Where's eco-design going?

McAloone, Tim C.

Published in:
Proceedings of Electronics Goes Green 2000+ Conference

Publication date:
2000

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

Where's Eco-Design Going?

T. C. McAloone, Technical University Of Denmark, Denmark

Abstract

Thirteen years after the Bruntland Report, we have had time to read and digest and postulate about what is required to make the many small steps towards something which we call sustainability. In those years we have come great distances. We know how to systematically seek for solutions to environmental problems. We use the lessons learned from these systematic attempts to construct methods for preventing the problems from occurring in the first instance. Further to this, some environmental 'leaders' are beginning to make pro-active attempts at using the environmental credentials of their products as the corner-stones for their businesses.

When we consider finding solutions to discreet environmental problems, we now have many tools and techniques [1], and these issues are relatively easily addressed – at least we know where the problems lie. When we talk about learning from these problems and developing repeatable methods, we are making good progress in this area too – we have ideas about how to prioritise and organise our efforts. If we are to move to thinking about how to be pro-active with our efforts and design-in more to our products than just snap-fits and expect more back from our customer than just complaints, we should look to some different areas for guidance. We could look at the domain of quality, to learn about how to get closer to the customer and the product and the product's life-cycle. We could look at innovation theory, to see how to be clever about the things that we do to our products, and how we 'package' them as a complete need-fulfilment.

But how can we be sure that we're on the road to sustainability? Thirteen years later and we have theories such as Factor 4, Factor 10 and Factor 20 [2]. We have seen sustainability broken down into eco-centric and techno-centric, strong sustainability and weak sustainability [3]. Is it really possible to have these shades of green?

This paper puts together some experiences and ideas around the state-of-the-art in eco-design, from both literature and personal experience and hopes to ask where, perhaps, we should be heading.

1. What's happening?

The foreword of the proceedings to the EcoDesign '99 Conference in Tokyo begins *"The environment has now become a subject for us not to study, but to manage"* [4]. But is environmental management really the name of the game? Or do we as a research community have a different goal than simply *managing* environmental issues and ensuring that they fit into our current structures of product development and business planning?

There is a great need for us to be aware of what we are doing in our research and to understand which areas of product development our research is affecting, and which stones are still left unturned. It is the author's experience that many research contributions claim to be reporting on eco-design when they actually report on Design For Disassembly, and many claim to be reporting on sustainable design, when they are actually reporting on eco-redesign. The eco-design subject seems to have reached a plateau, where achievements beyond a collection of environmental DFX's and a good environmental management scheme seem to be difficult for the research community to perceive. It is the author's feeling that there are many practical examples of step-changes to product designs that address the environmental performance of the product head-on and use this target as a vehicle for innovative change. And then there are the incremental improvements. A recent study of the literature has shown that we lack a confrontation with step-change examples in design and the discussion about how we might methodically and realistically achieve them - in a business and economic sense.

In an empirical study [5] it was heard from industry that, *"eco-design is coming of age"*, *"things get green all on their own!"*, and *"we are now practising*

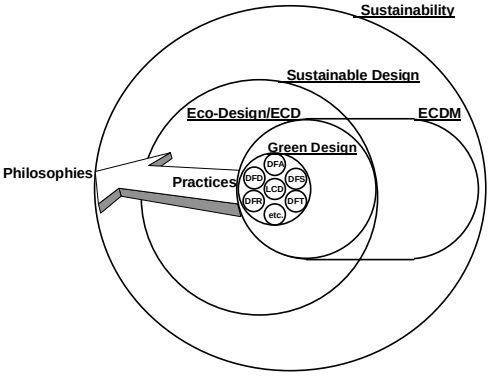
sustainable design". We seem to have reached a crossroads, where we have conveniently and conventionally built islands for our efforts. On one island sit the 'eco-technologists', working pragmatically and systematically on the technical issues that are making steps on a Kaizen-path towards continuous environmental harm-reduction. The neighbouring island, however, is populated with 'deep ecologists' – people who are trying to understand how we can go back to nature, understand the needs of the people, ensure the fair treatment of mankind, (thus the emergence of the picture of techno-centric and eco-centric sustainability [3]). Occasionally, 'lost souls' wander from one island to the next and maintain tentative links between the islands, but it is very often difficult for us to understand each others' language or culture.

This situation is both dangerous and ineffective; we need a bridge to permanently link the extremes in approaches to eco-design and to join our viewpoints of sustainability together again to a homogeneous goal. Now, of course, we are starting to talk about mindset. We should be able to identify the ideal 'eco-mindset' and the knowledge, skills and attitudes that are contained in such. Without getting into the realms of education (which is perhaps the most crucial opportunity to seed such an eco-mindset in the minds of up-coming designers/engineers/scientists) great steps can be made by imagining the individual as the focus and the receiver of our tools, techniques and theories.

Again, we can look for inspiration in creating a mindset. By visiting a student exhibition in any industrial design school, we see very strong identity and understanding of the subject in the way that their final products fulfil the initial design briefs. By studying high quality products we can learn how a quality mindset has been applied by engineers to ensure that 6-sigma is achieved and the product is both reliable and enjoyable. Our task is to identify the environmental mindset – or what should we call it?

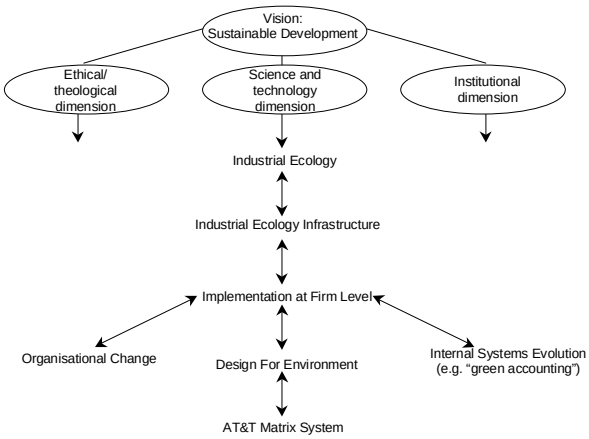
2. What *should* we call it?

Various attempts have been made to identify where we are and what the various terms and references are in our domain. The *eco2* group define a framework for environmental research efforts [6].



This definition differentiates between the single-issue 'DFX' efforts and much wider reaching terms, not least 'sustainability'. The original intention with the model was to give clarity and a common language for the *eco2* group when discussing various research efforts, but it quickly began to be used as a representation of an understanding of various shades of green.

Allenby [7] takes a different view of what sustainability means to his company (AT&T) in his conceptual framework:



…where industrial ecology and Design For Environment are defined as being:

- **industrial ecology** – the objective and multi-disciplinary study of industrial and economic systems and their linkages with fundamental natural systems;
- **design for environment** – one means of implementing the principles of industrial ecology in today's world, with the aim of designing products towards a more service oriented ends.

Industrial ecology is also termed here as being the 'science and engineering of sustainability', which

operates on a level between the individual's eco-design efforts and the high-level, philosophical vision of sustainable development, as Allenby's figure suggests.

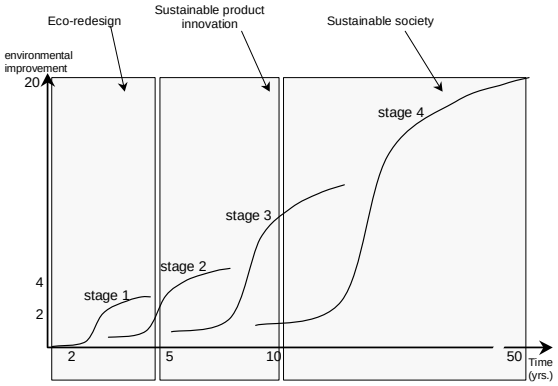
In this framework industrial ecology is used as a way in which to organise the various DFE activities (at individual level) into a company approach to eco-design. This approach is taken in recognition of the fact that not every DFE activity should attempt to tie itself directly to sustainable development.

However, we have a long way to go before we understand what sustainability is, let alone how to activate or realise it. The furthest we can presently go on a company level is to ensure that the company has integrated the economic, environmental and social 'dimensions' (as Allenby calls them) into all of its activities. But perhaps there is sufficient groundwork to be done in finding out *what* these dimensions are. In Allenby's model sustainability is the bigger picture, where all of these sustainable companies interact with each other to produce better integrated service- or function-oriented solutions.

Brezet [8] urges that we need to make leaps in order to achieve sustainability and that as we make these leaps, we move through a four stage process:

Stage 1. Eco-redesign
Stage 2. Eco-design
Stage 3. Sustainable Product Innovation
Stage 4. Sustainable Society

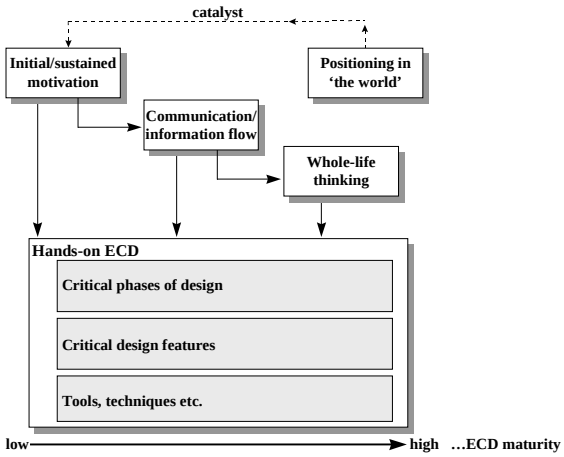
Brezet states that we (the majority of the research community) are presently well into stage 2 of his model; in the bridge between eco-redesign and sustainable product innovation. He speaks of the need to innovate in order to jump to the next s-curve and begin to climb the challenges of stage 3's sustainable product innovation challenge.



This figure gives fuel for certain discussion. Relating back to Allenby's view of the world, it could be argued that the framework put forward sits at the beginning of stage 2 in Brezet's model. This means that there is some work to do!

3. Where's industry?

In an empirical study carried out by the author [5], the electrical/electronics industry sector is studied in its attempts in integrating eco-design issues into the product development process. The study was carried out in 32 companies across Europe and the USA. It was found that there were three main stages that companies were moving through on their road to 'eco-design' (as defined by *eco2* [6]):



In the first stage of eco-design integration – ***initial/sustained motivation*** – the companies were observed to be reacting to a single external demand or force, such as CFC legislation or a competitor product. Progress to sustained motivation was said to require significant top management commitment, unlike the initial motivation which was a reactive posture. Initial motivation was sometimes observed to be entirely within the design process, with little management contact. However only after top management understanding and then commitment was gained could companies consider themselves to have achieved sustained motivation. It was in this phase of eco-design integration that companies were observed to be using DFX principles the most, due to the reaction to single issues, mainly from outside of the company (such as the need to recycle - due to European legislation).

The next stage of eco-design integration was observed to be ***communication/information flow***. This stage was only achieved when more than one of the factors in the category of initial/sustained motivation were active within the company, and with the necessary ingredient of top management commitment. The companies which reached this stage of eco-design

integration had begun to gain momentum towards the practice of eco-design (it was also observed that some had not yet managed to leave the reactive stage of initial/sustained motivation). This stage was characterised by increasingly wider involvement of departments into the eco-design process and by an introduction of some organisational learning about eco-design principles (be it in the form of education of the workforce, membership of design reviews, environmental workshops and training sessions, or the provision of specific information on topics such as hazardous materials). This second stage of eco-design integration is where the majority of the companies interviewed were seen to lie. DFX tools were still used in this stage, specifically as teaching methods for designers, so they could learn how to solve their specific eco-design problems. However, the more advanced companies in this category had begun to recognise the life-cycle effects of their decisions, and that choosing environmentally superior 'material x' in the materials selection phase does not just stop there – it has knock-on effects throughout the rest of the product's life-cycle. Indeed, by choosing the 'best' material from an environmental perspective, the overall environmental affect of the product may have been worsened. At this stage, designers stated that they could no longer use simple tools and techniques, as they were suddenly having to consider many different life-cycle stages and many different stakeholders all at once.

The final stage of eco-design integration – ***whole-life thinking*** – describes the few companies who were seen to be ahead of the majority, and had developed a high understanding of the trade-offs available between different product life-cycle phases. An initial realisation in this category was that ecological improvements could also mean economical benefits for the company. This often led to an adjustment in the view of what constituted core-business for the company, from focusing on product development and manufacture to service provision. It is this change in philosophy that was said to enable the company to take the view that their products were assets which should be fostered even after they had been sold to the customer. Companies in this phase still used DFX techniques to constantly improve the environmental performance of their products (especially at the time when they began to view their products as their assets - and so needed to be able to easily refurbish and recycle the products themselves). However, much greater emphasis was placed on the fact that every new product should now fit into the company's strategic environmental business plan (often referred to as the asset management plan).

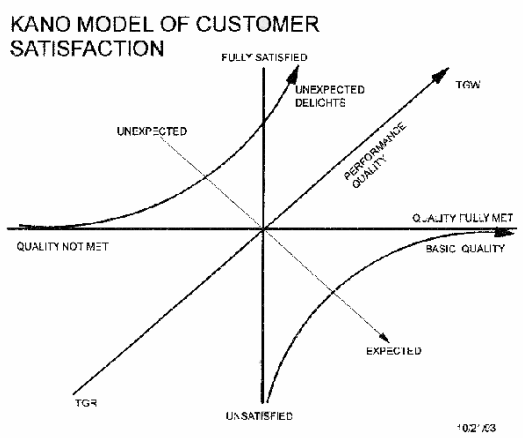
It is clear from this study that it was only possible to observe companies which ranged from 'no eco-design' to 'eco-design' – only as far as stage 2 on Brezet's model. A three-step development process was identified, which these companies followed, on their road to eco-design. Having completed this research and identified the three-step model, the next challenge we face is to try and identify what the *next* three steps are, beyond eco-design to 'sustainable product innovation', and then the next three or six steps towards 'sustainable society'. There is, however, little evidence in the literature that gives any clues as to what these steps might be.

If we compare Allenby's model to that of the author's, what Allenby comes close to talking about is not sustainable development or industrial ecology, but about the third stage of development on the way to eco-design.

In her thesis Dewberry [9] mentions a number of factors that are necessary to support the development of the design activity from having an eco-design focus to having a more mature sustainable design focus. These factors include the mindset of designers themselves, the educating role that designers have the potential to convey through their products, a new role of design (providing more holistic solutions than single-issue product solutions).

4. The need to innovate

Innovation is a term which both academia and industry are increasingly seeking to understand. Taking a broad definition of innovation, we can understand that it is the successful transition of an invention, or successful marriage of previously unrelated technologies, into a business success. There are a number of ways of trying to ensure innovation, based around a careful mix of key people and processes, and there is a broad range of examples of how industry is attempting it in environmental issues [10], [11], [12]. The motor industry is presently trying to innovate using the Kano model [13], which helps the industry to concentrate on their present strengths (mostly in basic and performance qualities) and the aim of innovation, to provide customer delights – the things that customers don't expect in the car, but are delighted to receive.



This is a good aim for the motor industry, but without a strategy, an aim is quite difficult to achieve.

We need an approach to design and product development that lets us:

- make step changes on Brezet's model, by vastly improving the environmental profile of the product;
- deliver the 'delighters' to the customer;
- consider the whole life-cycle of the product and the user situation;
- re-address the role of the product – focusing more on the provision of a service to the customer;
- put innovative thinking into action and be smart about combining solutions.

By attempting to consider all of the stakeholders in the very early product development stages, we can begin to anticipate the life-cycle of the products that we are designing, and so maybe ensure that the innovative joining of novel solutions is possible.

Through such techniques, we can begin to appreciate where LCA fits in, where DFD and DFR fit in, and how the product is to be constructed. If it is true that eco-design is coming of age, then it should be possible to place it in a mature way within the product development process and alongside the many other virtues that a product is expected to have, such as quality, cost-effectiveness, efficiency, reliability, etc.

In this manner, we can treat eco-design as one of the virtues that a product has, that make it an innovative product and hopefully a sustainable product – when we understand what sustainable is!

5. A glimpse of hope

Sherwin & Bhamra [14] describe a case study where an attempt was made to go from normal eco-design (based on corrective activities, which try to engineer-out inherent environmental problems) to eco-innovation. This case study was carried out with industrial designers from Electrolux on a project entitled 'Eco-Kitchen'. The exercise was to re-think the whole concept of the home kitchen, with environmental goals in the front of their minds. The case study was based on theoretical evidence that industry and academia are both beginning to recognise a need to be pro-active, holistic, and innovative towards a goal of sustainability – a goal which also needs to become more tangible. There were three goals for the case study:

- to balance desire and the environment;
- to support & not force the design team; and
- to look for near-future support systems (thus keeping the project as realistic and realisable as possible).

These goals were further supported by the aims of the case study, which were:

- to integrate eco-design at the early stages of product development – therefore the industrial design department was selected, due to their higher influence in this company;
- to go beyond simply including environmental considerations in the same manner as cost, quality, safety etc., and instead use eco-design as an innovation strategy in itself;
- to take a holistic view of the kitchen – so to overcome the potential problems of starting with discrete units (a fridge, a cooker, a sink etc.) in the mind, which might stifle creativity by drawing traditional solution boundaries;
- to go beyond the scientific and the technical issues that are the result of most existing eco-design tools, to providing insight into cultural and lifestyle issues.

The results of the case study were concrete prototypes, which could be used by the team to learn about the way in which adopting a new approach to eco-design had resulted. This case study concluded:

- there is a need to innovate. Existing tools can help to get some of the way, but a different approach is required that ties many of the existing methods together with new ideas to shape new products, rather than validate existing ones.
- 'the environment' needs to be considered earlier in product development. Rather than sticking to corrective action, it is indeed possible to go one step further and use environmental issues for product innovation.
- eco-design issues should be followed at more strategic levels of the organisation – such results as came from the project imply significant

changes into the way the business is shaped (product families, core business etc. are all re-addressed) all of which require commitment from management.
- there is a change required as an organisation matures its approach to eco-design that takes the organisation from thinking about technical to cultural issues.

This case is an example of what *can* be achieved when taking an innovative stance. We now need to work on what an eco-innovative strategy should look like, and what the steps beyond eco-design, to eco-innovation and then sustainable design are.

6. Conclusions

This paper took its point of departure in the findings from recent eco-design related literature and tried to identify a direction for eco-design efforts. It was postulated that eco-design research has reached a plateau and there is a need to re-address our goals for further work, and to imply strict but challenging steps towards an understanding of how to practice sustainable design.

Interdisciplinary research is the key to moving forward in our understanding of the complex issues that are involved in creating sustainable products, and in moving away from the belief that a series of single-issue 'DFX' attempts can deliver sustainable products.

The fostering of a sustainability mindset is imperative if we are to move towards Brezet's fourth S-curve, 'sustainable society'. Companies must start to rethink what their core business is: *production of products*; *provision of services*; or *satisfaction of needs and desires* – each of these three strategies has very different ramifications on the way in which we approach product development, and on the environment in which they operate.

Stages 1 and 2 of Brezet's model [8] can be (and have been) achieved by an engineering approach alone. However, if we are to move to stage 3 we now need to combine a social approach. We cannot any longer expect environmental improvements to come from a scheduled series of tools and methods alone, but must start to challenge our understanding of eco-innovation and sustainable product development and nurture new ways of developing products. Such new ways should include challenges to our understanding of how to deliver both product, service and value to the customer, and thus demand a new understanding of the product's role. Pointers for help and inspiration could be found in innovation theory, knowledge management theory and creativity literature.

7. Literature

[1] M. Simon, S. Evans, T. C. McAloone, A. Sweatman, T. Bhamra, and S. Poole, *Ecodesign Navigator*. Cranfield: Manchester Metropolitan University & Cranfield University, 1998.

[2] L. Reijnders, "The factor X debate - setting targets for eco-efficiency," *Journal of Industrial Ecology*, vol. 2, pp. 13-21, 1998.

[3] R. K. Turner, D. Pearce, and I. Bateman, *Environmental Economics: An Elementary Introduction*: Harvester Wheatsheaf, 1994.

[4] H. Yoshikawa, "Foreword to EcoDesign '99," presented at Eco-Design '99, Tokyo, Japan, 1999.

[5] T. C. McAloone, *Industrial Application of Environmentally Conscious Design*. London & Bury St. Edmunds: Professional Engineering Publishing, 2000.

[6] eco2-irn, "Defining Eco-Design," presented at Workshop: Ecologically & Economically Sound Design & Manufacture - Interdisciplinary Research Network, Forum #3, Manchester Metropolitan University, 1995.

[7] B. R. Allenby, "Industrial ecology and design for environment," presented at Eco-Design '99, Tokyo, Japan, 1999.

[8] H. Brezet, A. Stevels, and J. Rombouts, "LCA for ecodesign: the Dutch experience," presented at Eco-Design '99, Tokyo, Japan, 1999.

[9] E. L. Dewberry, "Eco-Design - Present Attitudes and Future Directions," : Open University, 1996.

[10] T. Jackson, *Material concerns - pollution, profit and quality of life*. New York: Routledge, 1996.

[11] W. R. Stahel, "The Service Economy: 'Wealth Without Resource Consumption'?," : Product Life Institute, Switzerland, 1996.

[12] C. Fussler and P. James, *Driving Eco-Innovation: A Breakthrough Discipline for Innovation and Sustainability*: Pitman Publishing Limited, 1997.

[13] N. Kano, N. Seraku, F. Takahashi, and S. Tsuji, "Attractive quality and must-be quality," *hinshitsu (Quality, The Journal of Japanese Society for Quality Control)*, vol. 14, pp. 39-48, 1984.

[14] C. Sherwin and T. Bhamra, "Beyond engineering: ecodesign as a proactive approach to product innovation," presented at Eco-Design '99, Tokyo, Japan, 1999.