

# Ecodesign strategies for good business practice: An overview

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## ABSTRACT

In the last few decades concern has been raised regarding the environmental impact of industry. Much effort has been made to improve the 'end-of-pipe' performance of industry through cleaner production and expensive mitigation measures. New and impending legislation and product policies recognize that these efforts have not been enough. Ecodesign has become a key approach for business in responding to these challenges. While design is regarded as a clean process it determines the majority of the environmental and financial costs incurred throughout a product's life, from production through to distribution, use and end-of-life. Therefore, the design stage is a crucial point of intervention in the elimination, avoidance or reduction of 'downstream' environmental impacts. Ecodesign refers to the systematic incorporation of environmental considerations into product design and development with the aim of reducing the environmental impact throughout the whole life cycle. Placing ecodesign in context this paper will outline the policy and business case and introduce some tools and methodologies for integrating environmental considerations into the design process. The paper will also highlight, through practical examples, how ecodesign is linked to creativity and innovation, and can be used to increase competitiveness, improve stakeholder relations, proactively comply with legislation and enhance brand image. The practical examples of ecodesign implementation will highlight the barriers and drivers to ecodesign implementation from a Small and Medium Sized Enterprise (SME) perspective.

**Keywords:** Ecodesign, business and policy context, SMEs.

## 1. INTRODUCTION

To many, products and services are the basis of human prosperity, wellbeing and quality of life. Yet, the negative environmental and social impacts of the economy are primarily driven by our over consumption and production of products and services. These impacts occur at different stages of a products life, i.e. production, distribution, use and end-of-life disposal. The need to decouple these environmental and social impacts from economic growth has drawn increasing levels of political, public and commercial attention in recent years. This has been partly driven by the development of a number of producer responsibility laws worldwide along with the rise in public and shareholder concern. Another key driver is the recognition that improved environmental performance can have numerous commercial benefits.

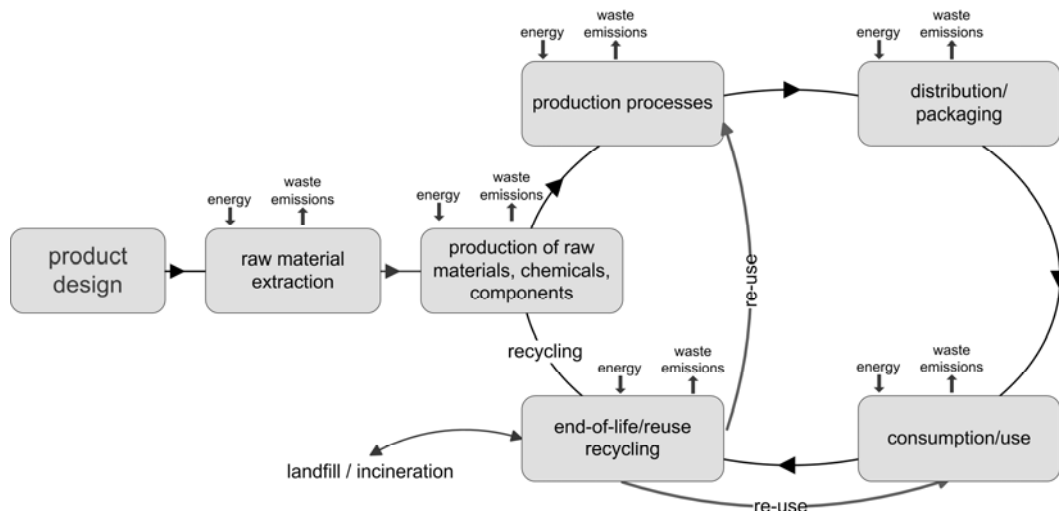


Figure 1: generic product life cycle [adapted from 1]

There are many examples of large organisations using ecodesign alongside measures such as environmental criteria within procurement specifications and Life Cycle Analysis (LCA). While many eco-innovations have come from small niche businesses the uptake of ecodesign across Small and Medium Enterprises (SMEs) has been limited. Many SMEs do not recognise or understand their impact on the environment and they lack the financial and human resources to implement ecodesign strategies and an environmental management system (EMS).

## 2. ECODESIGN IN CONTEXT

### 2.1. Policy context

The environmental policy agenda has evolved from focusing on reducing end-of-pipe pollution from industrial facilities to examining wider issues including the environmental and social impacts of products and services. This widening of horizons can be traced to the Rio Earth Summit of 1992, the publication of Agenda 21 and other Multilateral Environmental Agreements. More recently, in 2002, following the World Summit on Sustainable Development (WSSD), a 10 year framework of programmes for Sustainable Consumption and Production was established. As highlighted at the WSSD, “Fundamental changes in consumption and production patterns are needed” [2]. The agreements coming from the WSSD complement a number of other policy approaches such as the Millennium Development Goals, the Doha agreements and the recently adopted European Commission Communication on Integrated Product Policy (IPP).

IPP is a strategic instrument to establish an optimal mix of policy measures to encourage the development of products with reduced environmental impacts throughout their entire life cycle. While IPP seeks to reinforce and refocus existing policy measures it will introduce new approaches where necessary. The three pillars of IPP involve orientating the market to favour environmentally superior products, the design and marketing of those products and the sustainment of consumer demand for those products. Some specific measures that belong to this European policy mix include the Waste Electronic and Electrical Equipment (WEEE), Restriction of certain Hazardous Substances (RoHS), eco-design of Energy-using Products (EuP) and the End of Life Vehicles (ELV) directives. While WEEE and ELV are predominantly seen as a financial issue, RoHS and EuP will have a direct impact on product design. Table 1 highlights the most prominent European directives and their impacts on product design.

Directive	Aim	Impact on design
WEEE	to encourage prevention, reuse and/or recycling of Electronic and Electrical Equipment (EEE) waste	producers will be encouraged to design their products in a way that does not hinder recycling and reuse while facilitating the separation of key components (i.e. PCB's, batteries, plastics that contain brominated flame retardants)
RoHS	to minimise the amount of brominated flame retardants and heavy metals in the WEEE directed at landfill	immediate ecodesign requirements on all producers of electronic products containing 6 specified materials - lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and/or polybrominated diphenyl ether (PBDE)
EuP	to consolidate the legislative approaches to energy efficiency and full life cycle environmental impacts of electrical and heating products	EuP will require that compliance be demonstrated through prescribed conformity assessment procedures such as an internal design control procedure. This will involve setting up a technical file containing the evidence of compliance in the form of the assessment and the profiling of design solutions. CE marking will require EuP compliance
ELV	to reduce the environmental impact of businesses that process vehicles when they reach end of life	ELV is intended to drive producers to design for recycling so as to limit the costs of recovery

**Table 1: Main policy measures and their ecodesign relevance**

These policy measures are also reflected in South East Asia. For example, Japan has developed a policy framework to improve the environmental performance of its economy. This 'Recycling Oriented Economic System' includes mechanisms such as the Green Purchasing Law, Home Appliances Recycling Law and the Law for the Promotion of the Effective Utilisation of Resources [3]. The geographically diffuse nature of modern manufacturing means that these global policy measures will have future implications for product development worldwide.

## **2.2. Business context**

Ecodesign is currently being implemented by a number of leading edge multinational companies who have recognised the commercial benefits. These benefits include reduced production costs, efficient resource use, competitive advantage through potential product differentiation, reduced liability and a reduced regulatory burden. Even basic ecodesign strategies such as the elimination of toxic materials, reduced product footprints, ease of disassembly, ease of upgrade and reduced weight can result in products with significant environmental improvements that appeal to a wider range of consumers.

The positive effect of ecodesign on brand image also cannot be underestimated, not only for Tier 1 suppliers but all companies in the supply chain. More stringent environmental criteria are being integrated in procurement specifications for many large OEM's. For example, Nokia requests that suppliers provide material declarations on all components supplied to them – a difficult task for a supplier without at least a basic ecodesign strategy [4].

These drivers are mixed with a number of key barriers. These include economic short-termism ( i.e. the need for a quick payback on investments), a lack of understanding of the potential benefits of environmental improvements, a lack of internal expertise and resources, a view of environmental activity as peripheral to the core business and a managerial culture that is resistant to change. These drivers and barriers help demonstrate the synergy between ecodesign and innovation. How a company responds to these depends on a number of criteria including market and regulatory signals, existing commitment to the environment and operational capabilities. While being well positioned to exploit emerging technologies and develop new and innovative products SMEs, due to scale, encounter additional barriers when implementing ecodesign [5].

From a managerial perspective, ecodesign requires long term investment, something which SMEs struggle to establish. Developing an ecodesign strategy often dovetails a reactive compliance strategy. Seeking compliance is a positive step yet it holds little added value for business. Recognising the commercial potential of implementing ecodesign can lead to more proactive long-term strategies.

## **3. INTEGRATING ENVIRONMENTAL CONSIDERATIONS IN THE PRODUCT DEVELOPMENT PROCESS**

### **3.1 Background**

The development of environmentally superior products is not new although recent legislative developments have provided a new framework for exploring what is meant by environmentally superior products and ecodesign. While legislation is a major driver, ecodesign is not a compliance activity. Ecodesign, the incorporation of environmental considerations into product design and development, is an integrated, cross-functional strategy involving a number of business activities [6]. For example, R&D uses environmental and social impacts as an instrument for innovation, procurement sources environmentally superior materials and components, quality assurance highlights beneficial ecological enhancements while marketing promotes these attributes to the consumer. There are a number of entry points to integrate ecodesign in existing management systems such as environmental, health and safety (EHS).

### **3.2. Ecodesign process**

There are a wide range of models of product development displaying different levels of detail. They are generally characterised as iterative processes of analysis and synthesis with creative input in the form of experience and observation. Various factors place constraints on the product development process including performance specifications, manufacturing capabilities and existing design processes and competencies. The process of ecodesign is flexible to encourage creativity, maximise innovation and exploit opportunities for making environmental improvements [7].

It is important to note that while the core structure of the product development process remains unaffected by integrating environmental considerations, ecodesign requires the addition of some new steps. These include setting an environmental profile of the product, access to new forms of information and new decision criteria. These new decisions may include the choice of environmentally superior materials and the evaluation of an array of different product oriented environmental criteria. Ecodesign can influence relationships with customers and suppliers, and ultimately it can influence a company's business strategy, for example through logistical arrangements and new contractual obligations.

### 3.3. Outline of main tools

Ecodesign is an integrated, cross-functional activity and thus there is no 'silver bullet' for its implementation. There are a wide assortment of tools and methodologies available to support the implementation process and, broadly speaking, these can be categorised as follows;

- Single issue focus – driven by single issues such as waste reduction or energy efficiency
- Life cycle focus – including impacts such as transportation, material extraction and disposal
- Sustainability focus – including social impacts such as consumer aspirations and lifestyle

Practically speaking, these tools include guidelines, checklists and handbooks (e.g. Smart ecoDesign™ strategy wheel and Standard ECMA-341 - Environmental design considerations for electronic products), environmental management assistance tools (e.g. EIME - Environmental Information and Management Explorer), screening and benchmarking tools (e.g. Eco-Efficiency Analysis, Fraunhofer IZM/EE Toolbox), LCA methodologies (e.g. Eco-Indicator 99), LCA databases (e.g. ProBas, APME/Boustead data and EcoInvent) and full scale LCA tools (e.g. IDEMAT, SimaPro and eVerdEE). There are also tools and methodologies available for ecodesign planning, environmental assessment, ideas generation, solutions design, cost assessment and on-market product review and assessment. For better integration, ecodesign should be linked with existing management systems such as quality, EHS and environmental management, for example the Environmental Management and Auditing Scheme (EMAS). The International Standards Organisation (ISO) 14000 family of environmental management standards and technical reports include a product focus [1, 7 and 8].

Table 2 illustrates where some of the tools and methodologies can be incorporated into a product design and development process.

Stage	Priorities	Tools
<b>Planning</b>	<ul style="list-style-type: none"> <li>- establish scope, priorities &amp; tasks</li> <li>- acquire information</li> <li>- establish appropriate benchmarks - customer / market needs, compliance, market niches, competitors'</li> <li>- consider overall company strategy</li> </ul>	<ul style="list-style-type: none"> <li>- guidelines (e.g. Electrical &amp; Electronic ecodesign Guide, Envirowise)</li> <li>- standards, codes and technical reports</li> </ul>
<b>Conceptual</b>	<ul style="list-style-type: none"> <li>- analyse reference product or problem / idea generation / solution selection</li> <li>- integrate ecodesign aspects when drafting the specification</li> <li>- check feasibility (technological, financial)</li> <li>- apply guidelines, checklists to refine the specification</li> </ul>	<ul style="list-style-type: none"> <li>- brainstorming and other creativity techniques</li> <li>- checklists (e.g. Smart ecoDesign™ checklists)</li> <li>- software for full/abridged LCA (e.g. Sima Pro, Eco-It)</li> <li>- software for materials selection (e.g. EcoSelector)</li> <li>- spiderweb and polar diagrams (e.g. EcoCompass)</li> </ul>
<b>Detailed Design</b>	<ul style="list-style-type: none"> <li>- develop selected solutions</li> <li>- apply ecodesign tools and databases</li> <li>- consider design for assembly / disassembly</li> <li>- outline potential life cycle scenarios</li> <li>- source alternative materials</li> </ul>	<ul style="list-style-type: none"> <li>- ecodesign software (e.g. SimaPro)</li> <li>- ecodesign checklists (e.g. Smart ecoDesign™ checklists)</li> <li>- software for materials optimisation (performance/cost rather than environment-driven)</li> </ul>
<b>Testing / Prototype</b>	<ul style="list-style-type: none"> <li>- final assessment of solutions</li> <li>- benchmark with former product generation</li> <li>- communicate with your supply chain</li> </ul>	<ul style="list-style-type: none"> <li>- eco-accounting tools (e.g. life cycle costing)</li> </ul>
<b>Market launch</b>	<ul style="list-style-type: none"> <li>- market introduction / product profile and promotion</li> <li>- communicate key environmental aspects of your product alongside other key criteria, through environmental declaration or ecolabel</li> </ul>	<ul style="list-style-type: none"> <li>- market surveys</li> <li>- focus groups</li> </ul>
<b>Product review</b>	<ul style="list-style-type: none"> <li>- on-market observation</li> <li>- evaluate success of the product</li> <li>- identify further improvement potential</li> </ul>	<ul style="list-style-type: none"> <li>- observation e.g. ethnography</li> <li>- consumer panels</li> <li>- supplier workshops</li> </ul>

**Table 2: Tools and methodologies in a product development context**

Some larger producers are moving towards simple benchmark-style tools. For example, Philips has developed an internal competitiveness mechanism for their designers to increase the implementation

of ecodesign. Using five general criteria the product designers can compare a new product with existing ones to establish where environmental improvements have been made. Philips has hundreds of these “green flagship products” on the market. One example is an MP3 player that uses 87% less energy, weighs 39% less, and has 47% reduced packaging compared with the average of its closest competitors [5]. Panasonic (based in Cardiff) use a similar ecodesign approach focusing on five focal areas: energy, weight, packaging, recycling and hazardous materials.

Other examples of ecodesign implementation include the manifold approach taken by Fujitsu. This approach includes the development of the “super green products” in 12 product categories through a programme of improved eco-efficiency throughout full product life cycles, phasing out of specified hazardous substances in Fujitsu-brand products, green procurement (e.g. 98.3% of parts procured from companies with an EMS), improved recycling systems (e.g. recycling and reuse rate of 88.3% in Japan) and improved environmental management. These activities are supported by green assessment evaluations, LCA, the use of recycled and bio-based plastics and the application of proprietary ecodesign software [9].

#### 4. SUCCESSFULLY IMPLEMENTING ECODESIGN: THE SME EXPERIENCE

##### 4.1 The SME experience

Riochem™, a Welsh micro-SME, produces the TinyLab™, an innovative and revolutionary approach to titration analysis. Utilising cartridges that contain high grade volumetric standard solutions, the TinyLab™ allows for on-site and lab-based titration analysis – even by non-specialists. When the company set up it had no internal design capability therefore it sought the assistance and support of Design Wales. This helped the company place greater structure on the product development process by defining roles and responsibilities, developing a design brief and identifying long-term product strategies. Riochem™ identified ecodesign as a key strategy for the TinyLab™.



Figure 2: The TinyLab™

##### 4.1.1 Drivers for ecodesign

Impending environmental legislation brought the commercial benefits of implementing ecodesign into focus at an early stage. Riochem™ was also aware that the market for the product would be initially environmental goods and services. This reinforced the benefit of including ecodesign alongside criteria such as cost and performance, strengthening the company’s own sales and marketing strategy.

Supply chain pressures were also a key driver. Even though the product was highly competitive through market distinction, Riochem™ had to be aware of likely future changes in customer specifications so they would be in a position to capitalise on them. Riochem™ recognised the added-value of implementing ecodesign.

##### 4.1.2 Barriers to ecodesign

The main barriers Riochem™ faced reflect those experienced by most SMEs. These include financial and time constraints for exploring multiple design options, pilot investigations and R&D. The company also faced a number of product specific barriers in terms of technical specifications for materials. The decision to use some off-the-shelf components, although offering a number of financial and potential environmental opportunities, placed restrictions on the design process. These issues combined with competitiveness and cost considerations made it difficult to establish long-term strategic objectives.

##### 4.1.3 Ecodesign implementation

Because a full LCA was not possible Riochem™ approached life cycle thinking through broad systems definition and identification of where ecodesign could make a positive intervention to improve the environmental performance of the product. Through scenario building a general product environmental profile was established. This allowed Riochem™ to develop an awareness of the likely environmental impacts of the TinyLab™, leading to management level commitment and support for action.

A number of issues, including WEEE and ROHS compliance, guided the development of the ecodesign strategy. This strategy included a number of guidelines such as a reduced material mix, ease of disassembly and repair, clear identification of materials, component recyclability and the use of lead-free solder.

Design for disassembly can offer greater environmental gains than design for recycling as the reuse of the primary product with the replacement of components is less resource intensive. Having a high quality product that facilitates remanufacture, reuse, recycling and reprocessing extends the inherent value within the product, material and components. While extending the value cycle of materials has many environmental benefits it also has an economic value by reducing reprocessing and recycling times.

Riochem™ explored the potential of selling the product through a combination of eco-services. The Product Service System would help to reduce the full life cycle environmental burden of the product by reducing overall material intensity. Riochem™ identified the commercial opportunity of this and sought to build it into the sales and marketing strategy. This reinforced the environmental aspects of the product's overall sales and marketing strategy.



**Figure 3: Primary components**

It is clear that Riochem™ faced a number of barriers when developing the TinyLab™ which resulted in some compromises from an ecodesign perspective. The fragmented approach reflects the idiosyncratic nature of product development in SMEs. The experience highlights the need for flexible and scalable ecodesign tools and methodologies. The TinyLab™ has won a number of international awards and is an ecodesign benchmark for the company. For more information on this case-study, please refer to [10].

## 5. CONCLUSION

While legislation remains a key driver for many businesses to improve their environmental performance, more forward thinking companies are embedding ecodesign in proactive long-term strategies for product innovation. These ecodesign led strategies provide the added value of reduced production costs, efficient resource use, competitive advantage through potential product differentiation, reduced liability and a reduced regulatory burden. Many of the ecodesign methodologies that exist can be integrated into existing product development processes. Most ecodesign activity is occurring in larger organisations but many SMEs are rising to the sustainability challenge by implementing ecodesign. To support this process there is a need for public sector support alongside the development of flexible, scaleable and demand-led ecodesign methodologies.

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