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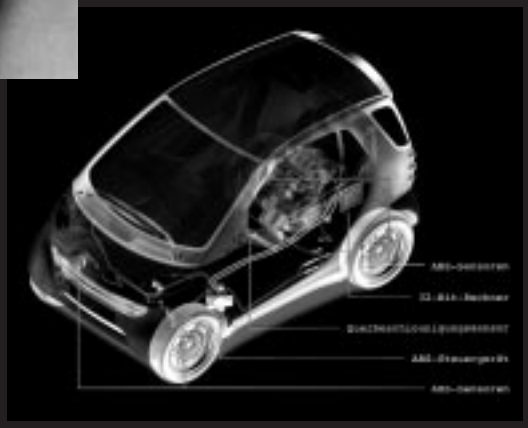

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The Journal of Sustainable Product Design
The Centre for Sustainable Design
Faculty of Design
The Surrey Institute of Art & Design
Falkner Road
Farnham
Surrey GU9 7DS
UK
tel +44 (0)1252 892772
fax +44 (0)1252 892747
email: mcharter@surrart.ac.uk
internet: http://www.cfsd.org.uk

Editorial Board

Welcome to the eighth issue of The Journal of Sustainable Product Design

Martin Charter

Editor, The Journal of Sustainable Product Design

New developments

There is growing worldwide interest in environmental aspects of product development. However, discussion over eco-service development is still in its infancy. Three recent events have highlighted the growing debate over eco-design and related issues: 'Integrated Product Policy' conference (Brussels), Eco-Design '99 (Tokyo) and the formation of an International Standards Organisation (ISO) working group on 'Design for Environment'.

The European Commission's DG XI (Environment) and DG 3 (Industry) jointly organised a conference in December 1998 on 'Integrated Product Policy (IPP)'. The conference follows on from a consultancy report commissioned by DGXI (see Editorial JSPD 7). The event included parallel workshops designed to consider the demand and supply side policy tools and issues involved in the development and implementation of product-orientated environmental policy. The eco-design workshops highlighted the continuing confusion in some quarters over the difference between life cycle thinking and Life Cycle Assessment (LCA) and also the need for the development of new tools to enable the integration of environmental considerations in product development. IPP is one of the environmental priorities within the German presidency of the EC, and the conference was seen as the first part of a consultative process.

Eco-design '99 was organised in March 1999 in Tokyo, Japan and attracted 488 delegates (including 100 from overseas). The event included a range of high level speakers and focused particularly on technical aspects of eco-design. Eco-design '99 was sponsored by the Inverse Manufacturing Forum and the Japan Environmental Management Association for Industry (JEMAI). Eco-design and environmentally-conscious product development (ECP) are becoming of growing importance in corporate Japan due to carbon dioxide (CO_2) emission reduction targets resulting from Kyoto climate change agreements and the implementation of a range of green laws in Japan in 1998.

The formation of a recent ISO working group on 'Design for Environment' has also highlighted a number of key issues. There are various existing ISO standards that refer directly or indirectly to product-related issues and which sub-divide broadly into two categories: product-related eg. eco-labelling, LCA; and management-related, eg. environmental management systems, environmental performance evaluation. The initial conclusions are that there is a general confusion over the issues and terminology surrounding eco-design and there is the need for some degree of clarification.

These three events highlight a number of key issues and trends.

Product development

Discussion is moving from eco-design to thinking about the integration of environmental considerations into product development. This means taking account of the different environmental issues and concerns at different stages in the product development process. This a multi-stakeholder process and new processes and tools need to be developed. A life cycle approach is essential, but LCA is not the panacea.

Decision-making

Tools should be designed to support decision-making at different stages in the product development process – and there is no one tool that is capable of fulfilling the different requirements.

However, as highlighted above the backbone should be lifecycle thinking. Some degree of judgement is always needed to make a decision over balancing environmental concerns, so a key question is what level of certainty is

needed to make a decision? If existing LCAs have indicated the biggest environmental impact of a product eg. the 'use' phase with washing machines, is there need to spend money and time commissioning a new LCA? Is investment better placed in developing new energy efficient washing machine technology and educating users about 'use' issues eg. energy efficiency (climate change) and powder dosage (water pollution)?

Management

The overall goal of integrated environmental product development (IEPD) should be to produce better products, that perform as well or better than comparative non-green products in terms of:

- function
- quality
- cost.

If companies are going to integrate environmental considerations into the product development process there needs to be clear objectives, strategies, programmes, responsibilities and budgets. There still appears to be considerable uncertainty over the hierarchies involved in IEPD management systems, ie.

- tools... fit within
- environmental product management system... that fit within
- environmental management system... that fit within
- broader business function strategies... that fit within
- corporate strategy.

Supply chain

To implement eco-design in many sectors will mean the need to work much more closely with suppliers. Many suppliers to large companies are likely to be small and medium-sized companies (SMEs) that will have low awareness of environmental, legislative and eco-design issues[1]. For example, as a result of the proposed EC WEEE Directive[2] in the electronics sector, companies are likely to need to implement eco-design programmes eg. 'design for dismantling', use of fewer components in product design, etc.

However, many previous electronics manufacturers are now 'system integrators' and contract out design and manufacture of, for example, components to companies in the Far East where environmental and eco-design awareness is low. Therefore there will need to better much greater cooperation between the different elements of the 'value chain' if, for example, products are going to be designed to be dismantled.

This issue of the Journal highlights…

Tim Cooper, Director, Centre for Sustainable Consumption, School of Leisure and Food Management, Sheffield Hallam University, UK provides an overview of the problems associated with the implementation of sustainable product design (SPD) within the existing economic structures and suggests some policy changes to enable SPD. Henrik Dahlstrom, Research Associate, IVF, The Swedish Institute of Production Engineering Research, Sweden, highlights the practical issues of implementing eco-design taking account of lifecycle considerations. He gives an example of the development of company-specific guidelines and its use in a valve company. Dr Diego Masera, Product Development and Marketing Manager, Micro-enterprises Support Programme, Kenya, illustrates the real issues associated with implementing of SPD amongst small enterprises in Mexico, with a description of an SPD training programme. Professor Han Brezet, Director, Section of Environmental Product Development, Faculty of Industrial Design Engineering, Delft University of Technology, the Netherlands, highlights the lack of research into eco-service development and the structural barriers to eco-innovation. Emma Prentis and Hedda Bird, Directors, Conservation Communications, UK, give an example of a lateral approach to involving the marketing function in the environmental debate, drawing on experience from Nortel. Edwin Datschefski, Founder, BioThinking International, UK, gives an alternative view of eco-design with numerous examples based on the 'bio-thinking' approach using the principles of cyclic, solar and safe. And, finally the O2 pages focus on the process and outputs of the recent 'O2 Challenge' held in the Netherlands, which concerned the development of sustainable business concepts. •

Notes

[1] 'Chain of Uncertainty', The Centre for Sustainable Design, January 1999.

[2] Waste from Electrical and Electronic Equipment (WEEE) Directive – this is a proposed EC Directive that is in its second draft – the document covers 'end of life' management issues but highlights prevention issues, eg. eco-design.

Creating an economic infrastructure for sustainable product design

Tim Cooper

Director, Centre for Sustainable Consumption, School of Leisure and Food Management, Sheffield Hallam University, UK

Tim Cooper is Director of the Centre for Sustainable Consumption at Sheffield Hallam University, UK. His research interests include the life span of consumer durables, the environmental impact of consumption, and environmental ethics. He worked in industry as an economist for ten years prior to undertaking research at the New Economics Foundation on the recycling and re-use of household products, producing a report entitled 'Beyond Recycling: the longer life option'. He is a trustee of CREATE, a Liverpool based charity employing trainees formerly in long term unemployment to repair household appliances. Currently he is acting as Specialist Adviser to the UK House of Commons Environment Committee for its enquiry into 'Reducing the Environmental Impact of Consumer Products'.

This paper identifies major changes to the economic infrastructure which are required in order to progress towards sustainable development and suggests that these could support sustainable product design (SPD). It focuses on the measurement of economic progress, the potential of fiscal reform to change the relative cost of manufacturing and after-sales services, environmental objections to industrial concentration and free trade, and the availability of products designed for the least possible environmental impact. The paper concludes that the present infrastructure of the economic system provides inadequate incentives for people to choose greener consumption patterns and offers little to encourage the development of SPD.

The economy and design activity

Any government's economic and environmental policies have significance for the design community, being part of the social context within which designers work. Through its budgetary policy, for example, a government can influence economic activity and, in particular, the amount of consumption, investment and taxation on individuals and company profits. It thus helps to determine the level of consumer demand and the resources available to companies to invest in product development, both of which affect designers' workloads.

Government policy can also change the price of factor inputs, such as labour, energy and raw materials, which determines the relative cost of different design options for products (as well as the designer's own running costs). Thus, for example, higher taxation on energy would increase demand for energy efficient products. Increased landfill tax might result in greater demand for products that are designed to be easily recycled. A reduction in employers' National Insurance contributions (effectively a jobs tax) could make repairing household appliances, which is often labour-intensive, more economically attractive.

The relationship between economics and design may be approached from different perspectives. Economists have most often addressed it in the context of innovation and, specifically, the impact of technological change on the rate of economic growth. A particularly important theoretical contribution was made by the Austrian economist Joseph Schumpeter, who earlier this century described innovation as the engine of economic growth (Hutton, 1979). More recent work has been undertaken by Freeman and others at the University of Sussex, who have explored (if not resolved) the relationship between technological innovation and cyclical trends in the economy known as 'long waves' (Freeman, 1984, 1992).

Designers have often sought to demonstrate that by improving the design input in the manufacturing sector, a nation can become more competitive and its trade performance improve (Roy and Potter, 1990; Design Council, 1997; Sentance and Clarke, 1997). Meanwhile sociologists, anthropologists and cultural historians have considered people's relationship with products and the impact on society of consumption trends (eg. Bocock, 1993; Douglas and Isherwood, 1979; Miller, 1995).

Since the publication of the Government commissioned Blueprint for a Green Economy (Pearce, Markandya and Barbier, 1989), it has been widely accepted that achieving sustainable development requires economic reform, although there has been less agreement over policy priorities and the scale of reform required. This paper explores several key economic measures that could increase demand for products designed for a reduced impact on the environment: new indicators of progress, ecological tax reform, restructuring trade, and improved environmental product information.

The paper assumes a need to shift beyond 'Design for Environment' or eco-design, in which the focus is on product attributes, to SPD, which requires a broader approach. In SPD the relationship between the product, suppliers, stakeholders, and external economic and social factors are taken into account, enabling more radical options to be considered.

Designer culture and the rise of 'green' consumerism

In order to place the following economic discussion in a historical context, it is worth recalling two recent social trends, the consumer boom of the 1980s and the emergence of green consumerism.

Between 1982 and 1989 consumer spending in Britain rose by, on average, almost 5% each year. Products with 'designer' labels flourished, although the extent to which such products contributed to more work for designers is less clear. The political shift towards individualism fed the desire of many consumers to display outward symbols signifying that they had made a financial success of life, ostentatious behaviour described by Thorstein Veblen at the end of the nineteenth century as 'conspicuous consumption' (Veblen, 1970). Veblen observed how some people buy products with a calculated desire to impress others and concluded that their satisfaction was often derived largely from this rather than the product's inherent utility.

In a trenchant critique of the compliance of designers in contemporary materialism, Nigel Whiteley cites design writer Jeremy Myerson bemoaning the fact that design has become 'a weapon of exclusivity' and he also highlights designer F.H.K Henrion's description of the prevalent view of design as 'the yuppy fun of a moneyed minority' (Whiteley, 1993, p.1). Whiteley argues that there has been a movement away from the ideal of designing for the benefit of society to 'consumer engineering', a trend which he traces back to a book of this title by Sheldon and Aren, published in 1932. As nations have become more affluent, the role of the designer has changed from meeting needs to stimulating desires. He cites Terence Conran:

'There was a strange moment around the mid-1960s when people stopped needing and need changed to want… Designers became more important in producing 'want' products rather than 'need' products, because you have to create desire.'

(Whiteley, 1993, p.18).

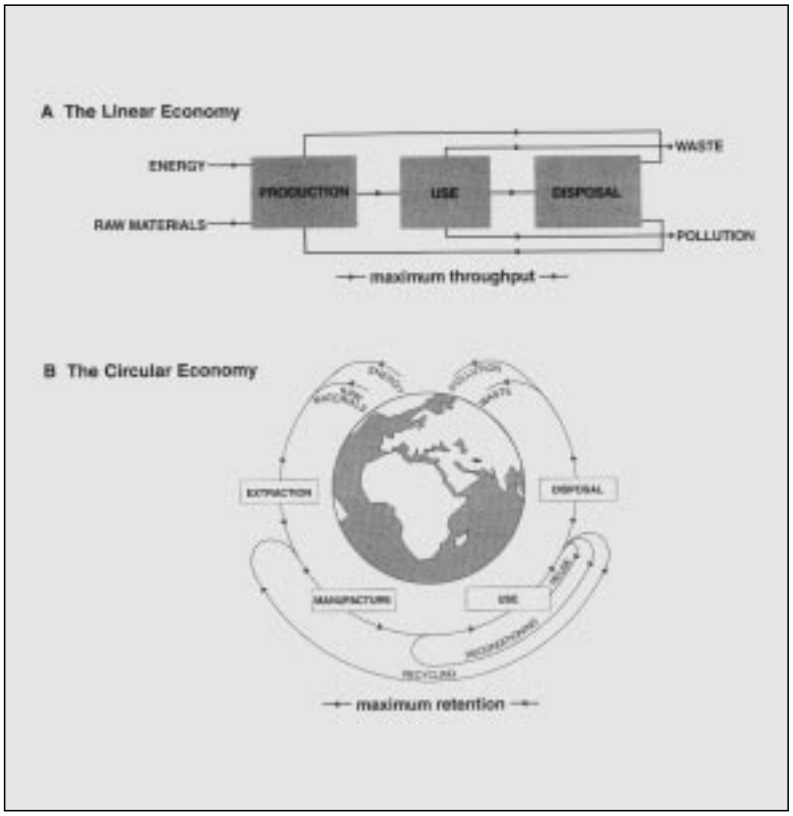

Figure 1: Linear and circular economies (Source: New Economics Foundation)

As nations have become more affluent, the role of the designer has changed from meeting needs to stimulating desires.

Designers, Whiteley concludes, have increasingly had to act in subservience to powerful marketing departments.

The economic boom of the 1980s ended when Government policies stoked up an already-booming economy, causing it to overheat and enter the 1989–91 recession. Around this time another trend was emerging which would affect designers: green consumerism. Scientific evidence had been building up during the 1980s of damage being done to the global environment. The thinning of the ozone layer due to the use of chlorofluorocarbons (CFCs), the potentially harmful effects of climate change caused by greenhouse gas emissions, and the destruction of tropical rainforests were regularly in the news. In 1988 the Prime Minister, then Mrs Thatcher, had a belated 'road to Damascus' experience and suggested in a speech to the Royal Society of Arts (RSA) that the Earth was, after all, threatened by environmental abuse. Environmental books such as The Green Consumer Guide (Elkington and Hailes, 1988) grew in number and influence.

The trend towards green consumerism soon began to affect designers as businesses began to evaluate the marketing potential of 'greener' products. An increasing number of products were specified to have a reduced environmental impact.

Tools such as life cycle assessment (LCA) began emerge. Even so, the concept of green consumerism, as distinct from sustainable consumption, was indicative of the resilience of the materialistic culture.

Economists' view of progress

It is widely assumed, not least by politicians, that most people want to increase their consumption. Consequently economists, particularly in the present century, have devoted considerable effort to identifying the means by which the output of the economy might be maximised. Since the development of national accounts in the late 1940s, the typical starting point has been a measure of the amount of activity in the economy, Gross Domestic Product (GDP), which aggregates the value of all goods and services produced in a year.

Economic growth, the annual increase in GDP, remains widely regarded as the key indicator of trends in people's 'standard of living'. In recent years, however, the value of GDP as a satisfactory indicator of human wellbeing has been questioned, in particular by environmental economists and increasingly within governments (eg. Daly and Cobb, 1990; Department of the Environment, 1996; Douthwaite, 1992; Jackson et al, 1998; UNDP, 1998). Critics of the GDP indicator argue that the kind of economic activity is as significant to people's sense of wellbeing as the level of total output. New indicators are now being developed to measure people's 'quality of life', some of them linked with attempts to measure progress towards sustainable development (Anderson, 1991; Department of the Environment, 1996; Pearce, 1993; Trzyna, 1995).

Moreover, the wisdom of promoting economic growth in its current form is increasingly questioned, based as it is on a throwaway culture in which a constant updating of products is required to give sufficient momentum to industrial output (eg. McLaren, Bullock and Yousuf, 1998). The model of a 'linear economy' (see Figure 1), in which it is assumed that there is an unlimited supply of natural resources and that the environment has an unlimited capacity to absorb waste and pollution, is dismissed. Instead, a 'circular economy' is proposed, in which the 'throughput' of energy and raw materials is reduced. In such an economy there would be a shift in activity from the manufacturing sector to service sector activities such as re-use, repair, upgrading and recycling (Cooper, 1994b; Krishnan, Harris and Goodwin, 1995). The current economic system, based as it is on the 'fast replacement' of goods, would be transformed into one which instead gave greater emphasis to the 'optimal utilisation' of resources (Jackson, 1993). The historic trend away from renting consumer durables might be reversed, with people paying for the service supplied by products rather than buying products designed for replacement at the earliest opportunity.

Even so, many mainstream economists remain too preoccupied with the perceived benefits of maximising production, economies of scale, and the cycle of depreciation and replacement to reflect upon the optimal use of products over time. The assumption is that whenever production is increasing, the health of the economy is improving: more people are employed, incomes rise, and higher consumption follows. Such economists regard the only limit to consumption as the productive capacity of the domestic economy – in other words, if the nation consumes more than it produces, the economy overheats and the result is a trade crisis, inflation or both. They do not accept that there are environmental constraints to ever-increasing economic growth (eg. Beckerman, 1995).

Few critics of GDP advocate a 'no growth' society, contrary to popular myth. Aside from being politically unattractive, to maintain the same level of economic output or reduce it will not necessarily result in a lower environmental impact. There are more sophisticated and positive ways of overcoming environmental degradation. For example, the likely impact of increasing product life spans upon economic output is uncertain but such a trend could offer significant environmental benefits.

Product life spans

As the proportion of people owning household goods such as refrigerators, washing machines and telephones began to rise towards saturation levels after the second world war, manufacturers feared the impact upon sales volumes. Many responded by reducing the design life of such products and increasing the frequency with which they updated models (OECD, 1982; Cooper, 1994b). As a debate ensued in journals such as the Harvard Business Review (Stewart, 1959), prominent critic Vance Packard popularised the term 'planned obsolescence' (Packard, 1963).

It was suggested that shorter product life cycles would benefit the economy. Typical was industrial designer J. Gordon Lipincott. Later critical of declining product quality, he once wrote:

'Any method that can motivate the flow of merchandise to new buyers will create jobs and work for industry, and hence national prosperity… Our custom of trading in our automobiles every year, of having a new refrigerator, vacuum cleaner or electric iron every three or four years is economically sound.'

(Whiteley, 1993, p.16).

George Nelson, another respected designer, said 'what we need is more obsolescence, not less' (Whiteley, 1993, p.15). Such people advocated the development of improved and more efficient products: 'Freezing design would, in most cases, perpetuate our problems,' wrote Harrison Grathwohl (Aaker and Day, 1978, p.345). Designers expressing strong reservations about the trend, such as Victor Papanek (1984), represented a small minority.

The situation has since changed. Many leading manufacturers now argue that longer product life spans should be encouraged in order to achieve progress towards sustainable development (Falkman, 1996). Managers are increasingly expected to integrate environmental considerations into product development (Environment Council, 1997). It is recognised that such a strategy could offer manufacturers a new competitive edge (Cooper, 1994a). Few designers today would publicly defend planned obsolescence.

In the past, it was feared that an economy in which products lasted longer would grow more slowly, with reduced manufacturing output and retailers suffering lower sales. However, these negative impacts could be offset by an increase in labour intensive after-sales work such as repair, reconditioning and upgrading. The 'throwaway economy' would be transformed into the 'service economy', with a net positive impact on employment. The economy would only suffer if domestic manufacturers proved unable to supply higher quality products designed for longer life spans.

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… One means of achieving a better balance is through ecological tax reform, switching taxation from labour to energy and raw materials.

Pricing for sustainable development

Developing longer lasting products is an example of 'eco-efficiency', a concept widely promoted within the business community. Eco-efficiency is the production of goods and services which meet human needs while reducing environmental impacts (Schmidheiny, 1992). It is closely related to the 'factor four' principle of increasing resource productivity to enable society to consume twice as much while reducing resource use by one half (von Weizsecker, Lovins and Lovins, 1997). Both demand the application of 'Design for Environment' principles to improve the functional unit performance of products. This could be achieved through a reduction in mass and energy intensity, the maximum use of renewable, recyclable or recycled materials in construction, or 'design for durability' and product life extension (Burall, 1991; Environment Council, 1997; Mackenzie, 1991).

One reason why resource productivity is not currently being maximised is that the relative cost of key factors of production – labour, energy and raw materials – does not provide producers with the right financial incentives. In the industrialised world, the high cost of labour relative to energy and raw materials has led many manufacturers to concentrate on increasing labour productivity (through, for example, automation) rather than improving resource productivity. One means of achieving a better balance is through ecological tax reform, switching taxation from labour to energy and raw materials (on the basis that taxes deter the use of the factor of production upon which they are levied) (von Weizsecker and Jesinghaus, 1992; O'Riordan, 1997). For example, employers' National Insurance contributions, which add to the cost of employing people, could be phased out and government revenue raised instead by higher taxes on finite natural resources.

As a consequence of ecological tax reform, repairing consumer durables, which tends to be labour-intensive, would become cheaper, whereas replacing products, which requires more energy and materials, would become relatively costly. Ecological tax reform thus provides consumers with an economic incentive to extend the life of products wherever possible and creates a more favourable climate for the development of products designed to be repairable or upgradable. This could have particularly significant implications for electrical and electronic products, for example, as economic pressures currently discourage re-use and recycling.

Any such change to the tax system would lead to reductions in output in some parts of the economy and growth in others. Companies manufacturing products with a relatively low environmental impact would be rewarded while the inefficient use of energy and raw materials would be penalised. Despite its attractions ecological tax reform has not yet been introduced in any comprehensive sense, not

least because in industry there would be as many losers as winners. Resource-intensive industries have successfully lobbied against the introduction of the carbon-energy tax first proposed by the European Commission in 1991.

Competition and the free trade ideal

A further important element of the nation's economic infrastructure is the degree of industrial concentration and the location of production facilities. Around 25% of global manufacturing is now controlled by 500 industrial corporations (Korten, 1995). Such companies are able to reap economies of scale by concentrating on a few, very large production sites, which reinforces their commercial strength. In the market for large kitchen appliances, for example, three manufacturers account for around one half of all sales in Western Europe.

Although the effect of industrial concentration on product development is complex, environmentalists influenced by Schumacher's philosophy that 'small is beautiful' associate large scale industrial production with the excesses of modern consumerism (Schumacher, 1974). Thus although the environmental performance of many small and medium sized companies (SMEs) is not always impressive, green political parties across Europe have argued for measures to reduce industrial concentration such as a progressive turnover tax on companies and stricter legislation on monopolies.

The environmental case for more localised production and repair facilities is less controversial as it is widely agreed that current levels of pollution and congestion caused by long distance road freight is unacceptable. Opposition has grown in recent years to the transportation of food over long distances (Paxton, 1994) and similar arguments could be applied to consumer durables. The use of centralised facilities for after-sales services has likewise been criticised. Stahel and Jackson argue that repair work is best undertaken 'in comparatively small workshops, scattered throughout the country wherever there are items in need of re-manufacturing and repair and customers who need them' (Jackson, 1993, p.270). Appropriate planning policies and increased taxation on road freight could encourage such workshops.

The current debate on free trade and the environment is particularly relevant to the foregoing discussion. Despite the environmental impact of road freight most politicians, influenced by neo-classical economists, are strongly supportive of free trade. This is a complex issue but there are two particular issues which need to be raised. First, many environmentalists object to the fact that free trade is being used as a dogma to challenge the right of countries to ban imported products that do not meet minimum environmental performance standards. The development of markets for products designed according to strict environmental criteria is consequently under threat. Second, free trade has resulted in much manufacturing being relocated to low wage countries and it is more likely that products imported from these countries will not be properly maintained. Servicing work is labour intensive and normally has to be done in the importing country, where wage costs are much higher. It is therefore often more cost effective to purchase replacements than to get faulty products repaired. In such circumstances life cycle thinking – such as designing products for reparability – is less likely to receive priority.

In the light of such arguments, it is not surprising that environmentalists are currently among the most vocal critics of free trade, calling for a 'new protectionism' and urging reform to the World Trade Organisation (eg. Lang and Hines, 1993; von Weizsecker, Lovins and Lovins, 1997).

Greener products and consumer choice

The assumption that consumers have a right to the maximum possible choice of products is often unquestioned. Classical economic theory suggests that increased choice is always beneficial as it leads to greater efficiency in the economy. In America today more than 400

How is a balance achieved between supporting free markets that offer virtually unlimited choice, irrespective of product quality or social need, and imposing regulations so strict that the variety of products available is unduly limited?

models of cars are available, while in one district of Tokyo it is possible to buy nearly 200 different types of television (West, 1992).

A more critical stance is taken by Stewart Lansley, who has suggested that 'the extra choice claimed for the consumer is easy to exaggerate' and argues that 'claims of greater responsiveness and differentiation are overstated, except at the top end of the market' (Lansley, 1994, p.92). In an economy geared towards sustainable development, how much consumer choice is appropriate? How is a balance achieved between supporting free markets that offer virtually unlimited choice, irrespective of product quality or social need, and imposing regulations so strict that the variety of products available is unduly limited?

Consider as an example the options for improving energy efficiency in household appliances. Policymakers who argue that choice is important might favour the use of market-based instruments, such as increased taxation on energy, to encourage the purchase of energy efficient models. On the other hand, advocates of a regulatory approach might prefer the imposition of minimum product standards, on the basis that preventing the sale of the least energy efficient products is certain and thus more effective. The regulatory approach directly reduces the choice of products for consumers, while the fiscal approach is restrictive in that the running cost of products is increased but consumers with enough money are able to maintain a degree of choice. The regulatory approach has been adopted recently by the European Union in respect of refrigerators, which must meet a minimum energy efficiency standard from 1999. However, critics could argue that consumers have a right to be able to purchase any products, even if it damages the environment unnecessarily.

An additional dimension to this debate is the possibility that as a result of greater customisation increased choice might in future co-exist alongside mass production. At the start of the century Henry Ford told customers that they could choose any colour of car 'so long as it was black'. Today, however, 'just-in-time' management and other modern techniques make custom-made products on mass production lines much more practicable. This has environmental significance; designers are now considering whether people might form closer bonds with custom-made products and be less likely to discard them prematurely (van Hinte, 1997). In 'The Joyless Economy', Tibor Scitovsky (1976) argued that much unnecessary waste is created because people sense little attachment to possessions which have been mass produced.

Consumer choice also needs to be considered in an ethical context. Increased attention has been given to the interests of consumer since President Kennedy's 1962 speech on

consumer rights, while more recently a strong case has been made for greater recognition that responsibilities, or duties, co-exist alongside rights (Selbourne, 1994). The idea that consumers have responsibilities as well as rights is now accepted by consumer lobby groups (International Organisation of Consumers Unions, 1993).

If the responsible exercise of choice is to have real meaning, however, consumers need access to adequate information. The European Union Eco-labelling scheme, which was supposed to help consumers choose products with a relatively low environmental impact, has proven far from successful. In Britain, a report by the National Consumer Council (1996) found that many 'green' claims are exaggerated. Although the UK Government introduced a voluntary 'Green Claims Code' early in 1998, the quality of information on the environmental impact of products remains unsatisfactory and pressure for statutory measures is increasing. SPD is only likely to flourish in an economy in which information about the environmental performance of products is accurate and readily accessible.

Conclusions

This paper has identified major changes to the economic infrastructure that have been proposed by environmental specialists to encourage sustainable development. They may be summarised as follows.

First, there is a need for greater public recognition that human wellbeing cannot satisfactorily be measured merely by aggregating the output of goods and services in an economy. Additional indicators of progress alongside GDP are needed in order to reduce the cultural pressure for ever-increasing consumption.

Second, progress towards sustainable development demands greater eco-efficiency, which will require fundamental changes in the relative cost of labour, energy and raw materials. This could be achieved through ecological tax reform, which is intended to create the financial incentives necessary to attract people to greener consumption patterns, such as buying longer lasting and energy efficient products, and repairing rather than replacing products whenever possible.

Third, issues relating to trade and the environment, although complex and often controversial, need to be addressed. Environmentalists have developed a strong case for questioning the case for unrestrained free trade. The location of production and after-sales services closer to customers would reduce the significant environmental damage caused by road freight.

Finally, consumers have responsibilities as well as rights. There are circumstances in which minimum environmental standards should be applied to products, even if this reduces consumer choice. At the same time, there are few currently available products that are designed for a low environmental impact and there is considerable confusion over claims made by producers. Consumer choice would be improved if environmental product information was regulated more strictly.

There can be no certainty that a country's development will be environmentally sustainable even if these measures to improve the economic infrastructure are introduced. However, they would at least provide people with better incentives to make environmentally sensitive decisions. Consumer demand could then provide the right conditions for SPD to flourish. •

References

Aaker, D.A. and Day, G.S. (eds.), Consumerism, London: Collier Macmillan (1978)

Anderson, V., Alternative Economic Indicators, London: Routledge (1991)

Beckerman, W., Small is Stupid, London: Duckworth, (1995)

Bocock, R., Consumption, London: Routledge (1993)

Burall, P., Green Design, London: Design Council (1991)

Cooper, T., The Durability of Consumer Durables, Business Strategy and the Environment, Vol.3, Part 1, pp.23-30 (1994a)

Cooper, T., Beyond Recycling: The Longer Life Option, London: New Economics Foundation (1994b)

Daly, H.E. and Cobb J.B., For the Common Good, London: Merlin (1990)

Department of the Environment Indicators of Sustainable Development for the United Kingdom, London: HMSO (1996)

Design Council, More for Less: Design for Environmental SustainAbility, London: Design Council (1997)

Douthwaite, R., The Growth Illusion, Bideford: Green Books (1992)

Durning, A.T., How Much Is Enough? London: Earthscan (1992)

Elkington, J. and Hailes, J., The Green Consumer Guide, London: Gollancz (1989)

Environment Council, A Manager's Introduction to Product Design and the Environment, London: Environment Council (1997)

Falkman, E.G., Sustainable Production and Consumption, Geneva: World Business Council for Sustainable Development (1996)

Freeman C., Design Innovation and Long Cycles in Economic Development, London: Royal College of Art (1984)

Freeman C., The Economics of Hope, London: Pinter (1992)

International Organisation of Consumers Unions, Beyond the Year 2000, The Hague: IOCU ROENA (1993)

Jackson, T., Clean Production Strategies, Boca Raton: Lewis (1993)

Jackson, T. et al, Sustainable Economic Welfare in the UK 1950-96, London: New Economics Foundation (1998)

Jacobs, M., The Green Economy, London: Pluto (1991)

Korten, D.C., When Corporations Rule the World, London: Earthscan (1995)

Krishnan, R., Harris, J.M. and Goodwin, N.R., A Survey of Ecological Economics, Washington DC: Island (1995)

Lang, T. and Hines, C., The New Protectionism, London: Earthscan (1993)

Lansley, S., After The Goldrush, London: Century (1994)

Mackenzie, D., Green Design, London: Laurence King (1991)

McLaren, D., Bullock, S. and Yousuf, N., Tomorrow's World, London: Earthscan (1998)

Miller, D. (ed.), Acknowledging Consumption, London: Routledge (1995)

National Consumer Council, Green Claims, London: National Consumer Council (1996)

OECD, Product Durability and Product Life Extension, Paris: OECD (1982)

O'Riordan, T. (ed.), Ecotaxation, London: Earthscan (1997)

Packard, V., The Waste Makers, London: Penguin (1963)

Papanek,V., Design for the Real World, London: Thames and Hudson (1984)

Paxton, A. The Food Miles Report, London: SAFE Alliance, (1994)

Pearce, D., Markandya, A. and Barbier, E.B., Blueprint for a Green Economy London: Earthscan (1989)

Pearce, D., Blueprint 3: Measuring Sustainable Development, London: Earthscan (1993)

Rickards, T., Stimulating Innovation, London: Frances Pinter (1985)

Roy, R. and Potter, S., Design and the Economy, London: Design Council (1990)

Schmidheiny, S. Changing Course, Cambridge, Massachusetts: MIT Press (1992)

Schumacher, E.F., Small Is Beautiful, London: Abacus (1974)

Scitovsky, T., The Joyless Economy, Oxford: Oxford University Press (1976)

Selbourne, D., The Principle of Duty, London: Sinclair-Stevenson (1994)

Sentance, A. and Clarke, J., The Contribution of Design to the UK Economy, London: Design Council (1997)

Stewart, J.B., Planned Obsolescence, Harvard Business Review, September/October (1959)

Trzyna, T. A Sustainable World, London: Earthscan (1995)

UNDP (United Nations Development Programme) Human Development Report 1998, Oxford: Oxford University Press (1998)

van Hinte, E., Eternally Yours, Rotterdam: 010 publishers (1997)

Veblen, T., The Theory of the Leisure Class, London: Unwin (1970)

von Weizsecker, E. and Jesinghaus, J. Ecological Tax Reform, London: Zed (1992)

von Weizsecker, E., Lovins, A.B. and Lovins, L.H. Factor Four, London: Earthscan, (1997)

West, A., Innovation Strategy, Hemel Hempstead: Prentice Hall (1992)

Whiteley, N., Design for Society, London: Reaktion Books (1993)

Company-specific guidelines

Henrik Dahlström

Research Associate, IVF, The Swedish Institute of Production Engineering Research, Sweden

Henrik Dahlström is a research associate at the Industrial Environment Division at IVF. He is doing research in 'Design for Environment' at The Swedish Institute of Production Engineering Research, Sweden, and design for the working environment. Current programmes concern eco-design in small and medium-sized companies. Mr Dahlström is also carrying out research to determine how environmental knowledge could be implemented in Rule Based Engineering (RDE).

The designer of today and tomorrow has to take environmental aspects into consideration. But it is a confusing world of LCA inventories, eco-design handbooks and disassembly software. Most designers really need to have a basic knowledge of the environmental impacts of their products and need guidelines that provide specific advice and strategies on how to reduce these impacts. At IVF, The Swedish Institute of Production Engineering Research, a method for developing company-specific guidelines has been developed. Based on information from the results of a life cycle assessment (LCA), key factors and possible strategies are identified. The strategies are developed into useful advice, which is then adapted to the policies and capabilities of the company. The result is a customised list on how to design products with a low environmental impact from 'cradle to grave'. This article describes the method and presents a short case study.

Introduction

Today, there are several manuals and guidelines covering eco-design. They give good advice on working methods, topics to consider and general strategies to design products with reduced environmental impact. The problem is that these strategies are often too general. A designer needs advice that can be applied to specific products for it to be of real value.

The most common method used for learning about the environmental impacts of a product is to undertake some kind of life cycle assessment (LCA). The result of the LCA then forms an inventory, ie. a detailed list of all the emissions and resources used during the life cycle of the product. The inventory can be evaluated using different methods and should identify the key environmental impacts in the life cycle, eg. production of material, energy consumption during use or transportation. It may also show the kind of impacts that are expected, eg. acidification and greenhouse effect. Evaluation results, however, do not indicate how to design the product.

IVF has developed a method for producing company-specific design guidelines. The results of an LCA on a typical product are evaluated to form the basis of the design solution. There is a need to remember that some environmental problems tend

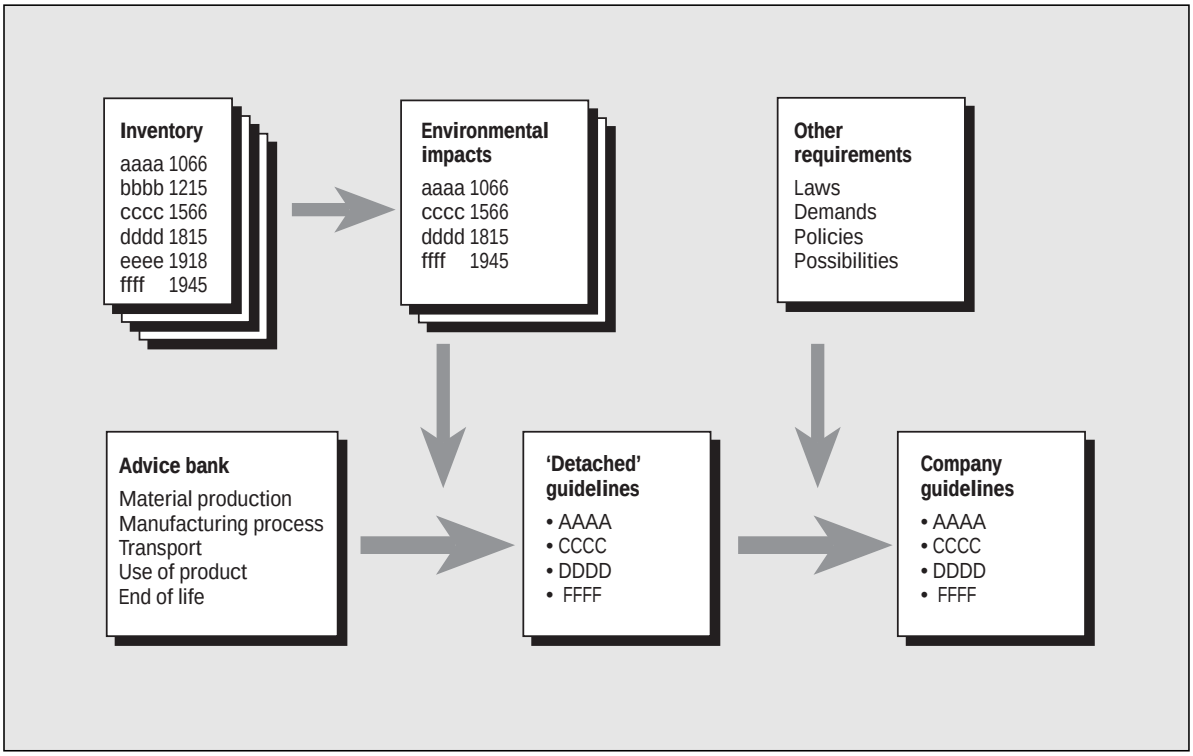


Figure 1: An LCA is the base for choosing advice, which is then adjusted according to other requirements. The result is a company-specific guideline.

to get lost in an LCA, especially after the inventory is evaluated, eg. substances not accounted for in the evaluation method, depletion of resources (some methods), etc. In addition to the LCA, external considerations such as customer demands, laws, technical possibilities and company policies have to be taken into account.

The IVF method consists of three main steps:

- analysing the product
- finding design strategies
- translating the strategies to company-specific guidelines.

This work will only be successful if those involved in the design process are aware of environmental issues like 'Design for Environment' (DfE) and LCA, and are able to apply it to the company culture and its products. The DfE expert should work in close co-operation with company employees to achieve best results. The DfE expert should have knowledge of DfE tools and processes and other internal business functions involved in product development, eg. marketing should have good knowledge of the products, company structure/culture and customer needs.

Analysing a product

The purpose of the product analysis is to assess the environmental impact of the products. This can be achieved in different ways, although it should always be based on life cycle thinking.

Choice of product

The guidelines should be appropriate for all products or at least one category of the products. With this in mind, a product should be chosen to be representative of the whole group of products. This implies that the product should:

- contain as many of the different materials used by the company as possible
- be produced with as many of the company's manufacturing methods as possible
- be transported to the same extent as the other products are transported
- be produced in large volumes.

Different methods of analysis

There are different methods of estimating the environmental impact of products. The choice of method depends on how detailed an analysis the company can afford. The more detailed the analysis, the more knowledge and financial resources are required.

A qualitative method that can be used is the MET-matrix, where use of material, energy consumption and toxic emissions are noted for each step of the life cycle, ie. production of materials and components, in-house production, use and 'end of life'.

Environmental indicators such as ELU-figures (indicators derived from the EPS evaluation system) and Eco-indicators give a measure of the impact from, for example, one kilo of steel. Figures are listed for construction materials, manufacturing processes, energy consumption and transport.

A screening LCA can be performed by using previous LCAs as bricks to build up a new LCA. The advantage of this approach compared to environmental indicators, is a far better transparency in data. It is possible to identify simplifications and assumptions. A computerised LCA tool with an LCA database is required.

Optimum precision is obtained by performing a full LCA including evaluation of the results with different evaluation methods. However, a complete LCA study calls for considerable resources in terms of LCA knowledge, time and money. The vast majority of companies do not have such resources.

When deciding on the extent and method of the analysis, it is important to remember that the purpose is to identify the essential impacts in the life cycle of the product. The analysis must be accurate enough to do this, but in most cases it is unnecessary to perform a full LCA to find the key issues.

Finding good design strategies

The result of the product analysis helps to identify the major impacts. These can be divided into five categories:

Production of material

The product may contain materials with high environmental impacts. For many products the consumption of materials has the largest impact on the environment. This is mainly due to emissions to air during mining and the decrease of material reserves.

Manufacturing processes

Production sometimes uses a lot of energy or consumes toxic chemicals. But the manufacturing process does not usually have a high impact compared to the use of materials.

Transport

Materials and components transported to the company and products transported from the company often cover considerable distances. In determining the environmental impact, the weight and volume of the product is important, as of course is the distance, but more important is the means of transportation used. The importance of transport is easily underestimated because a lot of short, hidden transportation exists across the whole life cycle of the product.

Use of product

If a product consumes material or energy during use, this generally accounts for the largest part of the product's environmental impact. The impact of energy used depends to a great extent on the country in which the product is used, ie. how the energy is produced. Coal and oil are many times worse than, for example, hydropower.

'End of life'

It is often difficult to know what will happen to the product when it is disposed of in maybe ten years time. The recycling of metals usually requires a small amount of energy compared to the production of virgin materials and the emissions to the atmosphere are usually relatively low. Recycling will continue to increase which means that products should be designed for ease of recycling, especially if they contain metals.

The advice bank

IVF has collected numerous examples about reducing the environmental burden of products across each of these types of impacts. IVF calls this an 'advice bank' which enables users to pick out relevant advice on the environmental impact reduction for specific products. To make it easier to find the design strategies that best apply to the

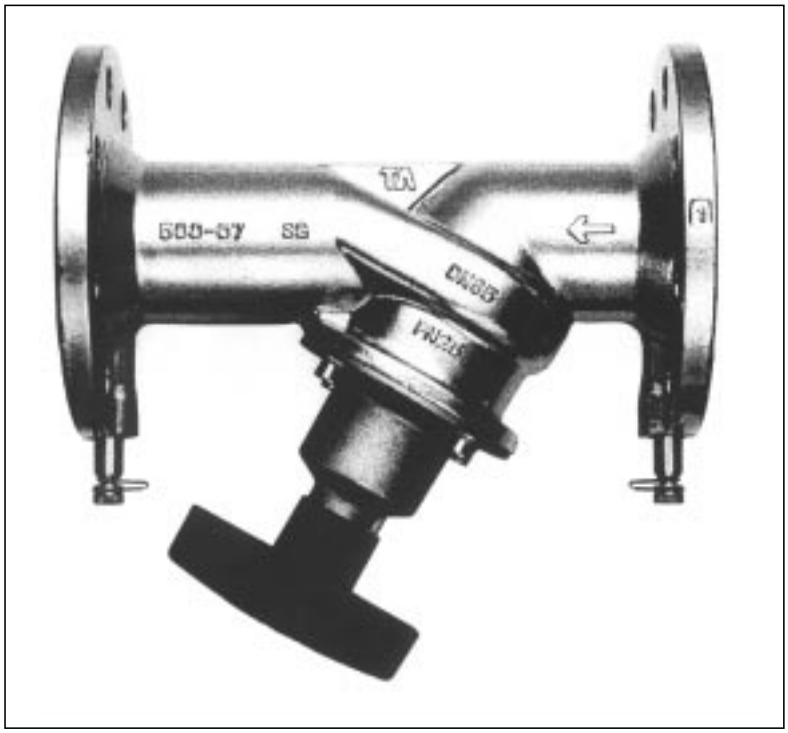


Figure 2: The TAH valve

specific product, the advice is sorted into the five categories mentioned above:

- production of material
- manufacturing processes
- transport
- use of product
- 'end of life'.

For example, if the results of an LCA imply that the energy consumption of a product during use produces a large impact, then advice will be found under the category 'use of product'. Until now the 'advice bank' has only been issued in printed form. However, as the amount of information increases, a computerised database may be developed. To pick out and find the most appropriate design strategies is a task that requires both knowledge, experience and a creative mind and should be completed by a DfE expert. When appropriate guidelines have been found the result will be a list of advice on how to design the specific product with less environmental impact.

General DfE advice can be found in many manuals, books and checklists for eco-design (eg. Brezet 1996, Beherendt 1997 and Burall 1996). But to be usable the advice should be as concrete as possible. The designer gains little help from a piece of advice such as 'Do not use toxic materials'. It is far more important to know which materials are regarded as toxic, eg. 'Avoid the use of lead, cadmium and mercury'.

Develop strategies based on company-specific guidelines

At this stage, the list of advice is based only on LCA information, which makes it somewhat detached. To be used in the 'day to day' work of the designer the guidelines cannot just be based upon objective environmental considerations. Parameters such as laws, customer demands, company policies, technical feasibility and finance have to be taken into account. Customising and adapting the strategies requires a wide knowledge of the company and the environment. To enable this to be carried out, a group of people from different elements of the company must cooperate, eg. production, design, marketing and sales.

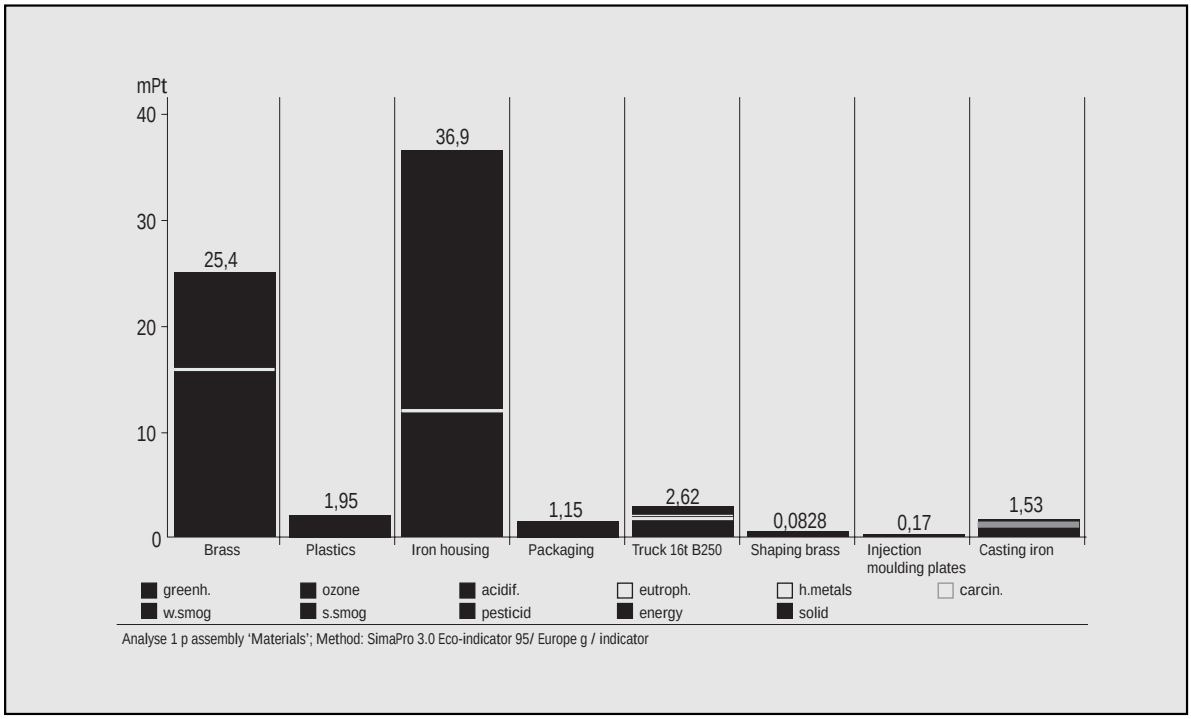


Figure 3: The environmental impact of the valve from cradle to grave. Evaluation performed using Ecoindicator 95.

Consideration of the requirements and customisation of advice could be achieved through discussions. However, it is easier to do this within some kind of framework. IVF has used an FMEA methodology (Failure Mode Effect Analysis) for sorting and customising the advice. Recently many different ways of using FMEA methodology for environmental purposes have appeared. In IVF's application of FMEA, figures are allotted to environmental importance, requirements and possibilities for change. These three figures are then multiplied to obtain a priority list.

Consideration must also be given to environmental problems not highlighted by the LCA. These might include the work environment or process chemicals not included in the inventory. The main gap is usually related to unusual substances and local environmental effects, which could be of significance in specific cases. Supplementary information could also be provided through the local authorities' lists of hazardous chemicals and the company's environmental review.

Case study: Valve

Tour and Andersson Hydronics (TAH) designs and manufactures valves and systems for water-borne regulation of heating or cooling media in buildings and employs 850 people. The products are used to obtain a desired indoor climate with a minimised energy loss. TAH has its own product development function and has recently started to integrate environmental considerations as part of the introduction of environmental management systems. TAH has, in cooperation with IVF, established a set of company-specific guidelines, for designing valves with a reduced environmental impact. TAH designers and buyers have collected product information and IVF developed a screening LCA study.

Choice of product

A representative product was chosen. The chosen valve contains mainly brass, cast iron and different sorts of plastics (materials which are normally used in the company). It is also one of the company's main product types.

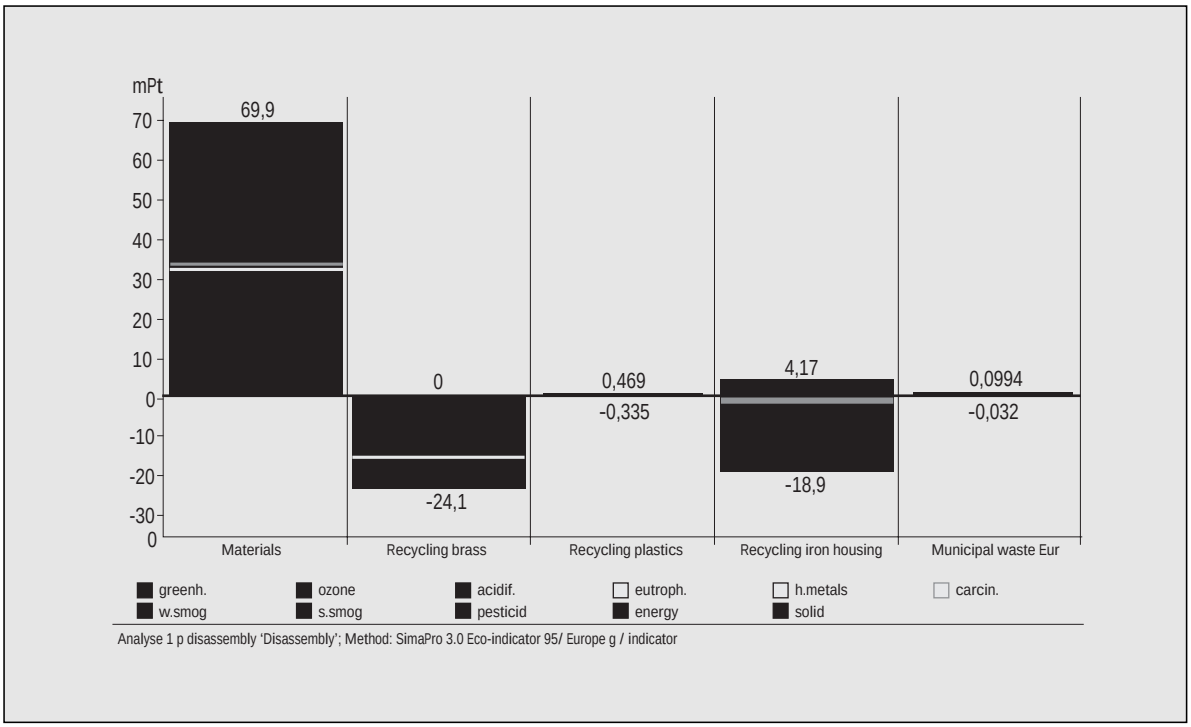


Figure 4: The environmental impact if the valve is recycled 100%. Negative values indicates a benefit. Evaluation performed using Ecoindicator 95

Analysis of the product

An inventory of the valve components was made and the materials, weight and origin (for the transport calculation) of each component noted. SimaPro, a software program, was used to complete the screening LCA, and inventories for material, manufacturing, transport, etc. were used from the BUWAL 250, Idemat 96 and Pre4 databases. Some inventories were old and contained weak data, others were not applicable for Swedish conditions. However, not all inventories could be verified due to economic restrictions. The researchers had to concentrate on the most important issues and adjusted some calculations for Swedish conditions, eg. brass has a high recycling rate in Sweden. Then the evaluation was performed using the EcoIndicator 95 method, and the Ecoscarcity method (an evaluation method based on actual pollution and targets derived from Swiss policy).

First, the product was structured into materials categories (eg. iron, brass, plastics and packaging) to identify the impact of each material and process. Results showed major impacts from the material production of iron and brass. Iron can produce smog due to emissions of dust and sulphur dioxide (SO_2), acidification due to SO_2 emissions, and contribute to the 'greenhouse effect' due to carbon dioxide (CO_2) emissions. The largest impact from brass was acidification due to SO_2 emissions from copper manufacturing. Transport and packaging produced only a minor impact.

Iron and brass are both metals which can be recycled. An interesting question concerned the possible benefits of designing the valve to be 100% recyclable. The analysis showed that recycling would decrease the impact to about 50%, as the extra transportation was of relatively minor importance.

The use of the product is often important but in this case it is very hard to calculate the impact. During its lifetime the valve regulates huge amounts of heat ie. energy use. Therefore, any changes in design must, under no circumstances, cause a deterioration in the performance of the valve.

Design strategies

When summarising the analysis above the major conclusions were that:

- the pollution due to the manufacturing of of brass and cast iron are important
- recycling brass and cast iron will create a considerable benefit
- packaging and transport have a relatively small impact.

Advice was then searched for in 'advice bank' categories 'production of materials' and 'end of life'. The suggestions were:

Minimise the use of materials

- do not over-dimension. Make suitable calculations and tests.

Choice of material

- where possible, use cast iron instead of brass. Note that it is an overall requirement that the function is not deteriorated or the lifetime considerably shortened
- if not recycled, metals have generally a higher impact than plastics (if recycled, metals can be a better alternative)
- the impact of metals is considerably reduced if the material is recycled
- if possible use recycled material.

Design for recycling

- use as few screws as possible. This saves time in assembly as well as disassembly
- use as few screw types as possible to minimise time for tool change
- if possible, avoid loctite in nipples
- use as few materials as possible
- gather material fractions in modules so that the materials can easily be separated
- be cautious about using additives like fillings, fibre reinforcement or fire retardants which make it hard or impossible to recycle plastics
- mark the plastics in the injection mould with standard marking according to ISO 11469.

These are in a sense general guidelines but they have been picked out to fit the TAH valve. These guidelines would be ineffective or even inaccurate when designing a different product, eg. food processor. Work is being completed at TAH to further develop these guidelines.

Conclusions and further work

It is essential to devise practical ways of performing DfE. The designer, especially in a small company, does not have either the time or the know-how to use complex methods or tools. On the other hand, environmental considerations are often complicated. This is a sensitive problem when dealing with DfE. The project illustrated that the company's knowledge of product development as well as the external knowledge of LCA and environment were needed to develop a tool utilising the skills of the environmental expert and the designer. The strength of this methodology lies in its relative simplicity and that it produces company-specific knowledge. Further improvements of the method are certainly possible. One weak area is the step from an LCA evaluation to generating advice and guidelines. This could be made more distinct. Another area to be improved is the consideration of environmental problems that are not accounted for in the LCA. There needs to be better instruments to assess these issues and further research should be completed on how to use LCA in product development. •

References

Brezet, H., et al, 'Ecodesign : a promising approach to sustainable Production and Consumption', (Paris, UNEP/IE, 1996)

Beherendt, S., et al, 'Life Cycle Design: A manual for small and medium-sized enterprises', (Berlin, Springer, 1997), pp 53-108

Burall, P., 'Product development and the environment', (Aldershot, England, Gower Publishing Ltd., 1996)

Goedkoop, M., 'The Eco-indicator 95 : Final report', (Amersfoort, Netherlands, PRÈ Consultants, 1995)

Willkrans, R., et al, 'Design for Easy Assembly', (Gothenburg, IVF, 1995)

Professor Han Brezet

Director, Section of Environmental Product Development, Faculty of Industrial Design Engineering, Delft University of Technology, the Netherlands

Martin Charter

Coordinator, The Centre for Sustainable Design, UK

After finishing his studies in Electrical Engineering at the Delft University of Technology (DUT), Han Brezet received his PhD in Environment Sociology at the Erasmus University Rotterdam. Since 1992, after a career in cleaner production consultancy, he holds the chair on eco-design at the sub-faculty of Industrial Design Engineering at the DUT. In his present position, he is leader of the Design for Sustainability Programme of his Faculty and is research director of Kathalys, the Joint Centre for Sustainable Product Innovation of TNO Industry and DUT established in 1998.

What do you think are the key challenges of sustainable development for product and service development?

One of the key areas that is often not discussed is the environmental impact of emerging service industries eg. information and communication technologies (ICT). Often it is believed that services are environmentally beneficial. There are a small number of people deliberately designing eco-efficient services, however, the majority of the service industry pay virtually no attention to eco aspects, such as infrastructure and products used to operate these services. Integrating eco-design thinking into the service design of emerging service industries is essential.

Another key issue is how government's should develop national product-orientated environment policies. So far this is limited and there is generally still a focus on production aspects – learning from the Dutch-thinking on Product Oriented-Environmental Management Systems (POEMS) approach could contribute to the debate. So governments should support different research projects in this area. One example is, a very successful eco-design project in the Netherlands, which included over 600 companies, primarily SMEs (see the following extract from 'The IC EcoDesign project: results and lessons from a Dutch initiative to implement eco-design in small and medium-sized companies' by Carolien G van Hemel, JSPD2, July 1997). But since the project was completed in 1998, there has been no proactive government policy to maintain the focus of these SMEs on POEMS. Also, more specific government attention is needed for improving the energy-efficiency of products in line with the requirements of climate change agreements.

It is essential to organise young students and entrepreneurs to enable them to increase the chances of developing better and more environmentally sustainable businesses. History has shown that, with the exception of what is emerging in Japanese industries at the moment, that the old-style dinosaur businesses are not capable moving into eco-(re)design, or particularly into eco-innovation. So how can

young students and entrepreneurs develop the eco-design knowledge to shift existing industries towards a more sustainable future, or create their own sustainable businesses.

There is a need for high levels of education and awareness throughout society, this includes better examples of successful eco(re)-design and eco-innovation. At present, these case studies are often difficult to find. Many engineers who are now involved in product development have not been educated about environmental considerations eg. integration of sustainable energy options like, photovoltaic cells or human power energy, and therefore miss out on opportunities to develop more sustainable products. More broadly, there is virtual no education and training in relation to eco-service development.

What do you think are the key barriers to eco-innovation? (eg. the incorporation of environmental and broader sustainability considerations into new product services and development)

It requires a step or radical change from industry as we can learn from research completed by Professor Nicholas Ashford at MIT (US). It is important for smart businesses to invest in young bright people from outside the company and even outside the industry in developing new, more sustainable business ideas and to 'invent' the sustainable consumer. A big problem is that governments , as potential powerful environmental change agencies, are usually slow to develop policies, concerted actions and instruments to stimulate radical change, this is especially true in the environmental area. In this respect, the rest of the world can learn a lot from the Japanese eco-design programme, in which the Department of Industry (MITI) is creating the preconditions for Japanese industries to become the world's leader in product energy efficiency, eco-efficient material use and sustainable new concept development.

What do you see as the key opportunities and problems faced by eco-service development?

One of the problems is that we assume that services are environmentally friendly but this sometimes is hard to evaluate this with existing LCA tools. Opportunities are there, many new types of services are already being developed eg. ICT. This is because service businesses are usually innovation-orientated and open minded, but neglect environmental aspects in their service design. In every service there is a product-part and there is opportunity to continue eco-(re)design steps as part of the process. We need some new measuring instruments and tools for eco-service product development. In the follow-up to TU Delft's Promise 1 project on eco-design of products, a Promise 2 approach is being developed, focusing on eco-design of services. New tools for meeting their environmental impact, will be part of Promise 2. •

Results of the Dutch EcoDesign project

Participating industries

The best represented industries were metal products, machinery, wood and furniture, electronics, rubber and synthetics.

Attitude towards eco-design

75% of the companies did not have any eco-design experience before starting the IC EcoDesign project. Most companies regarded eco-design as an opportunity rather than a threat. Eco-design was recognised by some for its marketing potential.

Some companies saw eco-design as a cost-neutral activity. However, the majority of the companies regarded eco-design as an initial investment, which would be paid back in the medium to long-term.

External parties that were perceived to be most concerned about eco-design were government, suppliers and trade associations. However, the parties which stimulated them to implement eco-design were government, industrial customers and the end-users of the product.

Motivation towards eco-design

The two most important motives for participation in the IC EcoDesign project were the wish to increase the quality of specific products, and the importance of anticipating future developments. A third

motive was that eco-design was seen as an important aspect of product innovation. With a fourth motive being a feeling of personal responsibility felt towards 'the environment' by the company representative. The search for environmentally benign alternative materials or components, and supply chain pressures were also strong motivations.

Direct project results

The 77 companies provided the following results:

- eco-design had been applied to 1 product that was totally new to the company
- eco-design had been applied to 21 products that have been thoroughly re-designed
- eco-design has been applied to 13 products that were slightly improved. These products were being or will be launched in the near future.
- the packaging of another 4 products was environmentally improved
- in 7 companies the focus was on improving the environmental aspects of production processes
- in 9 companies the product had not yet been improved, but research was being undertaken
- in 11 companies the product has not been improved, but research had been concluded
- in 6 companies the product had not been improved, but research was planned
- in 5 companies the project had not produced any results.

Focus on eco-design

Some eco-design strategies proved to be more popular than others. These eco-design strategies were recycling, reduction of weight/components, low-impact materials and high product reliability. After these four types, the most popular options concerned cleaner production, more efficient packaging, low energy-use in the use phase and the application of recycled materials.

Eco-design strategies that had a greater chance of being implemented were cleaner production, the prevention of waste of energy/consumables in use phase, high product reliability, easy maintenance and repair and recycling.

Indirect project results

The greatest increase in eco-design knowledge concerned eco-design in general, environmental aspects of materials and the environmental burden of the product in its total life cycle.

Most companies said that they were now able to apply eco-design independently.

- 30% had already applied eco-design principles to other products.
- 60% said that they would apply eco-design in the future.
- 25% said that they had developed an eco-design checklist to be used during product development.
- 25% wanted to integrate product-related environmental information and requirements in their environmental management system.
- 25% aimed to integrate environmental demands in their quality system.

Commercial results

- 67% expected their 'eco-designed' products to increase their market shares.
- 56% expected to enter new markets with their environmentally improved product.
- 25% expected a profit to be generated through eco-design within two years, ranging from 10% to 50%; 27% expected a profit ranging from 1% to 5% (profit was defined as being based on costs savings as well as sales increases).

Appreciation of the IC EcoDesign project

- 64% said that the IC EcoDesign project has led to concrete results.
- 71% said that they would continue to use elements of the auditing method.
- 90% said that they would recommend the project to other companies.

This is an extract from 'The IC EcoDesign project: results and lessons from a Dutch initiative to implement eco-design in small and medium-sized companies' by Carolien G van Hemel, which originally appeared in JSPD2, July 1997).

Sustainable product development: a key factor for small enterprise development – the case of furniture production in the Purépecha region, Mexico

Dr Diego Masera

Product Development and Marketing Manager,
Micro-enterprises Support Programme, Kenya

Diego Masera studied industrial design at ISIA in Florence, Italy. After working for several years with international development organisations in Africa and Latin America, in 1998 he received a PhD from the Royal College of Art in London, UK, for his research thesis titled 'Eco-production: sustainable product development in small furniture enterprises in the Purepecha region of Mexico'. At present he manages the product development and marketing component of the Micro-enterprises Support Programme in Kenya, the main programme of the European Union to support micro-enterprises. He is the author of several articles and manuals on product development for small enterprises in developing countries.

The growing recognition of the importance of small enterprises[1] to the economic development and social welfare of developing countries has led to the implementation of many projects and programmes aimed at assisting such enterprises in their development. Many, if not most, of the approaches have been geared towards easing financial constraints by the promotion of credit and to upgrading technical skills through vocational education. Until recently, little attention has been paid to product development and production, and its environmental impacts. Product development is increasingly being identified by various practitioners around the world as a key factor for social enterprise development.

The development of small enterprises depends on the products they make. Greater competition in traditional markets is leading to a desperate need for product diversification. The introduction of sustainable product development (SPD) has the potential to reduce the environmental impact of small enterprises and contribute to their development and sustainability.

In the context of small enterprises in developing countries, SPD is defined as the process which creates product designs that are sustainable in terms of environmental impact and resource-use whilst considering the need for the product. It examines the intensity and optimisation of resource-use in product design and the overall production efficiency, while taking account of local culture and tastes, with the aim of improving the product's quality to increase market opportunities. This paper analyses the way SPD can contribute to the development, and economic and environmental sustainability of small enterprises. Finally, it presents some products that have been designed by Mexican artisans as a result of the SPD training.

Product development and sustainability

Product development and sustainability are a recent combination of terms which have evolved from the recognition of the importance that design, manufacturing, material choice, product type, use and final disposal have on the environment. The recognition of a single global environment in which all activities are interrelated and affect each other is bringing researchers to an in-depth recognition of the importance of the design process and its relationship to the environmental impact of products. This analysis has led towards the search for more fundamental changes at design, production and user levels aimed at moving towards sustainable development:

The process through which all the physical and spiritual needs of the people of the planet will be permanently satisfied. Improving (and in some cases, maintaining) the present socio-environmental conditions.

Most of the current focus is on reducing the problems of current products, such as:

- improving energy efficiency in washing machines
- making products easy to disassemble for re-manufacturing to avoid waste problems
- minimising the amount of materials used in packaging.

However, there is also an increasingly serious and mainstream discussion of how we can make progress towards more fundamental changes, eg. 'Factor x' levels of energy and resource reductions.

The goal of sustainable development becomes particularly relevant in the context of small enterprises in developing countries. These small enterprises are fundamental as they provide one of the few employment opportunities for local people. However, in many areas these small enterprises represent a menace to the environment.

In the context of small enterprises in developing countries SPD is defined as follows:

SPD is the process which creates product designs that are sustainable in terms of the environment and resource-use whilst considering the need for the product.

SPD is the process of planning and designing that integrates the following elements into a product:

Resource-use efficiency: in terms of both energy and materials used in the manufacturing, and use phase. It also includes the selection of materials, favouring the use of local, renewable, recycled and low energy materials and avoiding those which are scarce or contain toxic materials.

Product quality: includes the use, need and function of the product, durability, optimisation of the life span, energy efficiency, proper use of materials and finishing.

Production organisation and efficiency: includes optimising human and technical manufacturing processes in terms of resources, labour and machinery, and the use and development of appropriate technologies and renewable energy.

SPD is the process which creates product designs that are sustainable in terms of the environment and resource-use whilst considering the need for the product.

Due to lack of resources, information, education and isolation, most artisans in developing countries tend to reduce economic risks by copying what others are producing.

Local culture and capacities: includes the understanding and application of local culture and indigenous knowledge, local people's needs, traditions, tastes and capacities (technical and economic) throughout the whole process. This means maximising opportunities for the use of local products for local consumption.

Market: includes the analysis and search for market opportunities that can make the process economically sustainable.

'End of life': includes considerations regarding the possible reuse, disassembly, recycling and final disposal of the products.

In summary, SPD considers the intensity and optimisation of resource-use for product design, while involving local culture and tastes, and the overall production efficiency with the aim of improving the product's quality to increase market opportunities. The incorporation of the long-term environmental, social and economic considerations at each step of the process gives it a new dimension. Moreover, SPD recognises the central responsibility that designers have in helping to prevent global pollution, destruction of tropical forests, emission of greenhouse gases, through the products they design.

The introduction of SPD could contribute to the development of small enterprises in developing countries in eight different ways:

Markets: expanding and creating new national and international markets for newly designed products. Product quality improvement, simplification of product manufacturing processes, reduction of production time and costs, product re-design or new product design, can all contribute to the expansion of the market or to help to identify a niche in the market.

Quality: promoting import substitution by manufacturing quality products to replace the imported products that consumers might normally buy. Quality products do not necessarily mean expensive production processes and machinery – which will not be available to the majority of the small enterprises. The production of quality goods can be achieved by using or adapting existing appropriate affordable technology. The design of a quality product should be completed, whilst considering the existing technological capacity. Copies of inappropriate designs from other countries will not help the process.

Needs: developing locally made goods that are more appropriate to the specific needs and conditions of the country. Every single product reflects the lifestyle and the production environment of the culture in which it was designed. Participatory training of local artisans in SPD will enhance the local culture expressed in the products and consequently increase the sales of those new products that will better respond to the customer's needs and way of life.

Employment: fostering the job creation process. As a result of the local market creation and expansion through SPD, more apprentices will be required in each workshop, and new jobs will be created.

Appropriate technology: introducing and disseminating 'appropriate manufacturing technologies'. New or improved product ideas will lead to the need for, in most cases, the creation of technological improvements or for the necessity of a new technology and vice versa.

Sustainable production: reducing the environmental impact of small enterprises by making product and production processes more efficient and linked to the sustainable production of local forests, as well as reducing the use of toxic materials.

Income: increasing the average income of artisans by improving the product quality and marketing channels as well as reducing raw material consumption.

'Quality of life': contributing to the achievement of sustainable development by reducing the environmental impact of small enterprises, enhancing community participation and contributing to a better 'quality of life' in rural communities.

Implementing sustainable product development

Due to lack of resources, information, education and isolation, most artisans in developing countries tend to reduce economic risks by copying what others are producing. The development of new products tends to be the result of a random process rather than a continuous and guided activity.

Today rural people are faced with situations they have not previously encountered, due to rapid change. In many cases, they have reached the point where they cannot sustain their livelihood within the framework of their existing knowledge, resources or institutions. In a wide range of situations rural people need assistance to maintain the sustainability of their local biomass economy. (van Gelder and O'Keefe, 1995:8)

SPD, as any new activity, implies a change in the current production patterns of small enterprises. It requires a process of understanding and training that needs to be initiated and promoted by organisations concerned with small enterprises and should include professionals trained in the subject (designers). The role of the designers in SPD training and small enterprise development needs to be recognised and enhanced. The presence of designers during the training is likely to be a key element in its success. It is surprising to notice that many training projects around the world that tackle product development are carried out by general trainers or professionals without a design background. This is because design schools tend to focus on the creation of designers that suit the needs of large industries. Hence, there is a limited number of designers working with small enterprises in developing countries. Moreover, there is a lack of recognition and awareness about the design profession by the main actors in the sector.

Due to the recent recognition of the value of SPD in the development of small enterprises in developing countries, there is very little experience in SPD training. Training in SPD can be provided to single artisans, groups of artisans, co-operatives, and artisan associations.

A combination of 'on the job' sessions with visits to peers and market places, with a few theoretical presentations proved the most successful approach amongst the Purépecha people of Mexico. This new approach rejected the notion that facts are taught, and encouraged experiential learning. The training is organised with artisans working in the same sub-sectors ie. furniture workshops and metal workshops, with visits to peers and market places designed to increase the artisan's exposure to new products, production processes and customers. This is critical for artisans that have limited access to information.

The suggested SPD training process should fulfil the following characteristics:

Practical: to be as practical and participatory as possible, based on the artisan's own experience and knowledge.

Short: to be as short as possible to enable participants to be away from their work as little as possible, as they rely economically on

Figure 1: 'Casas Blancas' chairs

their own labour for income.

Thinking: to stimulate a process of thinking and designing, not a single product solution.

Language: to be conducted in the language of the participants, not of the trainer.

Feedback: to encourage feedback from the participants

Focused: to work with groups of artisans from the same sub-sector (eg. carpenters).

Design: to be taught by a qualified trainer with background in industrial design and/or relevant SPD experience.

Applied: 'on the job' training and other practical techniques should be used in preference to to classroom training sessions.

Market: to expose participants to the market.

An example of improved furniture developed by local artisans in the Purépecha region of Mexico as a result of SPD training

The Purépechas, the largest indigenous group of people in the Michoacan state in Mexico, have a long and established tradition of making wood handicrafts. It is estimated that more than 150,000 people rely on the production of furniture, wooden toys, copper handicrafts, pottery, and a variety of other products for their livelihoods. On average one out of four and, in many villages, all residents, work in these small enterprises and most earn meagre wages (Castañon, 1993). The area is endowed with important natural resources (estimated to be 79,000 hectares (ha) of forest resources, mostly pine and pine-oak associations). Local forests are highly diverse for temperate areas, presenting more than 10 species of Pinus, and 12 of Quercus, among many other tree species. Currently, however, a rapid deforestation process, reaching close to 2%/yr (1880 ha/yr), and a degradation of a large fraction of the forested area is taking place (Caro, 1990; Alvarez-Icaza and Garibay, 1994). Large portions of formerly forested land have been completely eroded. A combination of issues creates a very competitive context that reduces profit margins to a minimum and poses serious threats to the sustainability of the forest resources in the region: the large number of small enterprises (more than 10,000 – of which 2,800 are furniture workshops) and their regional concentration;

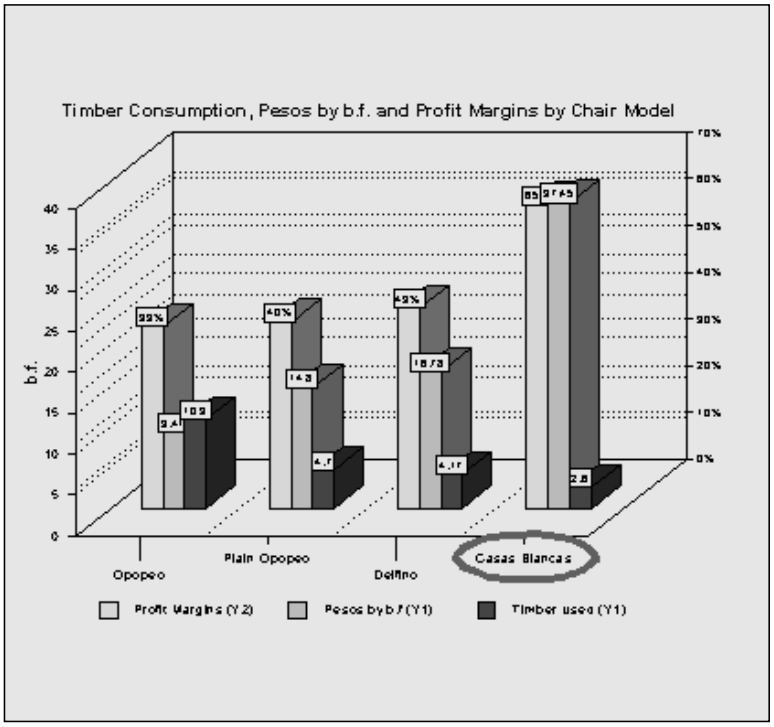


Figure 2: Comparsion among new and old products

the low product quality and diversity; inefficiencies in the manufacturing processes; lack of technical training; lack of support from official institutions; lack of organisation and training opportunities; and lack of financial resources. The search for cheaper prices for raw materials has favoured the use of illegally harvested timber because of its lower price. These conditions are also reflected in the products which tend to be of poor quality and are very similar in shape and style.

In the region, the author – in co-ordination with a local NGO called GIRA A.C. and with the active participation of local artisans – started a project aimed at exploring alternatives to sustainable development by suggesting ways that allowed local entrepreneurs to earn adequate livelihoods through the sustainable management and use of local natural resources. During its implementation 'eco-production' was developed as an integrated and interdisciplinary manufacturing and planning approach. 'Eco-production' can provide alternatives to the entire wood production cycle, including the sustainable management and supply of forest resources, improvements in the small enterprises production processes and a search for alternative market opportunities.

As part of the SPD training several products were developed, Figure 1 shows a chair that was developed by artisans of Casas Blancas, a small village in the Purépecha region devoted to the production of chairs. The chair was produced as a response to the critical economic and

Taking into consideration that the products (old and new) are almost entirely made out of timber originated from sustainably managed forests, the amount of timber used is a good indicator of their environmental impact at the production level.

Figure 3: New products

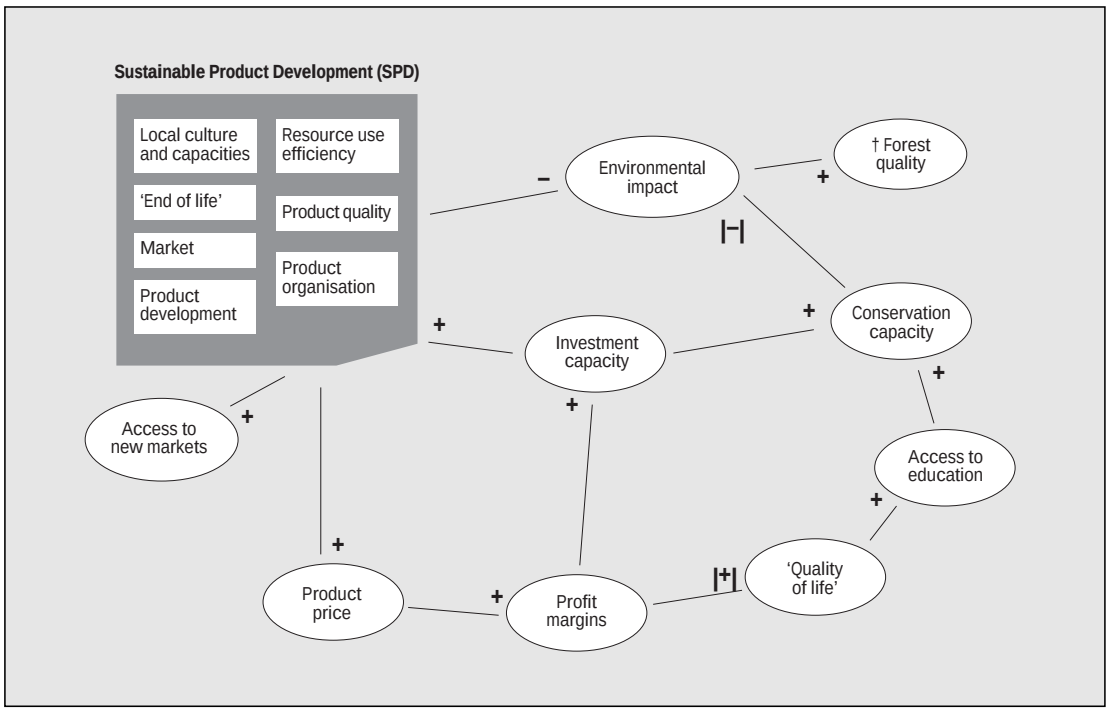


Figure 4: SPD contributions to small enterprise development

environmental situation that was highlighted after the initial phases of the SPD training. The chair achieved a series of improvements from a technical, environmental and design point of view (compared to other regional products). This has been reflected in its rapid success among customers.

In order to analyse the characteristics of the newly designed 'Casas Blancas' chair, a comparative method was used. To determine the level of improvement and reduction of environmental impact of the new product, it was analysed in relation to other similar chairs. Therefore, this comparative analysis provides information on the new chair but also contextualises it by referring to other similar products that are regularly produced in the region.

The comparisons include a series of ad hoc indicators such as material intensity, profit margins and 'pesos by board foot of timber' used. Material intensity refers to the extent to which materials are used in the production. The material intensity reflects whether or not an optimal or economic use has been made of the material(s) involved. It also refers to the amount of material per unit of product. Material intensity is particularly relevant in the context of a region with limited natural resources such as the Purépecha region – as it needs to make the production processes as efficient as possible. Taking into consideration that the products (old and new) are almost entirely made out of timber originated from sustainably managed forests. The amount of timber used is a good indicator of their environmental impact at the production level.

The 'pesos by unit of material used' is an important indicator for the economic sustainability of small enterprises. As it is in direct relation to the increment of the artisan's income (see Figure 2).

The market success of the chair is also an indicator of the product quality and the accuracy of its market orientation. The profit margin indicates an improvement in the production efficiency. 'End of life' considerations in the new chair included the ease of replacement of the seat and back, through the use of simple screws in the assembling process.

The new chair consumes four times less timber than the common Opopeo model and half of other locally produced chairs. In terms of 'pesos by board foot used', the returned value per unit of timber used was four times higher than other models. Finally, the profit margins achieved with the 'Casas Blancas' chair were 65% compared to 40% average of other models.

The analysis used focused on the environmental impact during the manufacturing stage of the products and the economic benefits to the producer (because it has been carried out from the perspective of the local artisans). Other considerations included the need to:

- reduce the volume during transportation
- ease of repair and disassembly

The 'Casas Blancas' chair is just an example of the potential benefits that the introduction and dissemination of SPD training can have in developing countries.

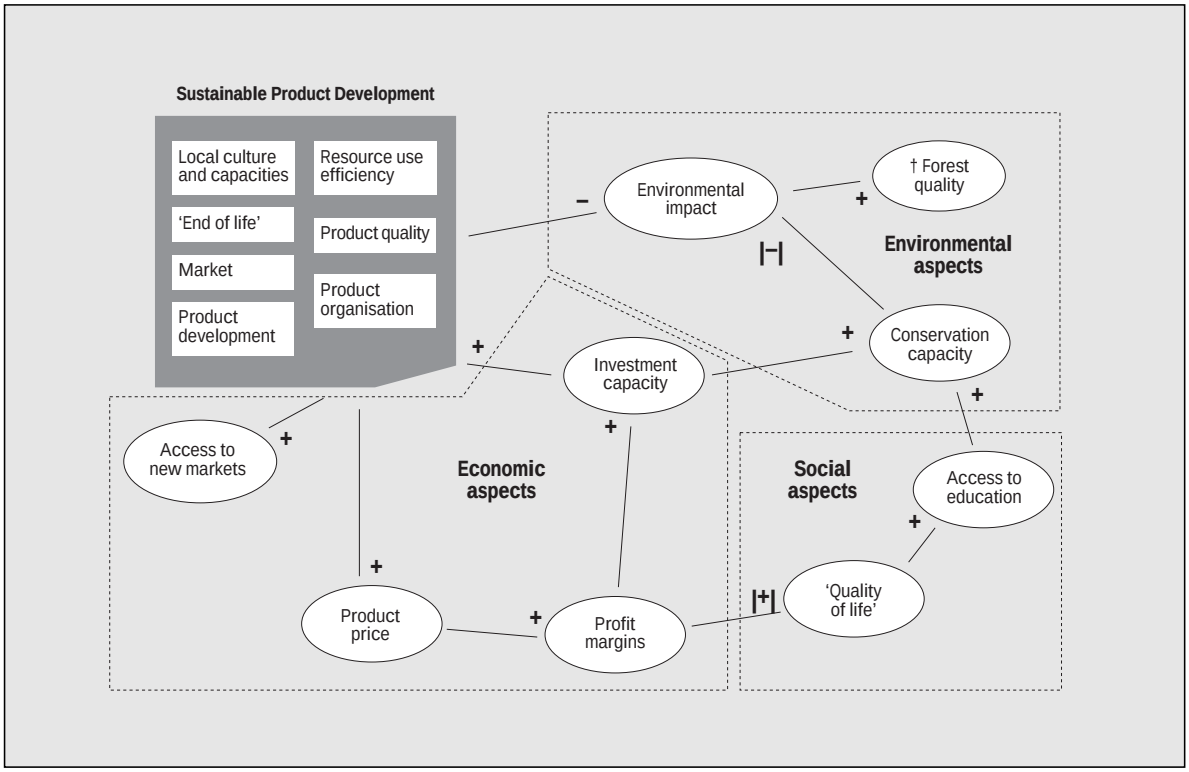


Figure 5: Impact of SPD

· use of local materials
· no chemical finishing
· regional distribution.

The 'Casas Blancas' chair is just an example of the potential benefits that the introduction and dissemination of SPD training can have in developing countries. Indeed, the production and marketing of a new environmentally sound product that doubled profit margins was also essential to reinforce the commitment of the local artisans to work towards forest conservation.

Sustainable product development contributions to forest-based small enterprises

Figure 4 (see page 34) presents how active involvement of small enterprises in SPD can contribute to improving the conditions of many forest areas that face similar challenges to those of the Purépecha region and also help to promote sustainable development. The figure was developed using the oval diagramming technique. Oval diagramming describes a problem as a set of complex relationships among system

variables and variables in the system environment, and provides an explicit statement of cause and effect relationships within a system and between the system and its environment. Variables are in ovals and the connecting arrows link them together. It allows the analysis of complex causes and effects in sequences that start from a key variable.

The diagram can be read starting at the SPD box (top left of page 34). The implementation of SPD increases the possibilities of accessing new market channels and increasing prices by improving products' quality and design. The resulting increment in the product price (reducing the production costs by improving the production organisation and technology) increases the profit margins which at the same time increase the investment capacities of the artisans[2] and the possibility of carrying out SPD activities. The process tends to be economically self-sufficient by increasing the artisans' opportunities to pay for SPD activities. Moreover, a continuous increment in profit margins can in the long run increase the 'quality of life' of the artisans by allowing them to have access to better housing and services, and by increasing their access to education. Education together with the increment in investment capacities improves the possibilities of enhancing the capacity to preserve the local natural resources by improving their understanding of the environment and in many cases going back to local traditions of forest use and management. The incremental improvement of the communities' conservation capacity together with the implementation of product development activities reduce the environmental impact of the small enterprises which has a direct effect in improving the forest quality.[3]

Figure 5 (page 36) underlines the impact of product development in social, economic and environmental terms. The economic elements are represented by the product price, the market, the profit margins and the investment capacity. The social aspects are represented by two variables, a very general one of 'quality of life' and the access to education. Finally the environmental aspects are represented by the conservation capacity, the environmental impact of small enterprise production and the forest quality. The SPD process presented in Figure 4 (page 34) cannot grow forever and it is limited by the production volume of small enterprises which is determined by the sustainable production potential of the local forests. The local production volume of small enterprises should not be larger than the sustainable forest potential. If the production of small enterprises increases to a level which requires more timber than the sustainable potential of local forests, the process will be reversed. However, this final scenario should be avoided by sustainable forest management and product certification which should limit production volume.

Conclusions

Most people in developing countries depend on small enterprises

Education together with the increment in investment capacities improves the possibilities of enhancing the capacity to preserve the local natural resources by improving their understanding of the environment and in many cases going back to local traditions of forest use and management.

for their living. However, the markets being served by small producers tend to be saturated by low quality and material intensive products, and suffer from lack of product diversification. This situation leads to a reduction of the profit margins of producers and to pressure over environmental resources.

Few studies have focused on the role of SPD in improving the low performance of small enterprises and how designers can improve the process. Furthermore, the environmental impact related to small enterprises' production activities has also received limited attention.

In this context this article represents a first step towards a more comprehensive understanding of the benefits that the implementation of SPD can bring to small enterprises in developing countries and the role that designers play in the process. Four main points arising from the analysis should be underlined:

- SPD training is essential in the reduction of the environmental impact of small enterprises in developing countries. It contributes by considering the intensity and optimisation of resource-use for product design, while involving local culture and tastes, and increasing the overall production efficiency with the aim of improving the product's quality to create market opportunities
- Artisans require training to be able to improve their current situation
- Designers should get more actively involved in SPD training for small enterprises in developing countries
- The results obtained in Mexico are encouraging and should be replicated in other areas. •

Notes

[1] For the purpose of this article small enterprises are all manufacturing enterprises with less than ten employees and an annual turnover of less than US$ 15,000.

[2] Artisans are all technically skilled people that work in small enterprises.

[3] The plus sign (+) between brackets stands for a direct threshold effect. Variable A has to increase significantly before variable B increases. The vertical arrow sign stands for an irreversibly increasing relationship.

References

Alvarez-Icaza, P., and Garibay C. . Producción Agropecuaria y Forestal. Plan Patzcuaro 2000. Toledo V. et al., México: Fundacion Friedrich Ebert Eds, 1994, pp91-133

Bakker, C., Environmental Information for Industrial Designers. Rotterdam, The Netherlands: Technische Universiteit Delft, 1995

Barret, L., and E. Datschefski, A Manager's Introduction to Product Design and the Environment, The Environment Council. 13pp, London, 1997

Becker, C. D., and E. Ostrom, Human Ecology and Resource Sustainability: The Importance of Institutional Diversity. Ecological Systems 26: 1995, pp113-33 .

Burger, K., Rapid Market Appraisal for Micro and Small Enterprises: background and first experiences. Amsterdam: FIT, 1995

Caro, R., La Problem·tica Forestal en la Meseta Tarasca. Los Problemas Medio-Ambientales de Michoac·n Zamora, Michoacán. México: El Colegio de Michoacán, 1990

Castañon, L. E., Artesanos Purépechas. Análisis Económico y Social de los Determinantes de la Productividad. Pátzcuaro, Michoacán: INI, 1993

Cernea, M.M. Primero la Gente. Variables sociológicas en el desarrollo rural. Fondo de Cultura Económico/Economía Contemporánea, 1995, 642 p. Méx. D.F.

INEGI, Encuesta Nacional Ejidal vol II. Mexico: INEGI, 1988.

Unknown, Michoacán Hablantes de Lengua IndÌgena. Mexico: INEGI, 1996.

Lélé, S. M., A Framework for Sustainability and its Application in Visualizing a Peaceful and Sustainable Society. Berkeley, California: University of California, 1991.

Unknown, Sustainability: A Plural, Multi-Dimensional Approach. Berkeley, California: University of California, 1993.

Masera, D., Recycling and re-using in Kenya. UK: Appropiate Technology Magazine vol 3 n.2, June, 1997.

Unknown. Product Development for the Informal Sector in Kenya. UK: Appropiate Technology Magazine vol2 n.2, September, 1994.

Masera, D., and F. Bedini, Local Farmers Innovate in Irrigation: The Development of Low-Cost Sprinklers in Kenya, Indigenous Knowledge and Development Magazine 2, no. 1, 1994.

Masera, D., and M. González, Aprovechamiento de la Madera en Talleres Artesanales de CarpinterÌa. Pátzcuaro, Michoacán. México: GIRA A.C., 1997.

Masera, D., and R. Okangaa, Scrap Metal Recycling, a Product Development oriented study of the Informal Sector. Undugu Nairobi. Kenya, 1995.

Masera, D., and J. Sana, Product Development for the Informal Sector. Kenya: Undugu Society of Kenya, 1994.

Unknown, Produt Dvelopment Training Module. Kenya: ILO, 1992.

Putz, F. E. Approaches to Sustainable Forest Management. Indonesia: International Forestry Research (CIFOR). 1994, 7pp.

Redclift, M. Sustainable Development: Exploring the Contradictions. London: Routledge, 1987.

Roy, R., Proposal For an Educational Module on Sustainable Product Development. Holland: United Nations Environment Programme Working Group on Sustainable Product Development, 1997.

Upton, Ch., and St. Bass, The Forest Certification Handbook. UK: St. Lucie Press, 1996

van Gelder, B., and O'Keefe P., The New Forester. London, UK: IT Publications, 1995.

Launch of the 'Smart', environmentally considered city car

The fuel-efficient 'Smart' car from German car maker Daimler-Benz was launched in October 1998 with a prominent message of environmental protection and resource conservation.

The Smart's life cycle phases incorporate strict environmental concerns from development and production through to use and recycling. Daimler-Benz are ISO 14001 accredited and thus all activities are supported by an environmental management system. A 100% powder paint coating system is being used for the first time which emits no solvents, uses no lead or cadmium and creates no hazardous waste such as paint slurry.

Visible exterior and interior areas and even some highly stressed parts contain a high percentage of recycled materials. Recyclability is encouraged by using single-material systems (coloured thermoplastic) and by standardising joining elements. Finally, the modular construction means that the Smart car can be dismantled at low cost and its parts can be recycled.

All green for orange – the Flymo experience

Flymo/Partner – Europe's largest lawnmower manufacturer recently celebrated its ISO14001 accreditation. A priority for Flymo is to develop products with lower weight and materials usage, lower operating noise, and, with an increased product and packaging recyclability.

In the manufacturing process, Flymo reports significant improvements following the implementation of environmental management systems. Particularly significant has been the minimisation of waste through the segregation and recycling of waste materials. Overall, process waste has been reduced from 3.7% in 1996 to 2.6% last year. Waste to landfill is down from 51% in 1996 to 36% in 1997 and the percentage of waste recycled is up from 47% in 1996 to 62% in 1997. Solvents have also been eliminated from the production process. Packaging has been another area of environmental improvement with 80% now using recycled cardboard.

left: Venturer 320 lawnmower, efficient in its use of materials and with an operating noise of only 77db

Plastic bottle cap to office chair

HAG has produced one of the world's first office chairs made from recycled plastic (polypropylene). Through the Norwegian bottle return system, used bottle caps separated from returned bottles are collected, ground up and converted into new plastic raw material. This is then sent to Dynoplast, HAG's business partner, to produce the seat and back shells for HAG's new 'Scio' chair. It is estimated that 100 tonnes of plastic bottle caps are used every year by this project.

Cyclic, solar, safe – BioDesign's solution requirements for sustainability

Edwin Datschefski

Founder, BioThinking International, UK

Edwin Datschefski is the founder of BioThinking International, a non-profit organisation that uses biological principles to develop new thinking for industry, management, government and education. After studying Biology at Bristol University, he spent five years working on business and environmental protection issues for The Environment Council, and five years as a consultant for blue chip corporations, central and local government. Since 1994, Edwin has trained over 4000 people.

Most environmental problems are caused by the unintentional side-effects of the manufacture, use and disposal of products. Improvements achieved via eco-efficiency is a good start, but by itself is not enough. Only by mimicking natural systems can we create an industrial system that is truly viable and sustainable. Tomorrow's bio-designed products will match or exceed the look and performance of today's products and will be cyclic, solar and safe.

Introduction

There are two main materials flows on this planet, both driven by collections of free agents. The first is made up of DNA (deoxyribonucleic acid) organisms, which has been operating for 3.85 billion years and is 'sustainable' by anyone's definition. The second is comprised of companies that compete for energy and materials flows in much the same way, and which has been operating for only 250 years. The 'biothinking' approach is to regard the global industrial system as another life form – one which has an extra metabolic boost in the form of fossil and nuclear power, and which ecologists might characterise as 'nucleo-fossilivore' driven, as opposed to photovore (plant) driven. Mankind relies on both flows for its continued prosperity.

The tree is an excellent model for a sustainable materials processing system. Its inputs and outputs are part of entirely closed-loop cycles, it's solar powered and produces no persistent toxins.

Industrial systems are deficient in those cyclic, solar and safe characteristics. One implication is that resources will eventually run out, and although the time horizon on this, typically 250 years by most estimates, is longer than current planning cycles, it does mean that this industrial model is already halfway dead. More importantly, the toxic by-products of mineral resource flows are affecting natural habitats and reducing the value of renewable material and genetic resources.

To use a timely metaphor – the global operating system is giving

us lots of error messages because our software is not compatible.

Only 0.001%

Only about 0.001% of industrial products and services on the market today could be described as having good environmental performance or being 'bio-compatible'. A relative handful of firms have already come up with eco-product innovations – and there are may be 1000 truly bio-compatible products on the market – out of an estimated 100 million products on sale worldwide. Pressure for change is coming from legislators, customers and campaign groups, but somewhere down the line somebody has to come up with better products, services and processes – the role of product and business concept design is crucial.

Efficiency in energy and materials use is a blind alley

Being eco-efficient has clear cost benefits, primarily because a firm can sell the same chunk of material to more people. Environmental benefits also accrue in theory because there is a reduction in upstream production impacts. But in the end eco-efficiency does not deliver sustainability. There are limits to efficiency gains, limits which are both practical and thermo-dynamic, and further improvement becomes harder and more expensive per kg or kWh saved. Reducing emissions does not make environmental problems disappear, and because of threshold effects, may not alleviate environmental problems at all – for example, dumping less pollution into a river can still kill all the fish...

Environmental Management Systems (EMSs) such as ISO14001 offer a framework to drive progress. But many firms have not been sufficiently rigorous in identifying their environmental aspects, and so their system simply manages a smaller subset of the real problems. EMSs don't do much to foster innovation, are not suited to smaller firms, and can tie up staff time in setting up systems and monitoring and reporting progress, rather than developing and using new solutions.

The idea behind 'Factor X' is laudable, but ecological theory shows us that ecosystems, whether industrial or DNA based, strive to maximise throughput of energy and materials. While each product or species may develop through competition to become very efficient in their use of energy and materials, the number of individuals will increase, as will the number of species, giving the whole system the same, or more likely an increased, level of total energy and material throughput.

The 'biothinking' approach says: *When activity equals damage, don't try to reduce environmental impact by trying to reduce the amount of activity – change the activities so that they are biocompatible and cause no damage.*

The 'biothinking' approach says: when activity equals damage, don't try to reduce environmental impact by trying to reduce the amount of activity – change the activities so that they are biocompatible and cause no damage.

Because it has been assumed that all industrial products must cause some environmental damage, the focus has been simply on reducing throughput as a proxy for reducing impacts, instead of working towards bio-compatibility.

Now there is a shift towards breaking down industrial products into two categories:

· those which are biocompatible
· those which are not.

BioDesign for industrial systems

How can we set about a re-design of the highly complex industrial system in a practical way? The idea that man-made systems and natural ones can be made compatible is not new. Hardin Tibbs defined the goal of industrial ecology to be *'to model the systemic design of industry on the systemic design of the natural system... to improve efficiency of industry and find more acceptable ways of interfacing it with nature'*.

What 'biothinking' offers is a simple framework:

· cyclic
· solar
· safe

which will guide product development towards the essentials of sustainability.

Cyclic

The cyclic requirement means that materials are either recycled in a 'closed loop' or are edible or compostable. There is no option for landfill or incineration. Minerals are cycled in a continuous 'closed loop', with the emphasis on re-use rather than reprocessing. Leasing, rather than selling, products containing such materials eliminates the concept of waste – customers may use them as long as they wish, but when the end-user is finished with their TV, carpet or washing machine, it goes back to the factory for remanufacture. Materials that are grown should be processed in a way that allows their eventual digestion by animals, plants or micro-organisms when they reach their programmed 'end of life'. Products that have combinations of these two types of material must include a system for disassembly by the end-user or on takeback.

Examples of fully cyclic products include returnable glass or polycarbonate drink containers, Interface's 'Evergreen' carpet leasing product, and 'film with lens' cameras. Using recycled materials in manufacture is a step towards full cyclicity, and some firms, such as IBM's keyboard division, have adopted 'closed loop' recycling for elements of their products. German chocolate maker Loser makes use of a handy consumer bio-digestion system – the trays in its boxes are made of edible wafer.

Financially, product takeback means that manufacturers can sell the same thing twice – something that current laws tend not to encourage, and which refurbishers such as Xerox, Dell and ICL are having to work on – their refurbished products are technically the same standard as new ones, but in some countries the law regards them as second-hand.

Re-use and recycling are not always strictly cyclic, especially for organic materials. For example, in December 1998, some over-enterprising florists in Newcastle, UK, were caught taking flowers from graves, and then selling them again. A laudable example of product takeback, but it earned them a nine month prison sentence. It was also more about materials life extension than being truly cyclic. If they mulched down the flowers when they finally died and put them as compost of the next crop of daffodils, then that would have been cyclic.

The rise in takeback will benefit firms involved in reverse logistics – whoever will be the new 'Fedex of Waste and Takeback' will double their business!

Solar

The solar requirement means that all materials flow and energy use is powered by photosynthesis, muscle or renewable energy. This covers products with mounted photovoltaic (PV) solar cells, or those hooked up to a mains supply powered by wind, wave, biomass, or PV, through to products that are grown or operated by hand. This also applies to 'embodied energy' – the energy used to provide or service or to manufacture and distribute a product.

PV cells are being produced for power stations in unprecedented numbers, and prices per installed Watt are tumbling. A PV-powered PV factory has been designed, known as a 'solar breeder'. Cells built into

BioDesign: ten tips to be cyclic, solar and safe

Almost all environmental innovation so far has been in one or two of the Cyclic, Solar, Safe, and Efficient categories. The next step is to achieve high levels in all four parameters at the same time. Here are some tips for design inspired by nature:

1 **Get microbes to do the work** such as digestion by bacteria for compost toilets, bioremediation clean-up of toxic waste, and cardboard coffins. Or use higher animals, such as eel farms making use of warm waste water, and edible packaging.

2 **'Gene' recombination** is the key to nature's innovation. Recombine existing, proven approaches instead of pioneering substantially newer technologies. Evolution always takes what is to hand and then builds the unexpected from reliable parts fitted together in new ways. The same is true of business innovations. Of over 1.5 million patents analysed in Genrikh Altshuller's TRIZ study, over 90% were found to be variations on solutions already in existence, often from within the same industry. An example – use biogas to power a fuel cell.

3 **Revive and recolonise** – sometimes a locally extinct species or product may reappear if conditions are right, like otters on the Thames in the UK, cargo sailing ships, native herbal remedies and the Jurassic Park dinosaurs. Look through the amber of history for potential new product DNA.

4 **Mimic nature's materials** with their elegant solutions to structural problems. Spider's webs, feathers, mother of pearl, deer antlers and butterfly wings are just a few examples that have inspired recent innovations.

5 **Exquisitely fine control** is found in the metabolism of living systems, something which maximises the use of materials. Make systems respond on demand (like the Ecoflush toilet with a dial for High, Medium and Low settings), use senses and feedback loops (like thermostats and presence sensors), and make use of everything (like Chinese cookery or the printworks which makes birdboxes out of pallets that are beyond repair). The solar-powered fan in the sun roof of a parked Audi automatically matches demand – as the hotter the day, the more cooling is needed and the faster the fan rotates.

6 **Generalists are more adaptable** than specialists, especially in times of change. Think of crows, foxes, and coyotes adapting to city life. Multifunctionality also ensures maximum utility, rather than having a specialist tool which is used once a year, for example. PC/TVs and fax/scan/printer/copiers are other examples.

7 **Think ahead a long time**. In south-west England, landowners sometimes plant a stand of willow trees when a daughter is born, to pay for her wedding – when the willows are harvested and they are made into cricket bats. All products are disposable in the end, so plan for takeback even if it'll happen in 20 or 50 years. Alternatively, try to be immortal, like the 800 year old Japanese temple which is still regarded as totally original even though every bit of the building's fabric has been replaced over the centuries, or like Porsche and Rolls Royce cars, almost all of which are still on the road.

8 **Muscle power** is a form of solar energy, which is used in the Brox human power vehicle, Eco-Drive quartz watches and which can be stored with clockworks, compressed air or flywheels.

9 **Photon power** is the secret to life on Earth. Photosynthesis can be a key energy provider via biofuels and biomass, and plants are being used for a wide variety of industrial purposes such as oils, fibres and plastics – for example soya crayons, Unpetroleum Jelly, Citrasolv degreaser, Earth Shell packaging, and cornstarch pens. Photovoltaics (PV) are particularly useful for local and mobile applications.

10 **Seasonal variations** are inevitable, so work with them. Natural systems are tolerant of flux and have strategies for feast and famine, winter and summer, and so should new products. PCs now hibernate when not in use. Grass roofs insulate in winter and the plants' transpiration cools in summer.

A 1998 study by Cornell University in the US… estimates that 40% of deaths worldwide are caused by environmental pollution such as air pollution and water contamination.

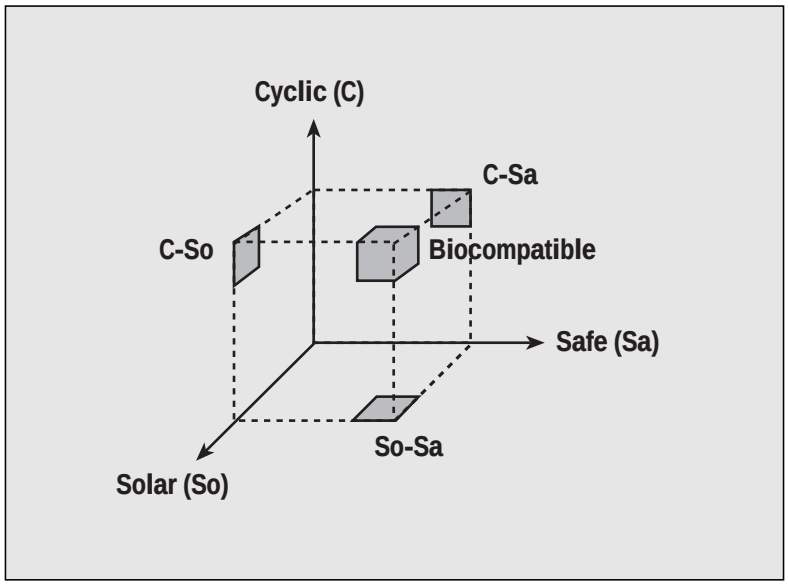


Figure 1: The BioDesign solution space

appliances have also appeared on calculators, robot lawnmowers, radios, watches, refrigerated lorries, mobile phones, boats, bikes, cars, smoke alarms, hearing aids, cameras and even cappuccino makers. Human-powered technologies are also enjoying a renaissance with the clockwork radio and 'kinetic' quartz watches.

The business implications of renewables are long term but profound – it's basically energy for free.

Safe

'Don't kill your customers' seems like a sound maxim. But the European Environment Agency (EEA) reports that for 75% of the 2–3,000 large volume chemicals on the market there is insufficient toxicity data publicly available for the most basic risk assessment under Organisation of Economic Cooperation and Development (OECD) guidelines. Testing products in use, their breakdown products and relevant mixtures would be very costly – testing just one substance costs £3 million. The implication is that some or many of these untested compounds are toxic, and of particular concern are those compounds which are persistent and bioaccumulative. A 1998 study by Cornell University in the US – to be taken with a 'pinch of salt' but placed here for context – estimates that 40% of deaths worldwide are caused by environmental pollution such as air pollution and water contamination.

To be safe a product or process has to be free from toxic releases at all stages. So what is meant by 'safe'? The legal definition of 'special waste' in the UK is defined in the Control of Pollution Act (1974) Special Waste Regulations (1980) as 'materials which, if a 45 cubic centimetre sample was ingested

by a child of up to 20kg in weight, it is likely to cause death or serious tissue damage'. In vernacular terms, 'safe' means that a person should be able to eat a handful or drink a glass of it. It also implies that a factory's water inlet should be downstream of its waste pipe.

There is a mistaken assumption that to be effective, a 'nasty chemical' is necessary. In a now-famous example, Rohner Textil commissioned an analysis of 8,000 chemicals used in fabric manufacture, and found only 38 that were completely free of any concerns about being mutagenic, teratogenic, causing birth defects, genetic mutations, or cancer. Fortunately, they could get all the colours and meet all the performance criteria such as fire retardance and strength with fabric made using just these 38 compounds. The other superior aspect is that the effluent coming out of the plant met Swiss drinking water standards, causing pollution inspectors to think their equipment was broken. Needless to say, the absence of compliance requirements and pollution abatement equipment meant useful cost savings.

Sustainability indicators

If all an organisation's activities are 100% cyclic, solar and safe, across the full lifecycle of all materials used, then that organisation would be sustainable. This means that we can score any organisation or product according to:

- % cyclic – % of total materials that are continuously cycled
- % solar – % of total energy and embodied energy that is from renewable sources
- % safe – % of lifetime releases that are non-toxic.

It is then possible to average these scores to give a single number sustainability index.

The BioDesign solution space can be imagined as being an xyz 3D graph with the axes being cyclic, solar and safe (see Figure 1).

Some solutions are Cyclic and Solar, some are Solar and Safe, some are Cyclic and Safe, and the furthest corner of the volume is Biocompatible.

Business benefits of BioDesign

There are five key business benefits for firms which adopt cyclic, solar and safe processes:

- avoidance of non-compliance and liability and related costs
- higher labour intensity and upsizing
- more value from a given mass of raw materials
- superior product performance and consumer acceptability
- early colonisation of new product and service areas.

Conclusion – a biocompatible future

Meeting one or two of the 'biothinking' requirements represents a major step forward for any product. But to be a true component of a sustainable industrial ecosystem, all aspects of the product's life must meet all three requirements. For example, Rohner Textil's fabric is fully biodegradable, but will it actually get separated from the chairs (which are made by another firm) at the end of their life and properly composted? Are renewables used to power all the factories in the chain?

Craft products and organic smallholdings, locally sold, are among the tiny handful of today's products that meet all three requirements. Yet we are on the cusp of seeing many more. Several of the examples above would qualify if their local utility company was hydroelectric or other renewable, or if they could contract with a specialist renewables-only supply firm where the local market is deregulated.

An entirely biocompatible industrial system would look very similar to that of today. Biomaterials are showing enormous promise. The 'carbohydrate economy' is already starting to displace unsustainable incumbents with fuels, drugs and plastics that are grown from seed. For example, cars would run on fuel cells powered by biogas, or solar-generated hydrogen. Trains would look identical, but be run with renewable electricity, and their interiors would be built from plant fibres (a luggage rack is being piloted in Denmark already), the seating fabrics would be organic and safely dyed, and the metals would be part of an ongoing 'closed loop' reprocessing system. Food would be grown using manure and sewage cycling systems, and would have no persistent or accumulative

chemical applications or artificial fertilisers.

Once the whole of the industrial system is biocompatible, something which may happen by 2100, then energy or materials saving will become redundant as a method for reducing environmental impact – a good thing, as energy saving is fundamentally unnatural. Any ecosystem will tend to maximise its use of energy and throughput of materials – an ecological effect known as 'maximum power'. The constraints on energy and materials will simply be the ability to pay for them – in other words, classic supply and demand or ecological competition. For a crowded world, it may well be that many products and processes will be more efficient than today – but efficiency by itself will not be the main route to environmental improvement.

There will still be important environmental concerns about the maintenance of biodiversity, and choices about allocation of land and water, and access to light, but the fundamental problems of our current unsustainability – toxics, fossil fuels and linear resource flows – will have been solved. •

The Environmental Innovator's Resource provides a free on-line course and over 100 product examples at: http://www.biothinking.com

Cyclic

- Plastic bags, wellington boots, video cassettes, computer keyboard casings, letter trays, plant pots, and benches are among many products made from recycled plastics.
- BioComposite fibre boards are made from waste cartons (Tectan by Tetrapak, as used in some Sony speaker cabinets), or soy flour and recycled newsprint (Phenix Biocomposites), which can be milled, sawed, drilled and nailed and is harder than oak.
- Compost is made from old German banknotes.
- Refurbished equipment such photocopiers (Xerox), car engines and computers (Dell, Compaq and ICL) makes use of old machines, saving them from the landfill and reducing manufacturing costs – while still achieving desired product quality.
- Erasers are made from recycled car tyres by Tombow in Japan.
- Recycled polyethylene (PET) from old fizzy drinks bottles is recycled into a fibre for carpets and clothes.
- Leasing of carpets and office chairs allows them to be returned to the supplier for remanufacture, creating a closed loop.
- Toner cartridges are now routinely remanufactured and refilled, albeit in relatively small numbers at present.
- AT&T's Definity Telephone is designed for disassembly and recycling at the 'end of life'.
- Companies are 'closing the loop' by taking their products back at the end of (their) useful lifespan and using them to create valuable new products. For example, GE Plastics in Pittsfield, US, has created durable, lightweight Lexan milk bottles that can be sterilized and reused up to 100 times, then melted and used for other high-value products, so that the original polymers may still be in use 100 years from now.
- Interface no longer sells its carpets, which are used in heavily-trafficked areas such as hotels, airports and offices. Instead, under its EverGreen lease, the carpet squares are rotated frequently for even use, and, when worn out, returned to the company, which someday hopes to depolymerise the carpets and use them as the raw materials for new ones.
- Retailers are increasingly adopting Reusable Secondary Packaging in the form of stackable plastic containers. Firms such as Boots and Marks & Spencer (M&S) use these to transport goods from the depots to stores, sending back empty containers on the same vehicle. This saves considerable amounts of cardboard, and the constainers last for many trips.
- Pallet pricing is a technique used to ensure that pallets are returned for re-use – otherwise the customer loses the deposit money (of about $20 per pallet). However, some 'clever people' have noticed disparities in the amount charged per pallet – and played the resulting system, by developing profits of up to $10 per pallet net!

Solar

- Solar calculators, lawnmowers, radios, watches, refrigerated lorries, mobile phones, boats, bikes, cars, smoke alarms, hearing aids, cameras and even cappuccino makers are all examples of current uses of photovoltaic (PV) technology. Over their lifetime, these devices are typically replacing battery-powered versions which would otherwise consume ten or twenty times their own weight in disposable batteries, or perhaps twice their own weight in rechargables.
- Bio-fuels are made from fermented sugar alcohols or oils from crops such as rapeseed. While they give off carbon dioxide (CO_2) when burnt, this CO_2 is part of the current carbon cycle, not adding to it as fossil fuels do.
- Straw bale construction methods result in huge savings in embodied energy.
- Solar PV wall cladding is cheaper than polished granite or marble.
- Seiko's Kinetic Watch and Citizen's Ecodrive range provide quartz accuracy without batteries by converting body movement into electricity.
- Electric vehicles, both battery and fuel cell driven are included here because their power will eventually all be provided by non-fossil and non-nuclear sources. In Japan, Toyota has sold more than 10,000 of its hybrid-electric 51mpg 'Prius' cars in Japan in the first 6 months since its launch in December 1997.
- Folding bicycles by Brompton, Bernd, Moulton and Birdy allow cyclists to take their bikes on trains and keep them inside offices, removing two of the major barriers to urban cycling.

Safe

- Greenfreeze fridges have no chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) or hydrofluorocarbons (HFCs), but use a propane/ butane mix instead, resulting in zero ozone (O_3) depletion potential and about a hundred times less global warming potential.
- Solvent Free Paint, especially gloss paint, produces no emissions on drying, reducing impacts on health of painters and occupants, and reducing smog-forming volatile organic compound (VOC) releases.
- CARE refrigerants for air conditioning systems are also free of CFCs, HCFCs and HFCs.
- Correction fluids are now almost all lower solvent or water based.
- Soy ink, waterless printing, and laser film are the current current best practice techniques in printing.
- Cockroach removal using the Zap-Trap, a non-poisonous insect trap designed by British entomologists uses an exclusive non-poisonous pheromone lure to bring the cockroaches to a safe electrified trap and sticky glue tray.

Efficiency: materials and energy

- British Telecom's Residential Phone Book now has 4 columns of text on each page, not 3, due to a layout change and a typeface specially designed to be legible at smaller sizes.
- Concentrated washing powders save up to 40% of packaging and transport impacts
- Volkswagen's Ecomatic model of their popular Golf model has an engine which cuts out going downhill! Instantly started again with a tap on the accelerator, this car has revealed that the engine typically can be switched off 30% of the time.
- Toner-only laser printers such as those made by Kyocera and OKi have a long-life drum, unlike most other types of printer, where both the drum and toner are replaced each time.
- Packaging has seen many 'lightweighting' innovations, for example: J Sainsbury's garlic bread dispensed with the cardboard outer, and now only has a plastic sleeve, saving 80% of packaging. Duracell's battery packaging is now cardboard-only, making it recyclable. It is also tamper proof, something which had previously only been achieved by using a polyvinyl chloride (PVC) blister pack. Marks & Spencer (M&S) mince pies are sold in a corrugated, rimless foil cup which is 10% lighter than the conventional rimmed type.
- Laptop computers use 90% less energy, and use 90% less casing materials, although the chipsets inside are about the same as desktop machines and so have similar impacts – the manufacture of a single pentium chip produces about 20kg of CO_2, 300 litres of waste water and 90g of hazardous waste.
- Thinner copier paper that is 75gsm instead of the typical 80, 90 or even 100 grammes per square metre means instant savings as the environmental impact of paper manufacture is directly proportional to the mass of paper made. Using less paper by weight (rather than by number of sheets) can make more of a difference to the environment than worrying about the differences between Elemental Chlorine Free (ECF) and Totally Chlorine Free (TCF), for example.
- Waterless urinals save 40% of office water use – they are cost-effective and don't smell! Currently in use at the UK Environment Agency's own offices, as well as tabloid newspaper The Sun and many other sites.
- Presence sensors for escalators (in the Vienna Metro), flushes, and lighting allow energy and water to be matched exactly with demand.
- Bagless vacuum cleaners such as the Dyson save a bag each time, and new models are available which are made from recycled plastic and remanufactured parts.
- Energy saver tyres eg. by Michelin save 5% by reducing rolling resistance. Window envelopes that can be resealed and sent back with payment are increasingly popular with energy and water companies, saving an envelope with each bill – probably saving 200 tonnes of paper a year in the UK alone.
- Inflatable furniture such as IKEA a.i.r. means an armchair weighs 95% less than a conventional armchair, a massive saving on materials. Previous inflatable chairs and sofas used PVC, but these new designs use an olefin plastic which improves on leak performance and has an attractive texture as well.
- A 'bag for life' is being tried by supermarkets such as Waitrose in order to try and reduce the amount of disposable plastic shopping bags used. The customer purchases an especially sturdy plastic bag for 10p (15 cents) and uses this for shopping, and if it wears out, the bag is replaced for free.
- 'Quality' products in general, from Barbour jackets to Swiss watches, cost more but last longer – however, they also tend to be more solidly built than their cheaper alternatives, so the mass: lifetime ratio may not always be more favourable.
- Multifunction equipment can mean considerable savings in manufacturing impacts, the increasingly popular fax/scanner/copier/printer combination being a good example.

Customers – the forgotten stakeholders

Emma Prentis and Hedda Bird

Director and Managing Director Conservation Communications, UK

Emma Prentis is a Director of Conservation Communications. She was previously European Environmental Manager with in Nortel's corporate environment and sustainability function with responsibility for developing strategy and programmes to support Nortel's marketing aned strategic business planning functions. Prior to joining Nortel, Ms Prentis worked with BT for seven years. She has a Masters in Environment Science and is a Director of the UK Institute of Environmental Management (IEM).

Hedda Bird joined Conservation Communications in 1986 and was appointed Managing Director in 1988. She has developed the company from a specialist promotor of recycled paper products to a leading environmental communications and research consultancy. Ms Bird has an MSc in Mathematics and Philosphy from London University and recently obtained an MBA from Warwick University in the UK.

The paper suggests that consideration of customers is usually excluded from strategic environmental thinking. However, customers hold the key to the environment team's strategic 'added value' as they drive the business. The authors give practical advice on how to 'green' marketing, using an example of work completed with Nortel.

Introduction

Environmental activity in organisations must demonstrate market (ie. customer) value if they are to deliver the genuine, fundamental change in business behaviour that is required by the concepts of 'Business Sustainability' and the 'triple bottom line'. The need to clearly identify market value from environmental activities is well understood; however, it is often regarded as being too difficult or just plain impossible. Indeed the ability to make a bottom-line case for strategic environmentalism is fast becoming the Holy Grail of the environmental business movement.

A variety of methods are currently used to show the financial benefits of improved environmental performance; these include:

- supply chain management
- operational cost avoidance and cost savings
- continuous improvement and quality management
- stakeholder dialogue
- 'Design for Environment' (DfE).

All of these are valid activities that can deliver environmental and financial business benefit. However the authors of the paper argue that while benefits, can and do, accrue from these actions the business value of these activities are rarely strong enough on their own to influence strategic business thinking and direction. For example, cost savings rarely transform overall company results. Indeed corporate strategy makers regard continuous cost improvement as part of operational performance indicators. A Board of Directors will not cost reduce itself into a new strategic direction! Thus if 'Environment' is about cost cutting, it will not be presumed to have anything to add to strategy development.

Similarly stakeholder dialogues by many organisations do not include customers in the

process! Even though it is clearly their customers requirements and products and services
that are central to the focus of business strategists. Without 'Customers', the findings of stakeholder dialogues, no matter how interesting, are of minimal strategic focus to the rest of the organisation. As the quote from a Tomorrow Magazine article (Frankel, 1998) on city analysts stated, a key strategy is to:

'increase demand-side pressure. When the world markets start to demanding environmentally superior performance, the investment community will take notice'.

Customers – the value strategy

The authors contend that while the strategies mentioned in the introduction 'add value' to the business through cost reduction and enhanced corporate image, in terms of core business activity the value is marginal. However add to these activities a strong customer, market focus and environment teams will be in a position of power.

Customer focus – environment blind spot

Environment teams are used to going to every stakeholder group to seek support except customers. Indeed, not all environment teams even identify customers as relevant stakeholders in consultation processes. For example in 'Bulldozing the Green Wall' stakeholders are identified as 'local community members, the media, financial markets, investors and employees'. Not a customer in sight! The arguments for not including customers are usually – customers don't understand the issues, customers cannot be expected to know our business, its too technical, customers are only interested in price and always – they don't care. The authors' experience is that such an attitude will not enable the environment team to be a success in influencing the business.

Some of the reasons why reluctance to engage customers has developed are outlined below:

- early environmental pressure was focused on manufacturing organisations from NGOs and not directly from customers
- long distribution chains for goods and services place many organisations at a distance from their end user customers
- many direct customer contacts on environmental issues are perceived as negative ie. customer complaints or queries
- environmental teams may perceive talking to customers will only stir up more complaints, misunderstandings or expectations which cannot be fulfilled
- environmental people tend to be technical, scientific by training rather than communication, marketing focused
- sales and marketing people rarely move into environmental roles
- failure of 'green' products in the market place.

The question then is how can we overcome barriers such as these to become market focused?

Market analysis – the business case

The discussion so far has demonstrated that environment teams must be market and customer focused if they are to be of strategic importance to the business. Being market focused means establishing environment as a core value with product, procurement and marketing managers of your key customers. To achieve this, the authors recommend a combination of market analysis and direct customer contact (through carefully managed workshops/ focus groups).

The ultimate objective is to have your key customer's value and become engaged in the process of environmental improvement of your products and services. In order to get access to your customers to begin the process of engagement it is advisable to undertake an integrated environmental market analysis. This will provide a clear view of environmental market trends, risks and opportunities and provide knowledge on which customers to start with and how.

The market analysis should include at a minimum:

· customers
· competitors
· legislation

and in addition you could add:
· voluntary standards
· technical opportunities
· investors
· best practice.

The final list will be dependent upon the specific nature of your own organisation and its business objectives.

A key point is to analyse the environmental information with respect to the strategic direction of your business. Demonstrate where environmental excellence will contribute to achieving key business objectives and always use the same language as that used by the Businesses Units you are seeking to influence. A case will make this clear.

Case example: Nortel

Nortel has an excellent environmental reputation with its peers and in support of its policy to remain an 'environmental leader' has its corporate team working to ensure sustainable development becomes part of Nortel's business ethos. Nortel's environment team recognise that to achieve this they need to be customer and market focused, that is to say aligned with Nortel's key business strategies and objectives. In 1997 in order to support this focus Nortel's corporate environmental team began a comprehensive review of environmental market dynamics.

The objective of the market review was to demonstrate to business managers that environment can be a market force capable of influencing Nortel's product and services, that is to say Nortel's core business activity. The reality remains that for most managers 'environment' is not a significant market driver on a 'day to day' basis. However the combined review of environmental market dynamics in relation to Nortel's business strategy proved to them it could be, and, in a few small markets it might be already.

Nortel business managers were used to hearing about legislation. The competitor and customer data linked to the business objectives helped them to understand the context of how changing societal attitudes, regulatory trends and voluntary standards could have a genuine bearing on core business activity and even present competitive opportunities.

While techniques for market analysis are well documented and understood, traditional marketers and business planners do not have the skills to understand which environmental aspects they should be considering when reviewing market issues, nor do they know how to interpret the information gathered. This is the value that the environmental teams bring to their organisations. They can take the existing business tools and apply them appropriately to the environmental market issues and interpret them in ways the business is able to use to its advantage.

Techniques for engaging customers

Customer data is a crucial part of any market dynamics research. However, the process of first engaging customers needs to be carefully managed. If these initial contacts within the customer base are not carefully handled you are likely to find yourself back into the 'customers don't care' mode of operation.

An important point to remember is that you need to identify the 'right' customers ie. individuals within the customer organisation who have either influence or power over procurement decisions regarding your products and services. There are many surveys that point to the increasing trends in environmental and ethical consumerism; there are also numerous corporate environmental reports, which indicate customers are active on environmental issues. However the reality is general customer trends and reports are rarely enough to persuade business managers to make fundamental changes to their business strategy. It is necessary to be able to demonstrate that their key customer contacts (the decision-makers and influencers) are interested.

Nortel understood the need to work, not only with environmental counterparts, but also with the business managers in the customer base. It was also understood that in order to get to the business managers and to secure benefit from these meetings Nortel's own account

groups had to be part of the process. The question then was how?

Nortel's environment group presented a business case to relevant account teams using preliminary results from the market research including an analysis of all the environmental queries Nortel had received from customers over the last 3 years. This presentation was enough to encourage the selected account teams to agree to 'face to face' sessions with key customers.

Environmental customer workshops

Environment teams are accustomed to running educational workshops for employees on specific issues, to attending external workshops, to participating in stakeholder consultation and a wide range of dialogue type activity. This activity is an excellent methodology to apply to customer focused market research. The 'Customer Environment Workshop' has the following aims:

- it explores an environmental concept in some detail
- it establishes the environmental values of each participant
- it is an educational event for all participants
- the facilitator is usually an expert in environmental and relevant commercial issues
- experts from both commercial and environmental perspectives are present
- there is usually a section of informed input
- both customer and supplier are engaged in dialogue.

Those experienced in stakeholder dialogue processes will see immediately how this sort of a process enables all participants to move forward together. At the end of the process:

- the customers are much better informed about the issue in hand
- the supplier has a better grasp of likely market values that customers will put on environmental options
- there is (nearly always) recognition by the suppliers that the customers do care
- there is (nearly always) recognition by customers that the process has given them a much better understanding of the issues.

Within the supplier, marketing and account management teams involved in the process are much more likely to take up the environmental ideas discussed and build environmental thinking into their daily processes. environment teams then have a clear role as expert advisor to the marketing teams. The Environment teams themselves acquire a much greater understanding of the market dynamics within which their organisation operates.

The customers have usually provided substantial input to the supplier, but often perceive that they have gained even more for themselves in terms of enhanced understanding. A tremendous amount of goodwill is generated.

In the tradition of business speak, the customer environment workshop is a 'win-win-win' for the environment team, the sales and marketing team and the customers.

In the tradition of business speak, the customer environment workshop is a 'win-win-win' for the environment team, the sales and marketing team and the customers.

Nortel's experience of customer environmental workshops

The initial customer workshops undertaken by Nortel and managed by Conservation Communications included 100 key customer contacts; a mixture of product and marketing managers from customers throughout Europe, the Middle East and Africa and approximately 50 Nortel's Account Team members. Given these were the first Nortel had run, detailed follow-up was undertaken to determine how the customers valued the experience. The feedback was outstanding with 83% of participants giving the workshops a value rating of 4 and 5 out of 5 and 81% asking for regular environmental communication from Nortel on an ongoing basis. Remember these were hard nosed business managers, and yet with skillful planning and organisation Nortel's environmental team were able to demonstrate that real customers do care and value environmental issues from a business perspective.

The success of these first workshops has enabled the environment team to offer their services to other major account teams in Nortel, including North American Accounts. These key account groups are eager to undertake similar sessions as a precursor to development of structured environmental customer communication programmes.

Benefits of a market focus to Nortel's environmental progress

The results of the initial workshops were included in the final version of the environmental market drivers research which is being used to open doors to the most senior business people in the Nortel organisation. It is providing the team with an opportunity to present the environmental opportunities of product and service changes and operational improvements with what is starting to look like genuine customer and market support. As a result serious discussions at the heart of Nortel's business activities are now starting to consider how fundamental environmental product and service improvements can be achieved. It is still early days but the initial successes of a market-focused strategy are such that it is one Nortel's environmental team intends to keep.

Conclusion

To get to an environmentally sustainable business you need to influence core business strategy and process. To influence core business processes you must focus on where the business focuses ie. Customers and Markets. This is not to say operational improvements, cost reduction and DfE are not appropriate – but they need the customer and market focus to support and direct the business case for these important activities. Up until now much has been achieved in these areas – but the customer has been neglected. Now is the time for the environmental teams to bring the forgotten stakeholder back into the fold – because as Nortel is finding out customers really do care! •

This is a slightly edited version of a paper originally presented at 'Towards Sustainable Product Design' 3rd International Conference, 26–27 October 1998, DTI Conference Centre, London, UK

References

Frankel, Karl; Sept-October; If You're So Rich, Why Ain't Ya $mart, Tomorrow Magazine, 1998, pp50–51

Moxen & Strachan ; Bulldozing the Green Wall, in Managing Green Teams, Greenleaf Publishing; (1998) pp112–130

O2 Challenge

Martin Charter

Coordinator, The Centre for Sustainable Design, UK

The Journal of Sustainable Product Design has developed a partnership with the O2 Global Network to further disseminate information and ideas on eco-design and sustainable product design. O2 Global Network is an international network of ecological designers. The O2 Global Network is organised into national O2 groups which work together to provide various services such as: O2 Broadcasts, which report live from O2 events using email and the Worldwide Web (WWW); O2 Text meetings, a meeting place on the Web; the O2 WWW pages, which provides an overview of activities; O2 Gallery, an exhibition of eco-products on the Web; and, an O2 mailing list.

For further information on the above activities and the O2 Global Network contact: O2 Global Network
Tourslaan 39
5627 KW Eindhoven
The Netherlands
tel/fax: +31 40 2428 483

O2 Global Network new homepage: http://www.hrc.wmin.ac.uk/o2/
e-mail: o2global@knoware.nl
mailinglist: http://ma.hrc.wmin.ac.uk/lists.o2global.db

'O2 News' will update readers of the Journal on the latest eco-design issues from around the world and on O2's national activities.

'Design for Environment' research

The German ecological design agency Econcept, Cologne, and the Office for Ecological Studies, Tuebingen, are completing a research study about existing guides for 'Design for Environment' (DfE), which has been commissioned by the German Federal Environment office in Berlin. Researchers will collect and analyse the most important national and international guidelines, tools and instruments for environment-friendlier design as well as examples of sustainable design and the implementation of DfE in industry and SMEs. The objective of the project is to develop new instruments and combine existing guidelines and criteria for DfE, so that a helpful toolbox can be developed for ecologically-oriented engineers and designers that can be implemented in companies worldwide. Such a DfE toolbox will make it easier to communicate environmental requirements along the supply chain and throughout the whole life cycle of products. An internationally harmonised communication basis is very important for implementing DfE on a global scale. The results of the study will be introduced and discussed with experts in two workshops in 1999.

Contact: Ursula Tischner, Econcept
email: 101233.3324@compuserve.com

Bosch: recycled portable electronic tools

Scissors and torches made from plastic recycled from Bosch hand tool products have been produced by Bosch as promotional products for their clients and partners.

The approach

1993: Bosch tools were collected by German retailers and sent to a recycling centre.

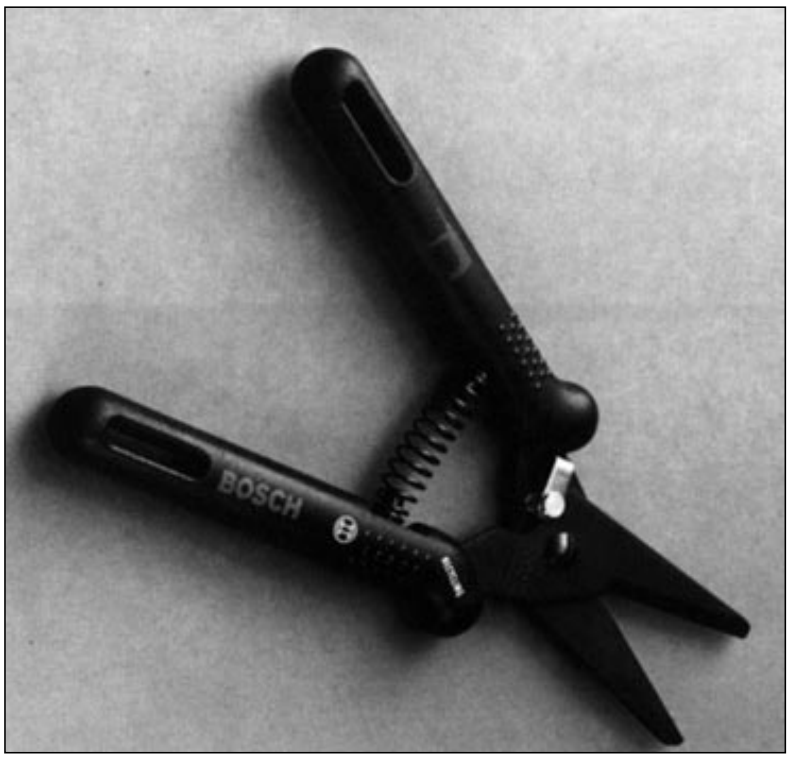
1996: A total of 412 tonnes of material were collected, 83% was recycled including 30 tonnes of plastic. 6.5 tonnes of plastic was used to make corporate gifts for Bosch and was presented in promotional catalogues.

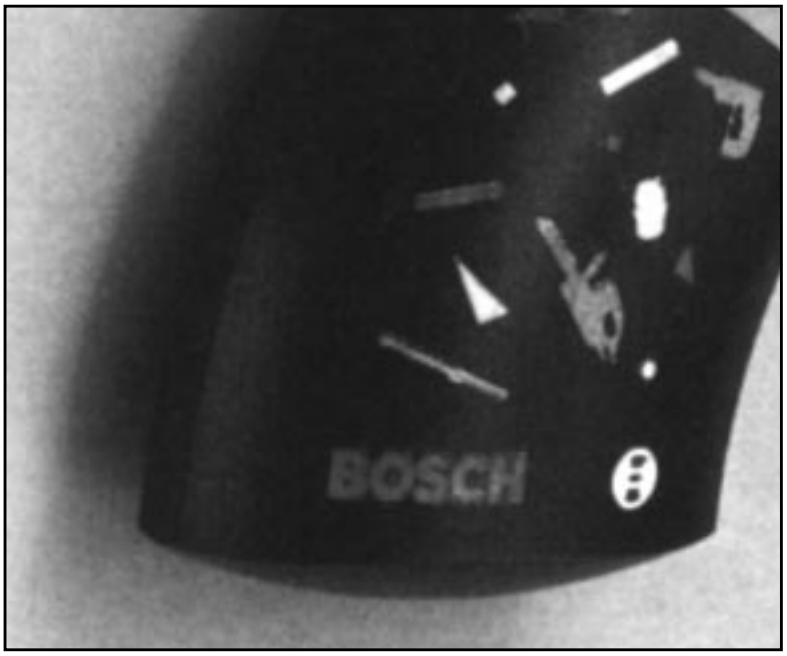
1998: Further products made from recycled material were launched: measuring tape, multi-bladed knife, alarm clock, Swiss watch, ball point pen, calculator, etc.

These ‘green’ product examples demonstrate the feasibility of recycling projects if they are managed creatively and efficiently.

Above: Bosch recharger unit

Below: Bosch secateurs





Above: Detail of Bosch recharger unit

Below: Detail of Bosch secateurs

The results

Environmental: the results for the environment are difficult to evaluate from this 'one off' experience. It is necessary to compare the recycling of these tools with their classical 'end of life' treatment (incineration followed by the recuperation of ferrous metals from the residues). In the absence of rigorous LCA, O2 France believes that the products have relatively low environmental impact.

Corporate: these 'green' product examples demonstrate the feasibility of recycling projects if they are managed creatively and efficiently. As a result of the process nearly nearly 100 products made of recycled material have been presented in a travelling exhibition throughout Europe.

The Habitat lamp

O2 France developed a lighting system for Habitat that incorporates a compact fluorescent light bulb that uses less energy – the CERunner. The lamp is suspended from a cable running between walls giving greater flexibility in 'use', therefore replacing the need for several fixed lamps. The 'system' includes all the accessories (cable, hooks, screw) to fix to the wall.

Contact: Thierry Kazazian, O2 France, o2france@wanadoo.fr

Habitat: energy-saving lighting system

The O2 Challenge Workshop on Sustainable Business Concepts, Van Nelle Factory, Rotterdam

Thomas Linders, the author of the workshop report, is a partner in the design agency Linders & Van Dorssen. He was one of the organisers of the 02 Event in 1993.

The second major international workshop organised by O2 Netherlands took place on 5, 6 and 7 November 1998 and followed on from the first workshop – the 'O2 Event' of 1993 – which centred around the theme of sustainable lifestyles.

Broad scope

The keynote speaker, Ezio Manzini of Poletecnico di Milano, Italy, stressed the opportunities of bringing about radical changes at a local scale, where ecological, social and cultural values will make a contribution to sustainable development. Trevor Baylis, the inventor of the clockwork radio, explained the difficulties of acceptance and achieving funding for his 'green' invention.

The event attracted 150 designers, architects and policymakers who spent two days brainstorming sustainable business concepts and then presenting and discussing their results. The participants were asked to imagine and describe attractive, progressive business activities that satisfied both commercial and sustainability criteria. In the Van Nelle Factory, Rotterdam, an auditorium, a party hall and several design studios were organised. The participants worked in fifteen separate project groups on a wide variety of issues. A few examples of the projects were 'Moving People', which was led by the Japanese designer Fumi Masuda, 'Ecosthetics', led by Jasper Morrison and Adriaan Beukers, and 'Immaterial Kicks', led by the sociologist Hans van der Loo.

Seeking

The first full day was one of discussion and seeking. Several groups had already found a theme by the Friday evening, but by Saturday, all the projects were ready for presentation in the design studios.

Despite the great diversity of people and designs, there proved to be several common themes. For example, there were several schemes to make more efficient use of existing resources. The 'Logic Logistics' group came up with 'Parasites', a business specialising in tracing wasted space in transportation and turning it to advantage. The business aims to 'parasitise' the many unused spaces in buildings.

Opportunities

The 'Online Forever' group devised a scheme using the Internet in which people would be able to place individual orders for goods, which would then be produced in the most eco-friendly place using the most eco-efficient means of production. Allowing the consumer to

Project leaders at the 'O2 Challenge'

assemble a customised product instead of offering only a fixed, ready-made product was an idea that occurred to several other groups too. It was also thought that better systems should be developed to recycle the product, or to lease or update it by replacing obsolete components. This would clearly create opportunities for countless service points, advisors (ie. sellers) and other enterprises.

The 'Small Business' group transformed the slogan 'you take care of your customers and we will take care of you' into an attractive new combination of existing services. Their 'Home Work Centre' aimed to provide teleworkers with such facilities as a creche, a laundry service and a shopping service.

Inspiring

Many of the nuances of the discussions and ideas were inevitably lost in the presentations. Still, an inspiring and diverse landscape of new small-scale and large-scale enterprise concepts emerged. A wide range of concepts was presented that aim to develop sustainable activities and services within existing structures, including several projects to take advantage of the present and likely future advantages in information technology.

This rootedness in the real world was one area in which ideas about sustainability have clearly advanced since 1993. It has also become clearer since the first O2 Event that people must be offered attractive sustainable alternatives alongside – rather than instead of – existing choices.

A new feature of the 'O2 Challenge' was the expert support available for participants to develop their plans further after the workshop, offered by the Kathalys and Syntens Institutes in the Netherlands. The ideas now exist, but writing convincing business plans is another challenge altogether. Several participants have already applied for this support.

New media

Another striking development at the 'O2 Challenge' was the ease with which both the groups and the organisers made use of the new media. 'Refuse Refuse' decided not to waste any materials on their presentation, and by Saturday they had created web pages to present ten enterprise ideas. The journalist Jules Marshall made use of the O2 Website to give outsiders a live report on the progress of the 'O2 Challenge'. The website, which is maintained by the Netherlands Design Institute, played an important role in prior publicity for the 'O2 Challenge'. Those interested in reading the 'O2 Challenge' reports are recommended to visit www.o2.org. •

Book

Ecodesign Navigator: a key resource in the drive towards environmentally efficient product deign

Matthew Simon, Stephen Evan, Tim McAloone, Andrew Sweatman, Tracy Bhamra and Steve Poole
Manchester Metropolitan University and Cranfield University, UK

ISBN-871315-743
£50.00
151 pages

The Ecodesign Navigator is the outcome of a three-year research project called DEEDS – Design for Environment Decision Support. The partners were Manchester Metropolitan University, Cranfield University, EPSRC, Electrolux, ICL. and ICER.

The project was grounded in the electronic and electrical industry and aimed to create methods of practical benefit to these industries in achieving increased environmental and product performance.

The core of the work, 85 out of 151 pages, lies in a very comprehensive survey of Eco Design tools: these range from Life Cycle Analysis (LCA) tools through to higher level strategic tools. This chapter is recommended to anyone wanting an up-to-date overview of the offerings in this field. The details of each product include brief pros and cons, price and contact details where appropriate.

The remaining materials generate less enthusiasm: the 'Navigator' attempts to serve too many different client groups, from complete novices in the field of eco-design to experienced managers; furthermore, it relies very heavily on a single strategy, the ARPI framework – Analyse, Report, Prioritise and Improve. This approach is similar to the well-known idea of continuous improvement – an iterative cycle of analysing the existing state of affairs, setting targets and making improvements. It is a comfortable, safe way of gaining steady small improvements. However, different approaches are necessary to bring about uncomfortable, revolutionary changes. There are those in the field of eco-design who feel that only the second, uncomfortable, approach offers the prospect of change fast enough to save the planet from unacceptable climatic perturbation.

The Ecodesign Navigator is at its weakest when it reaches out into descriptions of the ideas that lie at the core of environmental studies. Nowhere is this more misleading than the guide's treatment of sustainability. The authors appear not to be aware of the difference between 'sustainability' as crystallised in the Brundtland Report of 1987 and the more political agenda of sustainable development encapsulated in the Rio conference of 1992 and Agenda 21.

The statement of sustainability on page 1: 'In essence, sustainability is a simple notion: a product process or system is sustainable if it can continue forever. Therefore, something that consumes even a tiny amount of fossil fuel is not sustainable' is worryingly misleading, especially to the naïve reader for whom the guide seems to be written. Bio-diesel, bio-alcohol petrol and other renewable energy sources form a viable long-term solution to the provision of modest amounts of liquid fuel.

In Chapter 3, the product development process, the map we are offered begins with the idea of 'Need'. However, the text is heavily slanted to interpretation of 'Need' as our 'Need' for the next product. From an environmental perspective the product is the problem! The question should be, how do we identify and then satisfy the underlying human need without the intervention of a product: dematerialisation of products and services is the aim.

Finally, the addition of an index would make the guide more user-friendly.

As a comprehensive guide to both commercial and public domain eco-design tools currently available, the eco-design profiler is excellent; as an introductory guide to the issues in eco-design for a naïve reader, I do not recommend it. •

Professor Eric Billett is the Pro-Vice Chancellor at Brunel University and holds the Chair in Design.

References

Our Common Future, Brundtland Commission, 1987.

United Nations Conference on Environment and Development, Agenda 21, 1992. (The 'Earth Summit', Rio)

11 March 1999

Sustainable Lifestyles Conference
London, UK

✉ Fleur Rothwell
Global Action Plan
8 Fulwood Place
London
WC1V 6HG
UK
+44 (0) 171 405 5633
+44 (0) 171 831 6244
all@gapuk.demon.co.uk

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✉ Elaine White
ERP Environment
PO Box 75
Shipley
West Yorkshire
BD17 6EZ
UK
+44 (0) 1274 530408
+44 (0) 1274 530409
elaine@erpenv.demon.co.uk

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✉ Janene Kilson
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Conference@Rapra.Net

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✉ Cathy Johnson
Global Futures
801 Crocker Road
Sacromento
California 95864
USA
+1 916 486 5999
+1 916 486 5990
cathy@globalff.org

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✉ Mr Brymley Gibson
Events Manager
PO Box 259
Bromley
BR1 1ZR
UK
+44 (0) 181 289 8989
+44 (0) 181 289 8484
sustain@emml.co.uk

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✉ Conference Secretariat
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Copenhagen
Denmark
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✉ Conference Secretariat
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Washington DC 20036
USA
+1 202 429 8873
+1 202 429 2248
conf@aceee.org

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✉ Elaine White
ERP Environment
PO Box 75
Shipley
West Yorkshire
BD17 6EZ
UK
+44 (0) 1274 530408
+44 (0) 1274 530409
elaine@erpenv.demon.co.uk

12–13 July 1999

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✉ **Martin Charter/Russell White**
The Centre for Sustainable Design
Faculty of Design
The Surrey Institute of Art & Design
Falkner Road
Farnham
Surrey
GU9 7DS
UK
+44 (0) 1252 892772
+44 (0) 1252 892747
mcharter@surrart.ac.uk

14–17 November 1999

Sustainability: Ways of Knowing/Ways of Acting
North Carolina, USA

✉ Stuart Hart
1999 Greening of Industry Network
Conference Co-ordinator
c/o Monica Touesnard
Kenan-Flagler Business School
University of North Carolina
at Chapel Hill
Campus Box 3490
McColl Building, Chapel Hill
North Carolina 27599-3490
USA
+1 919 843 9731
+1 919 843 9667
greening99@unc.edu

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✉ Mr Gordon Landon
Town of Markham
Co–Chairman of R'2000
101 Town Centre Boulevard
Markham
Ontario
Canada
+1 905 479 7750
+1 905 479 7763
rmark@oak.net

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The Surrey Institute of Art & Design
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Surrey GU9 7DS
UK.

Email submissions should be sent to: mcharter@surrart.ac.uk.

A black and white photograph of the author(s) should be supplied.

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Author, A., and B. Author, 'Title of Journal Article: Subtitle', in Journal, Vol.x No. x (January 19xx), pp. xx–xx.

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