialisation			✓	✓
5 The Electrolux Group	Reducing energy consumption			✓	
6 IBM	Using recycled materials			✓	✓
7 Nike Inc	Material substitution			✓	
8 Volvo Car Corporation	Removing hazardous materials			✓	✓
9 Xerox Europe	Re-use and recycling			✓	✓

NB The companies above have worked on other aspects of cleaner design that are not outlined here.

Developing an Internet-based tool to document materials content

The Ericsson Corporation is a leading communications supplier providing systems, applications, mobile phones and other communications tools. The company employs over 100 000 employees in 140 countries worldwide.

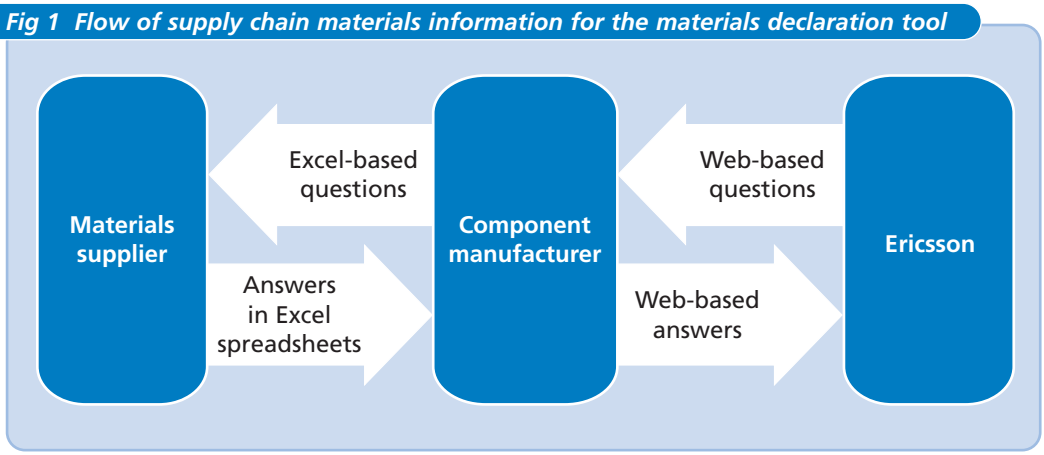
One way in which Ericsson aims to reduce the environmental impacts of its products is to reduce the use of substances that are hazardous or that hinder end-of-life recycling or treatment. To do this, Ericsson needs to know the material content of its products.

Cleaner design project

Ericsson has a strict policy on the materials it uses. Lists of substances whose use is banned or restricted have evolved over time - driven by legislation, consumer demand and environmental awareness. In the mid-1990s, Ericsson developed questionnaires to obtain information from its suppliers about the materials used in its products. These questionnaires were issued as Microsoft® Word® and Excel® documents, and the answers were received either by e-mail or on paper. Collecting and processing the data took a large amount of time and effort, and led to duplication of information and inconsistency. It was clear that a more efficient and cost-effective system was needed that would minimise the workload for both Ericsson and its suppliers.

At the beginning of 1999, Ericsson decided to develop a data tool for materials declaration and put it on a secure area of the Ericsson web site. Suppliers would then be asked to complete the documents online. This process is summarised in Fig 1.

Fig 1 Flow of supply chain materials information for the materials declaration tool



A pilot study was carried out on a multiplexer weighing 5.5 kg and containing a magazine, cables and connectors, a back plane and ten printed circuit board assemblies.

Substances were included in the materials declaration tool if they were:

- restricted by law or in the process of being restricted by law;
- substances about which customers wanted to be informed;
- substances that hampered end-of-life recycling or treatment;
- valuable metals.

Questionnaires in the form of Word® documents and Excel® spreadsheets were sent to manufacturers and suppliers seeking information about the components and parts for which there were no existing declarations. Each component was identified by its product number on the parts lists. The answers were combined with existing data and entered in an Excel® spreadsheet to provide a summary of the declaration. For each substance, threshold values were set below which no information was required. This allowed effort to be concentrated on those substances with the greatest environmental impact and those substances present in significant amounts.

Access to the information was restricted to the manufacturer or supplier providing the data and to authorised people at Ericsson. Further exchange of data through the supply chain was restricted to Excel® files. This system allowed confidentiality to be maintained.

The results were studied as they arrived and, if parts contained items on Ericsson's list of banned substances, the supplier was informed and alternative components were sought. Where parts contained restricted substances, discussions were implemented with the supplier about possible changes in the future.

Certain substances were identified that, although acceptable, were present in too high a quantity. For example, components were found to contain antimony at levels that were too high for end-of-life treatment by some copper smelters, and bismuth was found in components at levels that did not prevent recycling but would probably result in less revenue from the copper smelter. In both cases, the tool facilitated discussions with the relevant suppliers to resolve the issue.

Ericsson's materials declaration tool now operates as follows:

- A request for a materials declaration is submitted to each component manufacturer.
- The necessary links are set up so that materials declarations can be made in confidence via the Ericsson web site.
- Component manufacturers download the relevant Excel® spreadsheets from the web site and send them to the suppliers. The component manufacturers enter data from the returned spreadsheets directly into dedicated data slots on the web site.
- Component manufacturers can either submit a web site declaration for each part in a Part Declaration (see Fig 2) or make a single declaration covering a number of products with similar component materials in a Type Declaration. Ericsson also offers component manufacturers the alternative of completing a Substance Declaration where concentrations of listed substances exceeding threshold values are set out in downloadable Excel® spreadsheets.

Fig 2 Example Part Declaration

Part Declaration of a Microcircuit Type: SOP14 Weight: 0.135 g

No.	Name	Material	Mass (g)	Element	Weight (%)
1	Encapsulation	Epoxy	0.088	Antimony	2.0
				Bromine	1.0
2	Lead frame	Copper alloy SF	0.04	Copper	98
				Nickel	1
				Silver	0.5
		Tin alloy SFM1	0.0007	Tin	83
				Lead	17
3	Silicon chip	Silicon	0.005		
4	Adhesive	Epoxy	0.001	Silver	78
5	Bond wires	Gold	0.0003	Gold	100

The Internet-based materials declaration tool has allowed the company to add to its existing database of materials and avoided duplication of effort. The new tool has also enabled each material used in a product to be identified irrespective of where it appears in the supply chain.

Identified benefits

The materials declaration tool has allowed Ericsson to:

- confirm that components contain no legally banned substances;
- ensure that products comply with existing legislation in the many countries where Ericsson products are distributed and to prepare for forthcoming legislation;
- eliminate the use of all materials on its banned list from its products;
- obtain detailed information on the amount and location of restricted substances in the supply chain, thus facilitating discussion with suppliers about their replacement with less harmful substances and on the timescale for these changes;
- develop an end-of-life treatment plan for products, including the recovery of precious metals;
- determine the amount and value of copper, silver, gold, platinum and palladium in each product;
- provide information on product content to those responsible for end-of-life treatment.

Next steps

Following the successful pilot study, the materials declaration tool is used for all mechanical parts designed at Ericsson as well as parts bought from suppliers. New products are being documented in additional detail; new functions are continually being added to the tool to support different types of production analysis and reporting.

Ericsson is now actively seeking to phase out the use of substances on its restricted list (effectively moving them to the banned list). However, this process depends on the identification of economically and environmentally acceptable alternatives. Two substances on the restricted list, halogenated flame retardants and lead, are currently attracting particular attention.

Ericsson understands the need for common standards in relation to this kind of information. The company is continually developing knowledge and a greater understanding of the declaration tool which Ericsson is willing to share with others.

Developing a tool to determine a product's environmental impacts

RMC Group plc is a leading producer of autoclaved aerated concrete (AAC) and ready-mix concrete, selling to aggregates, cement and concrete markets in Europe, the USA and the Middle East. Its subsidiary, YTONG Nederland BV (YTONG), produces gas concrete building products applied in façades, floors, roofing and walls. YTONG employs about 200 people at three sites in The Netherlands.

Customer concern led YTONG to start a process of identifying and understanding the environmental impacts of its AAC products during their manufacture, use and end-of-life.

Cleaner design project

AAC products are more energy efficient than traditional materials such as clay bricks, but they are more expensive per unit. YTONG hoped that providing information about the lifetime costs of its products would help to increase sales.

During the first half of 1998, the board initiated a project to integrate environmental life-cycle assessment (LCA) into the company's existing quality and environmental management systems. An initial objective was the development of an LCA management tool and its application to the company's AAC products in a pilot study. The board wanted this pilot study to involve head office and one of the production facilities.

In September 1998, an internal project team was set up under the responsibility of a board member. Members included departmental managers from head office and representatives of the production team, the Health, Safety and Environment officer, the general plant manager, the quality officer and representatives of logistics and administrative services at the production facility. Financial support for the project was obtained from public environmental funds. External consultants were brought in as specialist advisors and to create the LCA management tool within the framework of YTONG's existing ISO 14001 environmental management system.

The project team began by building awareness within the company and providing an environmental LCA action list for the consultants. To raise internal awareness of the project, the team set up an internal helpdesk, an implementation barometer and a weekly internal newsletter.

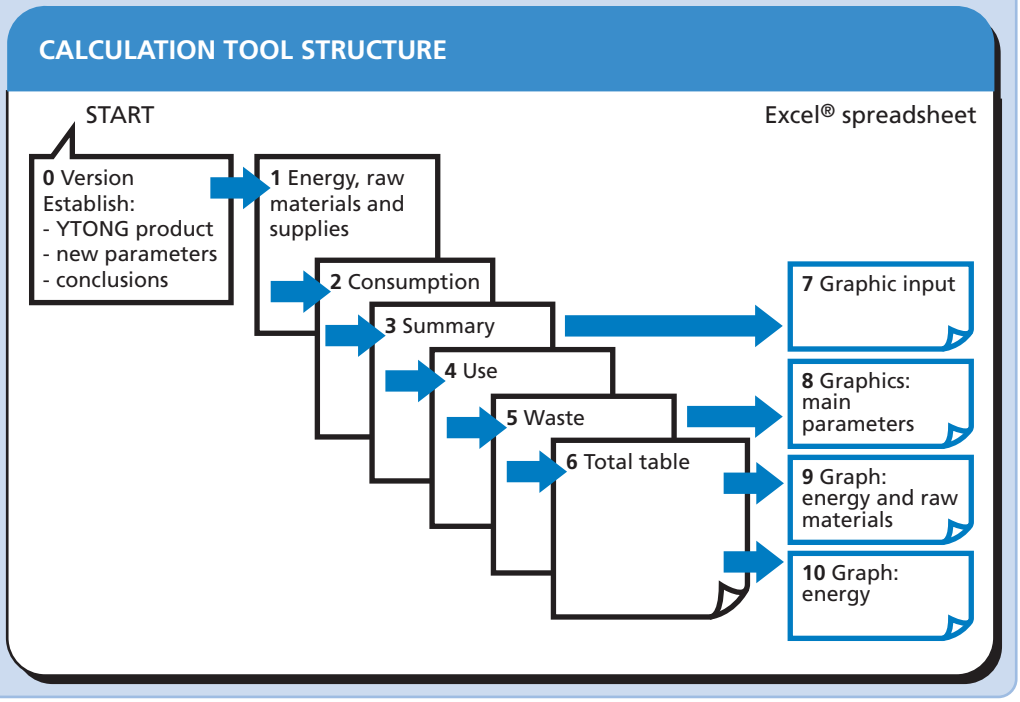
The LCA management tool is based on a computer spreadsheet which makes life-cycle calculations using data generated from YTONG's existing product registration system. The tool calculates how much pollution is generated at each stage of the life-cycle of a product. It is used to determine the environmental impacts of new products and to evaluate the effects of environmental improvements.

Various environmental issues are identified within the series of sub-elements making up the LCA spreadsheet calculation tool (see Fig 3). The tool generates values for the environmental impact per cubic metre of AAC product and enables environmental impacts to be estimated for:

- using different energy sources, raw materials or supplies;
- using other modes of transport for materials;
- different transport distances, eg changes in suppliers;
- changes to the product formula.

The tool shows whether such changes result in an increase or a decrease in environmental impacts or whether they move to another stage of the product's life-cycle.

Fig 3 The overall structure of the LCA spreadsheet calculation tool



Identified benefits

The development of the environmental LCA management tool has allowed YTONG to:

- create a comprehensive database of environmental information about its products;
- provide high quality information on the environmental impacts of its products to suppliers and customers;
- enhance its profile in the marketplace;
- obtain a good information base for any decisions to create cleaner design products;
- gain an insight into its environmental performance and ways to achieve improvements;
- develop the necessary tools, organisational infrastructure and internal expertise to deliver improved environmental performance.

Work on the LCA management tool also generated a momentum for innovation, with several investment projects related to the environment and to other fields. In particular, the R&D centre in Germany operated by YTONG AG (another RMC Group subsidiary) adopted a strategy of de-materialisation with an emphasis on energy and raw material inputs. This has resulted in the development of a new process to produce materials with similar thermal properties to the more traditional YTONG product, but weighing considerably less.

Analysis of capital expenditure across YTONG plants during 1996-1999 has shown an average payback period of two years for innovation linked to the LCA project.

Next steps

The success of the LCA management tool has encouraged YTONG to:

- apply the system to more of its existing products;
- initiate environmental improvement projects in co-operation with supply chain partners, with YTONG adopting the lead company role within these projects.

In addition, an application has been made to the Dutch Ministry of Housing, Spatial Planning and Environment for funding for five further projects in this area. These deal with corporate environmental management and, particularly, how a company can integrate environmental issues into its strategic planning.

The LCA initiative of YTONG Nederland BV is part of an on-going commitment to eco-efficiency and Design for the Environment (DfE) within the YTONG division of the RMC Group plc.

First steps to creating cleaner design products

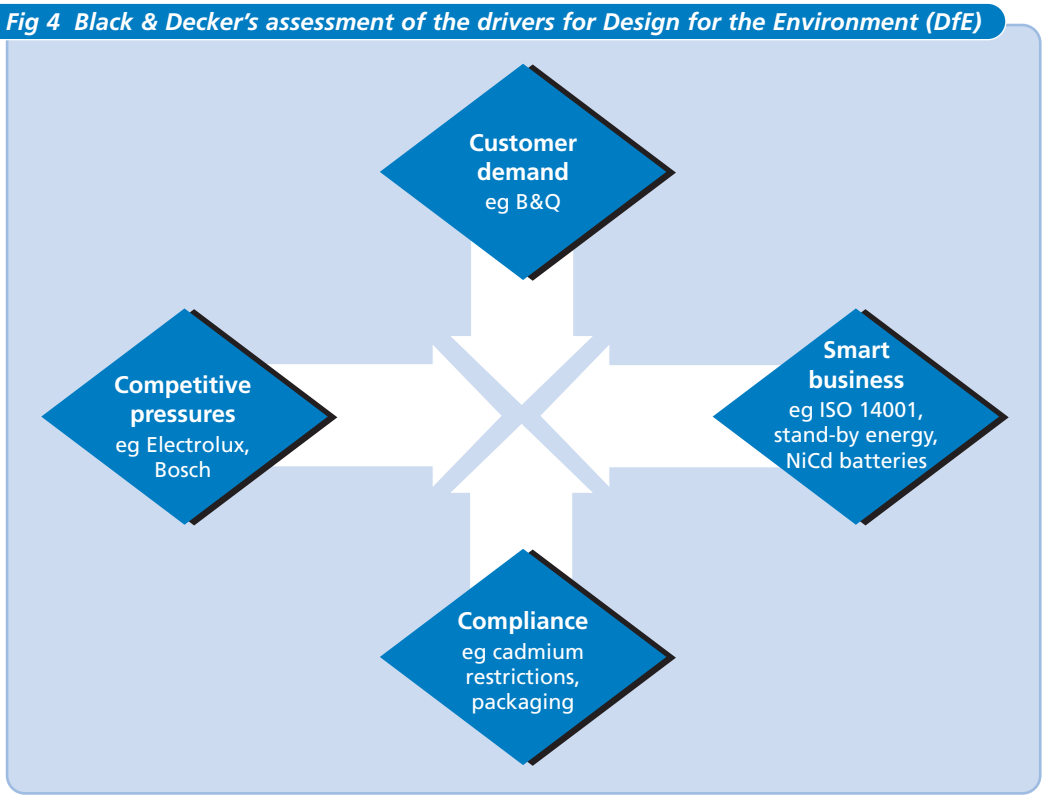
Black & Decker Corporation is a global manufacturer and distributor of power tools, hardware and home improvement products used for DIY and commercial applications. The company, which had an annual turnover of US $4.5 billion in 1999, has manufacturing operations in 14 countries worldwide.

Black & Decker's interest in cleaner design stemmed from a growing awareness of the need to consider the environmental impacts of its products to maintain its market position.

Cleaner design project

Black & Decker's marketing analysis showed that its different types of product have substantially different customer profiles. Performance is of particular importance to householders, while commercial customers consider energy consumption during use to be critical. The company was also under pressure (from customers, competitors and to comply with legislation) to integrate environmental aspects into product development processes. Design for the Environment (DfE) drivers identified by Black & Decker are summarised in Fig 4.

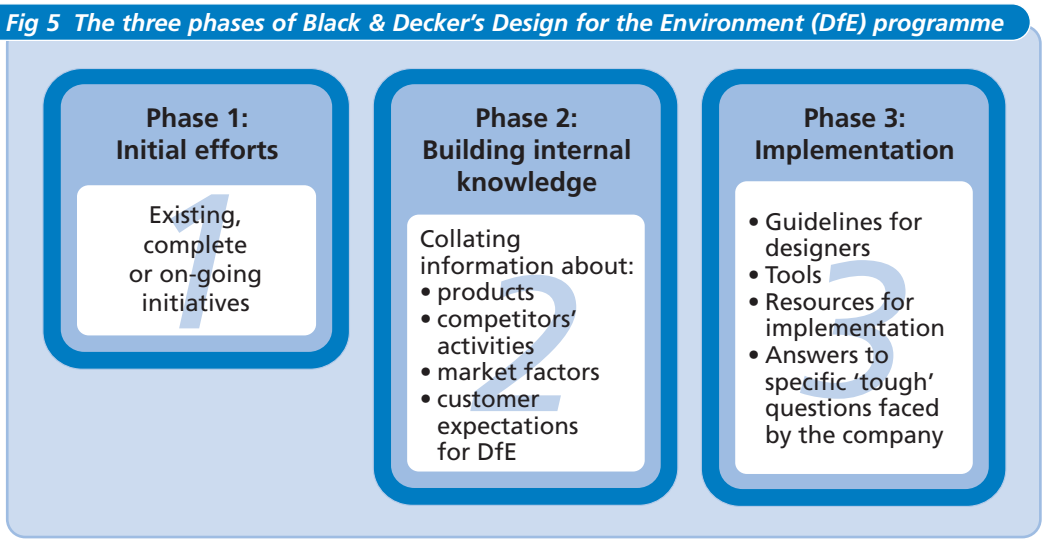
Fig 4 Black & Decker's assessment of the drivers for Design for the Environment (DfE)



Work on the internal case for a DfE programme began with a study of the reasons why the company should be involved in cleaner design. For example, it was found that up to 80% of product life-cycle costs are determined at the design stage even though the actual costs occur downstream during manufacturing, distribution and end-of-life disposal. Black & Decker also believed that a systematic analysis would help to identify and focus on opportunities for improvement. Helping to reduce material impacts by design for disassembly was another reason for adopting cleaner design.

The company had already developed tools for life-cycle assessment (LCA) and impact analysis. Use of these tools to prioritise cleaner design opportunities at Black & Decker led to a decision to implement the DfE programme in three phases (see Fig 5).

Fig 5 The three phases of Black & Decker's Design for the Environment (DfE) programme



Initial efforts in Phase 1 focused on:

- preparation of a DfE checklist;
- elimination of ozone-depleting substances during manufacture;
- the use of leaded brass in faucets;
- minimising packaging use.

Initiatives were set up within Phase 2 to:

- develop awareness of the concept of DfE within the company as part of the progress towards an ISO 14001-accredited environmental management system at its Spennymoor site in County Durham;
- continue to put together the necessary internal resources for a DfE programme;
- carry out proactive programmes on energy issues throughout the company;
- participate in an internal discussion group on life-cycle issues;
- carry out an LCA of a corded domestic power drill being developed at Spennymoor.

In addition, two pilot projects were launched at the Spennymoor and Towson sites. These involved:

- Performing LCAs at Spennymoor on a battery-powered and a mains-powered tool. The results have contributed to improved environmental design and are now taken into account in the design process.
- Development of a cleaner design training package by external consultants. The package, which is aimed at designers and engineers, has now been implemented at both sites.

These pilot projects focused on the following aspects of cleaner design that had been identified by Black & Decker as priorities, ie:

- ease of assembly and disassembly;
- co-moulding and serviceability;
- material selection and manufacturing safety based on the type of materials used;
- importance of the quality management tool already used by Black & Decker to identify cost savings.

The main criteria for the selection of these projects were:

- the extent to which the project would address questions and issues currently being faced by Black & Decker;
- whether the project addressed an issue with a major impact on the company's capital investment decisions.

Phase 3 involved a number of elements. Implementation of the DfE programme required the setting up of appropriate structures and resources. This included developing internal DfE guidelines aimed particularly at designers and engineers. Efforts were also made to integrate the DfE programme with other relevant Black & Decker programmes, eg takeback initiatives.

Another major element of the decision-making associated with implementation of the DfE programme (Phase 3) was to obtain the answers to specific 'tough' questions. The first was concerned with materials selection, ie whether there were any materials that the company should not use, and which materials should be preferred. The second question related to the initiation of leasing programmes.

Identified benefits

Introduction of a DfE programme has given Black & Decker:

- A useful insight into its environmental performance and provided a good information base for the creation of cleaner products.
- The necessary tools, organisational infrastructure and internal expertise for continual delivery of improved environmental performance.
- The ability to ensure product compliance with existing legislation in the many countries where its products are marketed and distributed. It has also enabled the company to prepare for forthcoming legislation.

Next steps

Black & Decker has come to regard cleaner design as the 'smart thing' to do for legal, corporate responsibility and business reasons. The promotion of DfE and the establishment of the necessary infrastructure are now a continual process within Black & Decker. Work to identify the environmental impacts of its products is on-going.

The essential elements of the company's support system for its DfE programme are:

- use of the DfE checklist;
- the availability of resources to collect information and participate in pilot studies to further test DfE value within power tool production;
- introduction of market analysis of environmental drivers by marketing groups;
- a continuous flow of internal communication of DfE efforts and outcomes within different programmes.

Delivering product function with less material

Coca-Cola Enterprises Ltd (CCE Ltd) produces and distributes beverage products of The Coca-Cola Company. CCE Ltd is a major producer of canned soft drinks in the UK, accounting for about two billion soft drink cans per year.

Sales of cans of beer and soft drinks increased with the invention of the easy-open end in 1963, followed shortly by the two-piece impact extruded can. In the late 1980s, the reduced size '206' can was introduced, providing considerable cost savings in materials to producers such as CCE Ltd. In the early 1990s, revenues fell due to the recession and a customer switch to plastic bottles. This put pressure on both beverage can manufacturers and fillers to reduce costs. However, further lightweighting was not thought possible with the existing '206' can design.

Cleaner design project

A new '202' can was first proposed by a supplier to CCE Ltd in June 1992. The project involved designing a new beverage can with a reduced end diameter, while retaining the existing can body diameter and maintaining customer demands for can quality. This change (see Fig 6) meant considering:

- can manufacture;
- the filling process;
- general can robustness and stackability for transport and distribution;
- customer perceptions.

Complex design work was required to achieve the reduction in can end diameter. This allowed the function to be maintained whilst the use of materials was reduced.

Fig 6 Before and after cleaner design

The old '206' beverage can

The new '202' beverage can

In 1993, CCE Ltd carried out a consumer test to:

- establish consumer perceptions about the new design;
- determine any changes in purchasing behaviour;
- examine the effects on product and brand perceptions.

It had been thought that the shape of the can might put off consumers and that the reduced end size could create problems when drinking from the can. However, consumers showed no particular adverse reactions to the new '202' cans and no particular preference for the existing '206' cans.

CCE Ltd carried out trade and supply chain testing to:

- identify any handling issues;
- ensure that the new cans were sufficiently robust to withstand stacking;
- establish the reaction to the product of the 'impulse' buyer.

Production quantities of the '202' can end were first produced by the supplier at its plant at Milton Keynes in April 1993. At the same time, CCE Ltd obtained the agreement of all leading European can manufacturers to a common design and specification for the '202' can end and body. As well as having the same overall performance as the existing '206' can, a key criterion was that no modifications to vending machines would be required for the new design.

A trial filling of '202' cans manufactured by the three main can suppliers in the UK took place on a fully-operational production line at CCE Ltd's plant at Sidcup in April 1993. The trial attracted considerable interest and was attended by observers from the major can fillers.

One problem was can stackability, which required further development work to ensure market acceptability of the cans. The fillers encountered several issues. First, the reduction in headspace (the space above the liquid in the can) caused problems that had to be addressed for certain soft drinks. Second, the can end proved difficult to handle with automatic machinery. This problem was solved by modifications to the manufacture and seaming processes.

An extended trial was carried out at the CCE Ltd plant at Wakefield before full conversion to the '202' can was completed in 1994. Some further incremental reduction in weight has since been achieved.

Identified benefits

The project demonstrated that lightweighting can produce significant cost savings through reduced raw material costs. Benefits were also achieved through reduced production complexity.

- Conversion from the '206' to the smaller '202' can produced cost savings of over £1 per thousand cans and led to savings worth some £40 million/year in reduced metal use for the beverage can industry worldwide.
- As a result of the project, CCE Ltd saved an estimated £2.3 million/year from 1995 onwards.
- Total conversion costs were approximately £2.2 million, net of asset write-offs. This made the project a profitable investment with a payback period of less than two years.

Table 2 shows the estimated profit and loss account for the '202' project for 1993-1998.

Table 2 Estimated project profit and loss account

	Cash flow return (£000)					
	1993	**1994**	**1995**	**1996**	**1997**	**1998**
Gross contribution			2 300	2 300	2 300	2 300
(Marketing)		(15)				
(Fixed costs)	(111)	(372)	(420)	(420)	(420)	(420)
Trading profit/(loss)	**(111)**	**(387)**	**1880**	**1880**	**1880**	**1880**
Capital expenditure	(396)	(1 700)				
Fixed asset disposals		392				
Depreciation			420	420	420	420
Annual savings	**(507)**	**(1 695)**	**2 300**	**2 300**	**2 300**	**2 300**

NB The £420K fixed costs represent depreciation being paid on the capital investment shown below the Trading statement line. The bottom line represents the cash-flow implications with the capital investment taken account of in years 1 and 2 (£396K and £1700K). The £420K fixed costs representing this investment in the Trading statement are thus reversed out of the equation to leave a simple project cash-flow (annual savings).

Next steps

CCE Ltd is committed to advancing cleaner product design as, in addition to the potential cost savings, the company is aware of the market demand for cleaner products. The company is also keen to build on the co-operation and discussion between can manufacturers and can fillers achieved during the '202' can end project. For example, before this project, there were no common specifications for cans and can ends in Europe. This meant that seamers had to be reset between different suppliers' cans and different end profiles. Achievement of a common specification for the '202' can has eliminated this problem.

Since the launch of the '202' can, CCE Ltd has made a number of other environmental improvements, which include:

- The use of lightweighted cans has enabled CCE Ltd to carry more product on a single truck, thereby reducing the number of truck movements.
- Lightweighting PET bottles, in a similar manner to '202' cans. For example, the 2 litre bottle now uses approximately half the amount of PET used in the mid-1980s, when the pack was first launched.
- Removing cardboard trays from 2 litre PET bottle packs. By using a shrink wrap system, packs of six bottles are held together without the need for cardboard trays.

Creating products that are more energy efficient

The Electrolux Group is one of the world's leading producers of refrigerators, washing machines, cookers, vacuum cleaners, etc for household and commercial use. The Electrolux Group is the European market leader in white goods and the third largest white goods company in the USA, employing 93 000 people.

Electrolux initiated a cleaner design programme in response to increased environmental regulation and customer concerns about running costs. Concerns about environmental issues were also thought to be affecting sales of some products, eg refrigerators and freezers containing ozone-depleting substances.

Cleaner design project

Life-cycle assessments (LCAs) of most of Electrolux's products showed that the environmental impacts of appliances during their use was much greater than those arising from production. For example, 80% of the total environmental impact of a washing machine was found to be due to water, energy and detergent consumption during use, with less than 20% of its environmental impact attributable to manufacture and distribution. Although the relative importance of environmental impacts was found to vary between products, energy consumption was always a key issue. A similar analysis of the total cost of the entire life-cycle of a washing machine showed that the cost of water, energy and detergent consumption exceeded the initial purchase price. For the customer, this meant that choosing an appliance with a high environmental performance could deliver long-term cost savings.

Electrolux designated the reduction of energy and water consumption during product operation as its cleaner design priorities. Other environmental impacts to be addressed included the use of hazardous substances, product re-use and recycling, and product noise during use.

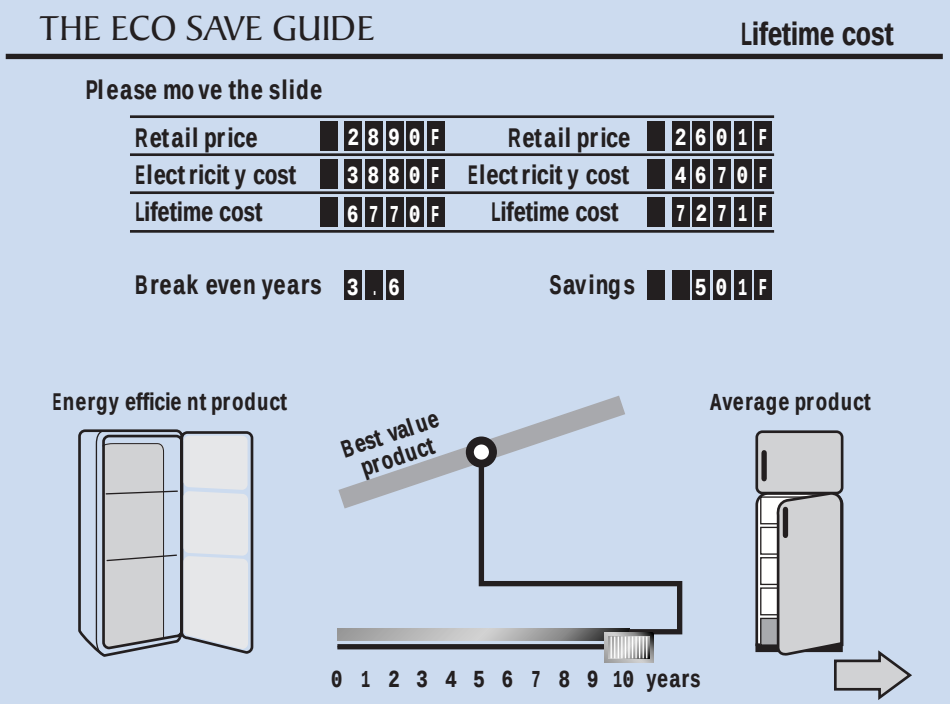
Cleaner design is implemented at Electrolux via environmental assessment procedures that are part of the company's product development process. Eco-design handbooks were prepared for most product lines and tools were developed to monitor improvements in the environmental performance of products. Two environmental performance indicators are used by Electrolux to monitor performance values for products. The Fleet Average indicator monitors the overall environmental performance of Electrolux's product ranges by assessing factors such as energy and water consumption and emissions. The Green Range indicator identifies those products with environmental performance that places them in the top 10-15% of the marketplace for their product category.

To develop internal expertise in cleaner design, Electrolux set up a database that is available via the company's intranet. The database provides information to the environmental co-ordinators and other staff about environmental policies, available tools, corporate minimum requirements and accomplishments. It also gives access to reports, updates and analyses of legislative and market developments. This is complemented by further information that aims to build environmental skills among employees.

To provide business customers with comprehensive information about a product's environmental impact during its life-cycle, Electrolux has developed a system of environmental product declarations. These declarations cover the product's environmental impact during manufacture, transport, packaging and recycling.

To encourage consumers to consider lifetime costs (retail and running costs) of household appliances, Electrolux has developed its own Eco Save Guide (see Fig 7). This tool is designed to be used by customers at retail premises, and has already been installed at major retailers in France. The Eco Save Guide allows potential customers to calculate the total costs of a product and the savings from choosing energy-efficient products.

Fig 7 Example display from the Eco Save Guide

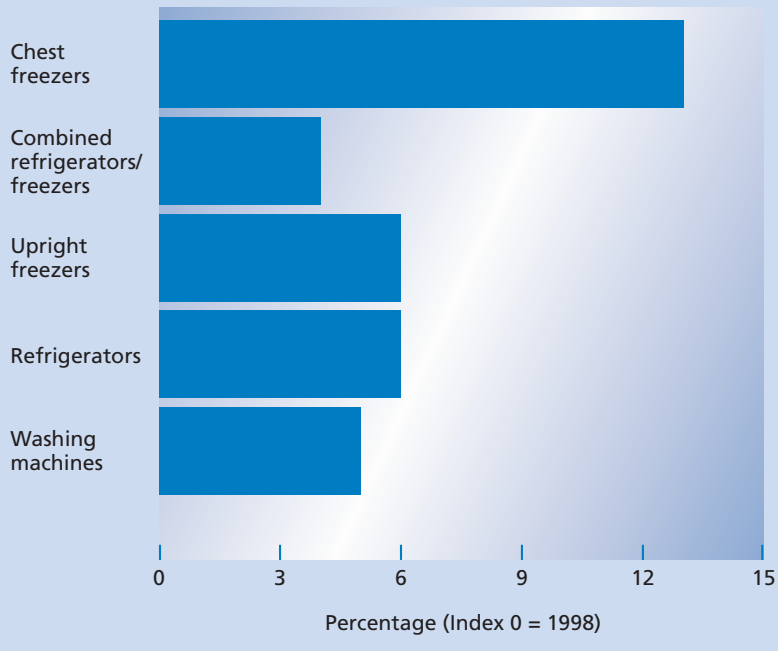


Identified benefits

A key benefit of Electrolux's cleaner design programme has been to increase the company's market share and profitability.

- In 1999, Green Range products accounted for 21% of total sales and 31% of gross margins.
- Fleet Average environmental performance indicators showed a significant improvement in the energy efficiency of washing machines, refrigerators, freezers and combined refrigerators and freezers sold by Electrolux in Europe in 1999 (see Fig 8). This improvement provided customers with corresponding energy savings, as well as the related environmental benefit of reduced carbon dioxide emissions.

Fig 8 Improvement of energy efficiency index 1999



- Focusing on energy consumption as a cleaner design priority has allowed Electrolux to increase its share of the market for energy-efficient appliances. For example, the proportion of Electrolux freezers in energy classes A and B[1] increased from 31% in 1997 to 41% in 1998.

Next steps

Electrolux regards consumer concern for the environment as a business opportunity and expects the driving forces to reduce costs and improve environmental performance to increase rather than diminish. The company is developing its cleaner design programme to:

- take a more precautionary approach to hazardous substances;
- assess the opportunities for product remanufacture and the selling of product function (eg 'pay-per-wash' washing machines), rather than products.

[1] A universal energy labelling system was introduced into the EU in 1995 and now covers most white goods. Labels - ranging from A for the most energy efficient to G for the least efficient - are currently applied to refrigerators and freezers, washing machines, tumble-dryers, combined washer/tumble-dryers and dishwashers.

Using more recycled materials in an IT product

IBM is an international company specialising in information technology and business communications. IBM employs over 300 000 people worldwide and has an annual turnover of over US $80 billion (1998 figures).

IBM's corporate environmental policy was the main driving force behind the company's involvement in cleaner design. In the early 1990s, IBM recognised that its customers were becoming more aware of environmental issues and that to maintain its market position, it was essential to demonstrate a commitment to these issues. In its environmental policy, IBM aims to:

- conserve natural resources by re-using and recycling materials, purchasing recycled materials and using recycled packaging and other materials;
- develop, manufacture and market products that are safe for their intended use, efficient in their use of energy, protective of the environment, and that can be re-used, recycled or disposed of safely.

An Environmentally Conscious Products programme was set up to allow IBM to meet these commitments.

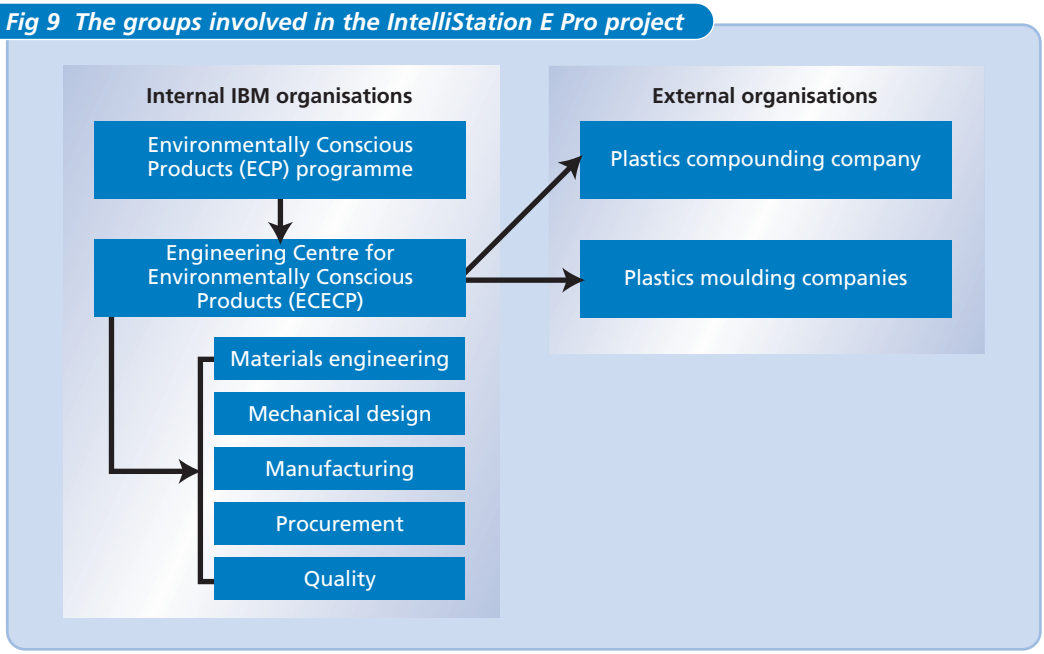
Cleaner design project

One project involved the use of 100% recycled material for the plastic content of an existing, high-volume product - the IntelliStation E Pro system unit. This project was undertaken to:

- demonstrate that recycled plastics could successfully replace prime resins in business machine applications;
- achieve corporate targets for increased use of recycled plastics in IBM products.

The project involved significant effort and co-ordination. The groups involved in the project are shown in Fig 9. The Engineering Centre acts as a resource both within IBM and for its suppliers.

Fig 9 The groups involved in the IntelliStation E Pro project



Working with the plastics compounding company, the Engineering Centre produced material specifications for the development of an acceptable, commercially available, 100% recycled content resin. Together they developed a blend containing 100% recycled polycarbonate (PC) and acrylonitrile/butadiene/styrene (ABS) that met IBM's functional specifications.

IBM then tested the resin's performance characteristics in terms of function, safety and long-term reliability. Mouldability, worldwide stock availability, colour matching and dimensional stability were also investigated.

The next stage was to implement the material change without affecting the cost and the production schedule. The development team identified nine key stages (see Table 3) that needed to be evaluated for the planning, procurement and production phases of the project. A separate person or group was designated as the 'owner' of each stage and given responsibility for the work involved.

Table 3 The nine key stages to implement the use of 100% recycled resin

Stage	Action	Owner
1	Collaboration with resin suppliers to develop and characterise the recycled resins	Materials engineering
2	Identification of candidate parts/ applications	Mechanical design, manufacturing engineering and materials engineering
3	Selection of a suitable recycled resin for a candidate part	Mechanical design and materials engineering
4	Evaluation of the mouldability of the resin for the plastic part	Manufacturing engineering and procurement
5	Moulding of test parts	Manufacturing engineering and procurement
6	Qualification or testing of test moulded parts	Mechanical design, materials engineering and quality
7	Establishment of worldwide availability and volume procurement agreements	Manufacturing engineering and procurement
8	Updating of engineering drawings to specify recycled resin	Mechanical design
9	Implementation of the use of recycled resin	Mechanical design, manufacturing engineering and procurement

The work carried out during each of the nine key stages is summarised in Table 4.

Table 4 Work carried out during the nine stages of the implementation phase

Stage	Work involved
1	Internal testing and verification by IBM of the material using standard test methods.
2	Identification by IBM's hardware development engineers (in consultation with materials and manufacturing personnel) of plastic parts and applications that could be made from recycled resin. Both decorative (external) and structural (internal) parts were considered, as well as factors such as cost, the complexity of the part to mould and its colour requirements.
3	Collaboration between IBM's materials engineers and parts designers to determine which IBM-approved recycled content resins were suitable.
4	Liaison between IBM's manufacturing and procurement engineers and the suppliers of the selected moulded plastic parts to help them optimise moulding conditions.
5	Production of several test parts in the production mould by the supplier (once the recycled resin had demonstrated acceptable mouldability).
6	Checking that the test parts passed all functional performance requirements. Testing against International Electrotechnical Commission (IEC) standard 60950, *Safety of Information Technology Equipment, including Electrical Business Equipment.*
7	Establishment of the logistics of the recycled resin's availability worldwide. Negotiation of procurement contracts.
8	Additional testing of the manufacturing and assembly process. Preparation of engineering drawings.
9	Use of the recycled resin in normal production.

Identified benefits

Switching to using 100% recycled resin for the plastic components of the IntelliStation E Pro system unit had a number of benefits for IBM:

- The 100% recycled PC/ABS resin was 30% cheaper than the comparable prime PC/ABS resin and was no more expensive than other prime resins for which it was substituted.
- Company-wide use of recycled plastics diverted nearly 680 tonnes of plastic waste from landfill in 1999.
- The project's success provided a new benchmark for IBM designers. Other recycled plastics were introduced in two other IBM product families, which now contain resins with a recycled content ranging from 6% to 25%.
- The project increased competition between IBM's traditional resin suppliers and convinced them of IBM's commitment to using recycled plastics.
- The project gave IBM a market advantage by meeting or exceeding customer expectations of its environmental performance.

Next steps

IBM is keen to capitalise on the experience and knowledge gained during this project and similar initiatives. However, the continued success of such projects depends on the availability of 'clean' sources of recovered plastics and the cost of recycled plastic remaining competitive compared to that of prime resin.

IBM continues to work to increase its use of recycled plastics in new products and to reduce the use of landfill for the disposal of waste from disassembly operations. Recycled content is now a frequently requested product attribute in purchasing criteria.

Substituting organic cotton for conventionally produced cotton in clothing

Nike Inc is a US $9 billion international company specialising in sports footwear, clothing, equipment and accessories. The company has its headquarters in the USA, with business units around the world. Nike's sustainable product design policy aims to create innovative products that conserve natural resources, eliminate known and potentially harmful or wasteful substances, and close the product loop.

As part of its commitment to reducing the environmental impacts of its products, Nike is working to introduce organic cotton in its T-shirt products as a substitute for conventionally grown cotton.

Cleaner design project

Cotton is a major raw material for Nike. Conventional cotton farming uses vast amounts of pesticides and other chemicals that pose a significant potential risk to human health and the environment. In response to growing government and consumer pressure to reduce the use of these hazardous substances, Nike initiated a programme to use at least 3% organic cotton in its clothing division. As a major cotton purchaser, Nike saw that it could use its purchasing power to boost the growth of the organic cotton industry worldwide and reduce the environmental impacts of its products.

Another driver for change was Nike's desire to adapt its business model from focusing predominantly on manufacturing and sales issues to accepting responsibility for the environmental costs of doing business. By adopting this policy before it is made mandatory, Nike plans to be in a better position to manage and reduce these costs. With regard to organic cotton, Nike's strategy takes the form of partnerships with spinning companies, farmers and farming co-operatives both to guarantee the long-term supply of organic fibre and to reduce fibre costs.

The Sports Graphics Division, one of the highest users of cotton fibre, was chosen for the project. The Division is responsible for most of the 40 million/year printed and promotional T-shirts produced by Nike. A pilot programme was set up involving two key partners: Bassett-Walker, a US supplier of large quantities of Nike T-shirts, was selected to produce the new T-shirts and Parkdale Mills, a US spinner, was chosen to buy the organic cotton and to produce the blended yarn.

Extensive research by Nike found that adding a straightforward production step would allow Parkdale Mills to prepare a blend of the company's conventional 153 g jersey T-shirt fabric containing 3% organic cotton. This change would add 2 cents to unit costs. The company felt that the competitive nature of the T-shirt market would prevent any price increase and so decided to absorb the higher production costs internally.

As the organic cotton industry was still small and Nike's potential demand would far outweigh current supplies, Nike adopted a strategy of gradually increasing its use of organic cotton as the market allowed. For example, had Nike chosen in 1996 to convert to 100% organic cotton, the company would have required 3 400 tonnes/year or 42% of the world's total organic cotton supply for just four T-shirt styles. Nike is supporting farmers as they shift from producing conventional cotton to organic cotton - a process that takes a minimum of three years.

Organic cotton substitution began with the 18/1 and 20/1 open-end carded yarn used in Nike's basic T-shirt programme. In 1997, Nike began blending 3% organic cotton into 3.8 million units of its US-produced 153 g lightweight jersey T-shirts. This involved the use of 110 tonnes (250 000 lbs) of organic cotton. Since then, Nike's purchases of organic cotton have increased significantly (see Table 5).

Table 5 Summary of progress

Year of project	Cotton harvest	Product lines	Amount of organic cotton bought
First	1997	T-shirts made from 153 - 158 g jersey with 1x1 rib trim	110 tonnes (250 000 lbs)
Second	1998	T-shirts made from 153 - 158 g jersey with 1x1 rib trim	140 tonnes (320 000 lbs)
Third	1999	T-shirts made from 153 - 158 g jersey with 1x1 rib trim, plus fleece and French terry	370 tonnes (816 000 lbs)
Fourth	2000	T-shirts made from 153 - 158 g jersey with 1x1 rib trim, plus fleece and French terry	450 tonnes (1 million lbs) (projected for USA, Europe, Asia)

Nike worked with the Director of Cotton Purchasing at Parkdale Mills to develop criteria for material substitution for organic cotton in the USA, ie:

- The final product must contain 3% certified organic or certified transitional organic cotton. In jersey and rib, this 3% would be blended into the main yarn. In fleece, the backing yarn would be 10% organic/transitional cotton content (this translates into 3% for the garment based on weight).
- The organic or transitional organic cotton for the US-based programme must come from US farmers.
- The spinners must retain detailed bale certification documents on-site and provide Nike with farm certification and bale reports. This allows tracking of the organic and transitional fibre into the mill and out to the suppliers. Nike also requires quarterly yarn shipment reports from the spinners to ensure they are ordering the 3% blended yarn.

The following criteria were determined for Europe:

- for the first year of the European programme, one supplier was asked to arrange all the fibre purchases and then spin, knit, cut and sew the garments;
- organic cotton for the European programme had to come from European farmers;
- similar certification requirements to those in the USA were imposed, but with independent certification.

In Asia, Nike is working with key suppliers and the Organic Cotton Improvement Association (OCIA) to get Asian farmers certified for organic or transitional organic cotton. Nike hopes the Asian certification programme will be in place for the 2001 harvest; until then, organic/transitional organic cotton for the Asian programme will be sourced from Europe or the USA.

Identified benefits

The programme to convert from conventional cotton to 3% organic cotton in its basic T-shirt products has generated significant benefits for Nike while maintaining product quality.

- The environmental benefits of organic cotton production include reduced water consumption, less groundwater pollution, improved soil health and reduced human exposure to pesticides and synthetic fertilisers. For every 1 million T-shirts that incorporate 3% organic cotton, the use of 4 tonnes (9 000 lbs) of chemicals is avoided.
- The expanding programme is increasing the market for organic cotton and facilitating the development of the organic cotton industry. This is expected to reduce the price of organic cotton, making the incorporation of more organic cotton into Nike clothing more affordable.
- The project receives strong support from staff involved in the project at both Nike and its suppliers.
- Despite a decision not to actively market the initiative, the organic cotton project has attracted favourable comments and enhanced the company's profile.

Next steps

Nike is committed to the further expansion of its organic cotton programme. The programme will be expanded to cover more products and to include more textile suppliers and spinners. The company's overall goal is to blend all cotton fabrics used by its clothing division with a minimum of 3% organic fibre by 2010 and introduce 100% organic cotton products to the marketplace beginning with the Autumn 2002 season. Nike expects to achieve this target in Europe by 2003, in the USA by 2003/2004, the Americas (Canada, Central and South America) by 2004/2005 and in Asia by 2005/2006. The small increase in production costs is expected to fall as the market for organic cotton grows.

Working with suppliers to eliminate hazardous substances from products

AB Volvo is an international transport equipment company with marketing and production in 30 countries worldwide. The company's product range includes passenger cars, trucks, buses, construction equipment and drive systems for marine and industrial applications, as well as the development, production and maintenance of aircraft engines. Passenger car manufacturing is carried out by Volvo Car Corporation (VCC), which is now owned by the Ford Motor Company.

Volvo has an overall policy to maintain and increase its market share by being a leader in environmental care and to minimise the environmental impacts at all stages of product manufacture, use and disposal. A key element of this policy has been to eliminate hazardous substances in Volvo products by working with the supplier network as part of material procurement decisions in product design.

Cleaner design project

As part of Volvo's environmental policy, a statement of environmental requirements was sent to all suppliers and contractors. One requirement was for all suppliers and contractors to adopt internal working procedures that restrict the use of hazardous substances in materials delivered to a Volvo company. Specific materials were named in two separate lists of hazardous substances prepared by AB Volvo. A 'black' list contained substances whose use is prohibited and a 'grey' list detailed substances whose use should be limited or, if possible, phased out.

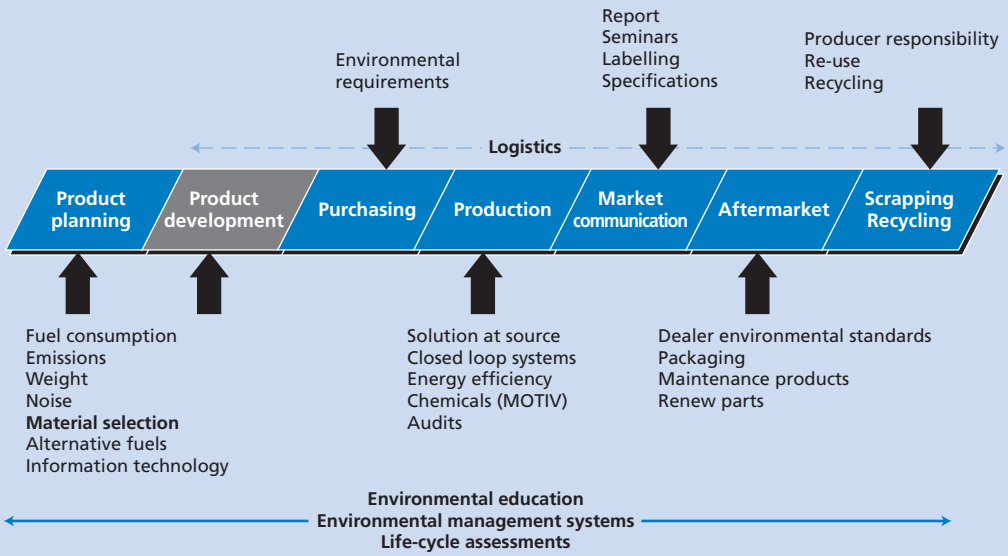
Suppliers and contractors were required to:

- comply with these black and grey lists;
- guarantee that no black list chemicals are present in new components;
- account for the presence of any listed chemicals;
- draw up plans to phase-out the use of any listed chemicals; the plans had to include a final date of use.

Key suppliers were responsible in turn for their respective sub-suppliers. All suppliers were also required to be aware of the environmental policy of the Volvo company they were dealing with.

This approach has been adopted by VCC. Like other Volvo companies, VCC is responsible for setting its own minimum purchase value that requires the application of the full environmental requirements. The role of material selection at VCC in reducing the environmental impacts of its products is shown in Fig 10.

Fig 10 Improving environmental performance at Volvo Car Corporation



The substances included on the lists were selected after extensive studies by AB Volvo of the detailed information on thousands of chemicals held in the company's environmental database (known as MOTIV) and official lists of restricted chemicals. The hazards covered by the lists included mutagenic, carcinogenic, toxic, neurotoxic, allergy-causing and ozone-depleting. For both lists, exceptions may be made where legal or safety requirements limit Volvo's possibilities of prohibiting the substance's use. In such cases, Volvo procedures demanded that precautionary measures were taken to prevent harm to humans and the environment.

Examples of the type of substances included on the two lists are shown in Table 6. The full list gave the Chemical Abstract Service (CAS) number, an example of the type or area of use, and the risk category.

Table 6 Examples from Volvo's black and grey lists of hazardous substances

Black list		Grey list	
Group	***Example substance***	***Group***	***Example substance***
Amines	Phenyl-β-naphthylamine	Acids	Hydrofluoric acid
Chlorinated hydrocarbons	1,1,1-trichloroethane	Additives	Diphenylamine
Chlorofluorocarbons (CFCs)	CFC 11	Biocides	Chlorocresol (ortho- and meta-)
Fibres	Asbestos	Complex mixtures	Creosote
Flame retardants	Polybrominated biphenyls	Flame retardants	Triphenyl phosphate
Halons	Halon 1211	Hardeners	2,4-toluene diisocyanide
Lubricants	Chlorinated paraffins	HCFC compounds*	HCFC 141b
Metals	Mercury and its compounds	Metals	Arsenic and its compounds
Rubber-chemicals	Thiocarbamide	Plasticisers	Dibutylphthalate
Solvents	Benzene	Solvents	Chloroform
Surface-active agents	4-nonyl phenol	Surface-active agents	

* Hydrochlorofluorocarbons (HCFCs) used as a refrigerant are on the grey list. HCFCs used as a blowing agent or as a solvent are covered by the black list.

AB Volvo and VCC decided that the lists should:

- follow relevant national or local regulations;
- be revised annually;
- refer to the deliberate use of a particular substance;
- ignore substances that occurred in low concentrations as impurities;
- ignore substances that were handled only in small quantities by trained staff in laboratories.

Phase-out plans and the final date for use were decided when new substances were placed on the black list. New chemicals were assessed by expert groups within AB Volvo and VCC.

Identified benefits

Use of the black and grey lists of hazardous substances has produced significant benefits for VCC:

- the components used in Volvo cars now contain fewer hazardous substances, thus reducing their environmental impacts during manufacture, use and final disposal;
- VCC has been able to ensure that its products comply with existing legislation in the countries where they are distributed and to prepare for forthcoming legislative changes;
- the system has improved working conditions for VCC employees and increased their environmental awareness;
- the lists provided a driver for more extensive environmental initiatives at Volvo plants and suppliers;
- there has been an improved exchange of technical information and expertise between VCC and its suppliers.

Further developments

Since the introduction of the black and grey lists of hazardous substances, VCC has adopted the Common Ford Motor Company list: Restricted Substance Management Standard, which is based on the black and grey lists and the Ford Chemical list.

Next steps

Volvo is implementing more projects with the aim of minimising the total environmental impact of its products during their whole life-cycle. Techniques such as life-cycle assessment (LCA) and environmental failure mode and effect analysis (E-FMEA) have been introduced and co-operation with suppliers and contractors is being strengthened.

Environmental instructions for designers have also been developed. These include practical hints and directions on how to reduce the environmental impacts of new products at the design stage. Working procedures are continuously being modified to make full use of the new environmental tools.

Working with the supply chain to facilitate product re-use and recycling

Xerox Europe, the European operation of Xerox Corporation, is one of the world's largest information technology companies, and markets Xerox's products, solutions and services throughout Europe.

Xerox has a goal to become a waste-free company by delivering more product function with similar material quantities. In particular, its cleaner design programme aims to reduce the cost of waste disposal to landfill and reduce production costs by re-using or recycling parts. Remanufacturing has been an important part of company strategy at Xerox since 1993.

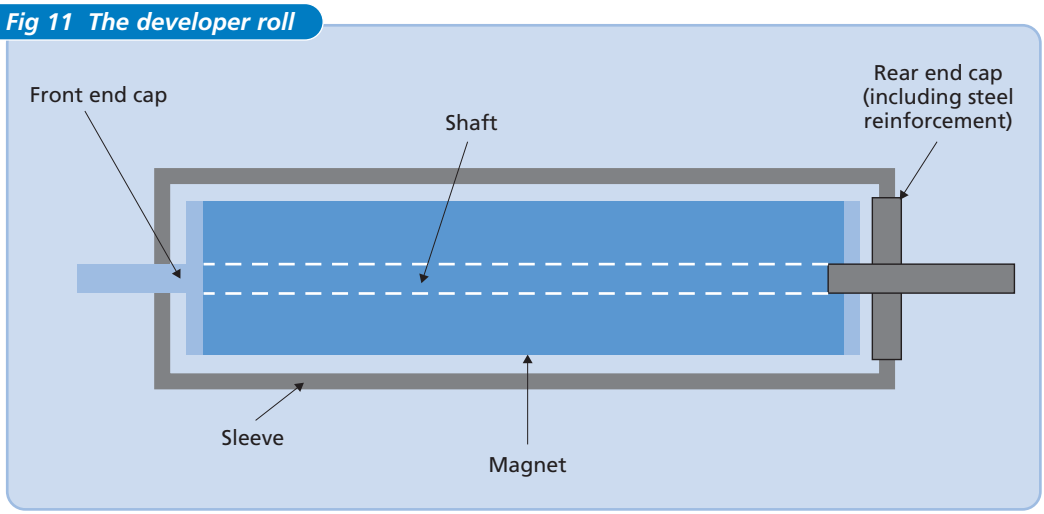
Cleaner design project

Maximum re-use and cost-effective recycling are essential to the costing of internal business unit activities at Xerox. This is because the Asset Recovery Organisation (ARO) pays a 'buy-back' price to individual Xerox business units for each customer replacement unit (CRU) it receives from the business unit. It is in the interest of the business unit to receive the highest possible buy-back price, and it is in the interest of the ARO to make the most cost-effective use of the assets it purchases from the business units. One cleaner design project at Xerox involved redesigning the developer roll, a high cost item that is part of the CRU, to maximise its re-use and recycling.

The developer roll (see Fig 11) is a mixed sub-assembly unit made up of the following parts:

- a magnet (magnetised ferrite and plastic materials);
- an aluminium sleeve;
- a front cap (polyethylene);
- a rear cap made of cast aluminium with a steel reinforcing coating;
- a shaft (polyethylene).

Fig 11 The developer roll



The design of the developer roll was reviewed to maximise opportunities to re-use it in product remanufacture and to facilitate its recycling. A multidisciplinary team was set up involving buyers, engineers, the ARO and an external recycling company. The team also worked with suppliers in Germany, Switzerland and Italy, providing assistance with tooling and quality issues, and financing trials. The suppliers generally had little experience in cleaner design and were initially reluctant to get involved. However, the close co-operation between the suppliers and the Xerox team led to a successful and mutually beneficial outcome.

On their first return to Xerox, developer rolls were inspected and those suitable for re-use (about 55%) were sent to the remanufacturing line. The remainder, along with second-life developer rolls were sent for dismantling with recovery of plastic for recycling.

The main reason that developer rolls were declared unfit for re-use was that the rear end cap had been sheared off. The team therefore began by looking at ways of reducing the number of damaged units. To strengthen the rear cap end and alleviate this problem, a steel reinforcement sleeve costing US $0.60 was fitted to give extended life to a part costing US $10.50.

The team's second major achievement was the development of a demagnetising process to allow the magnetised material to be recycled within the moulding process. Once the material had been demagnetised, there were two options. The first was to return the demagnetised material to the supplier of the virgin material. However, the supplier was doubtful about the quality of the recycled material and concerned about the implications for the moulding process. The ability of the recycled material to produce the necessary magnetic strength to perform its function was also questioned. These concerns were reflected in the price the supplier was willing to pay for the demagnetised material. Therefore, this option was not pursued.

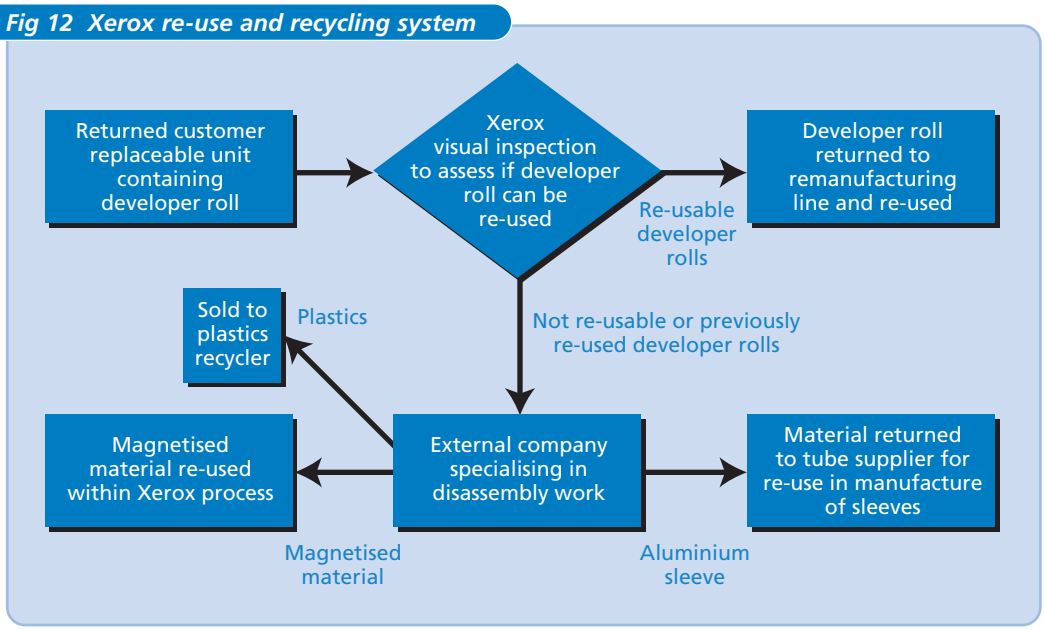
The second option was to send the demagnetised material directly to the moulding company for regrinding and incorporation into the moulding process. This supplier was also concerned about the quality of recycled material, particularly about its effect on the moulding process. Xerox worked closely with this company and, by supplying the necessary finance, convinced it to test the recycled material in the moulding process. Trials using 20% and 40% recycled material were carried out. Incorporating the demagnetised material at 20% of the total magnetic material did not affect the moulding process. Following these successful trials, 20% of the magnetised material in the developer roll now consists of recycled material.

Following the design improvements, around 80% of the developer rolls can be re-used on their first return to Xerox. These rolls are marked to show they have been classed as suitable for re-use. The remaining 20% are sent - along with returned second-life developer rolls - to an external contractor in Germany. Developer rolls that are damaged because the shaft on the rear cap end has been sheared off can be repaired and subsequently re-used on the Xerox remanufacture line. If the developer rolls cannot be repaired, they are disassembled and the individual parts are re-used or recycled as follows:

- aluminium from the sleeve is returned to the supplier for re-use;
- plastic parts are sold to a plastics recycling company;
- magnetised material is re-used.

The Xerox re-use and recycling system is summarised in Fig 12.

Fig 12 Xerox re-use and recycling system



Identified benefits

The project to redesign the developer rolls from the CRU produced a number of cost and environmental benefits for Xerox:

- Equipment remanufacture and parts re-use produce financial benefits for Xerox worth several hundred million dollars a year.
- In 1998, 85 920 developer rolls were recovered in Europe. This saved Xerox US $9/roll and produced demagnetised material for sale to the supplier worth nearly US $1 million/year.
- The number of first-return developer rolls being re-used has risen from 55% to 80%.
- More material is recovered and recycled from the non re-used rolls, including the magnetised material and aluminium sleeve.
- The re-use and recycling programme prevented over 65 770 tonnes of waste from being landfilled in 1998. Some 27 215 tonnes were re-used and 38 555 tonnes were recycled.
- The well-established return infrastructure, together with its expertise in designing products to maximise re-use and recycling, puts Xerox in a good position to meet future regulatory requirements for product take-back.

Next steps

Concerns for the environment and actions in support of the concept of sustainable development have been part of Xerox's business for more than 30 years. The company is committed to designing, manufacturing, distributing and marketing products and processes to optimise resource utilisation and minimise environmental impact. This commitment is put into practice through internal product stewardship, Design for the Environment (DfE), remanufacturing, waste minimisation and supply chain integration programmes. New product designs aim to create products within the Xerox 'waste-free' ideal, ie waste-free products from waste-free factories for waste-free offices.

The aim of the manufacturing and supply chain division is to 'take back all we produce and ensure that nothing goes to landfill'. This aim is fulfilled by the recovery and re-use of as much material as possible.

Conclusion and action plan

This Good Practice Guide has shown how nine companies have benefited from adopting cleaner design. Some have found out more about the environmental impacts of their products, some have developed a cleaner design strategy for their company, and others have made changes to reduce the environmental impact of their product.

The benefits achieved by these well-known companies include:

- cost savings;
- greater preparedness for forthcoming legislation;
- reduced use of hazardous materials;
- reduced use of raw materials and utilities;
- increased use of recycled materials;
- increased use of materials with a lower environmental impact;
- easier re-use and recycling;
- improved working relationships with suppliers;
- less waste sent to landfill.

The Industry Examples highlight the many different ways of carrying out cleaner design, while emphasising the common themes, issues and thought processes. Some of the key actions undertaken by the various companies in order to achieve cleaner design are:

- obtaining expert help where necessary;
- obtaining government funding;
- publishing the relevant information;
- building awareness and support within the company;
- developing a simple tool to assess the environmental impacts over the life-cycle of a product;
- involving their suppliers;
- communicating with their customers;
- building on initial success to initiate other environmental projects.

To find out more about cleaner design, see the companion Good Practice Guide (GG294), *Cleaner Product Design: An Introduction for Industry*. This Guide explains what cleaner design is, the benefits of carrying out cleaner design and what it involves. Checklists are provided to help companies plan and implement a cleaner design programme. Sources of further help and information on cleaner design tools are also given. GG294 is available, free of charge, through the Environment and Energy Helpline on freephone 0800 585794 (or via the Envirowise web site at www.envirowise.gov.uk).

Action Plan

- Obtain a copy of Good Practice Guide (GG294) *Cleaner Product Design: An Introduction for Industry* if you haven't already got one.
- Develop a strategy for implementing cleaner design in your company.
- Consider your customers' requirements.
- Find out about the environmental impacts of your product during its life-cycle (raw materials, manufacture, distribution, use and end-of-life).
- Think about how you can reduce the environmental impacts of your product at different stages of its life-cycle.
- Decide your priorities for cleaner design.
- Design your cleaner product.
- Obtain feedback from your production and sales departments and also your customers.
- Aim for continual improvement.

For further help and advice on cleaner design, contact the Environment and Energy Helpline on freephone 0800 585794 or visit the Envirowise web site at www.envirowise.gov.uk

Envirowise - Practical Environmental Advice for Business - is a Government programme that offers free, independent and practical advice to UK businesses to reduce waste at source and increase profits. It is managed by AEA Technology Environment and NPL Management Limited.

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- Free, on-site waste reviews from Envirowise consultants, called Fast Track Visits, that help businesses identify and realise savings.
- Guidance on Waste Minimisation Clubs across the UK that provide a chance for local companies to meet regularly and share best practices in waste minimisation.
- Best practice seminars and practical workshops that offer an ideal way to examine waste minimisation issues and discuss opportunities and methodologies.

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