CRANFIELD UNIVERSITY

JOANNA LOUISE LAMBERT

THE INTRODUCTION OF SUSTAINABILITY INTO COMPETITIVE DESIGN NETWORK (CDN)

SCHOOL OF INDUSTRIAL AND MANUFACTURING SCIENCE

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CRANFIELD UNIVERSITY

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MRes THESIS

Academic Year 2001-2002

JOANNA LOUISE LAMBERT

The Introduction of Sustainability into Competitive Design Network (CDN)

Supervisor: S. Evans

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Abstract

Competitive Design Network International (CDN) a design consultancy based in Barcelona, Spain is considering the move towards making their business processes more sustainable. This concept was initiated with the encouragement of Cranfield University, by the realisation of Antoni Flores the CEO, and Menno Marien the head of the Innovation department.

This study was conducted to discover firstly **if** and **why** CDN would want to introduce sustainability, **how** it could be effectively brought into their practices and **what** action CDN would need to take.

At the close of the project CDN had decided that sustainability would be an important aspect for their business particularly for competitively and market differentiation. CDN being an innovative, adaptable and influential business, it was identified that they are in an advantageous position to do this.

Through continuous researcher involvement in the company, a process of education and discussion was initiated. The observations from involvement in the Flores Valles furniture project will be presented, among other implementation issues. The reactions from CDN to the internal seminars carried out will be described and conclusions will be drawn out for other design consultancies.

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Chapter 1. Introduction

This chapter contains a brief description of the project sponsor and background, followed by information on the researcher, then the project aims and objectives.

1.1 CDN International

Competitive Design Network International is an industrial design consultancy based in Barcelona, Spain. CDN has had over 500 products to market within the 12 years since being established, and are market leaders in Spain. The industrial supervisor is Menno Marien, the Division Manager for Innovation. It is through his and the CEO's recognition of the growing importance of sustainability in business that this project was undertaken.

1.2 Researcher Background

Joanna Lambert has been actively involved in EcoDesign and sustainability initiatives since 1995. She graduated with a First Class BA (Hons) in EcoDesign from Goldsmiths College University of London where she has also taught. Her previous experience includes practical EcoDesign projects and time spent working in Holland for a biodegradable packaging company and studying in Finland. Joanna has also won an award for a bamboo table design in the 1999 International Design Eco Awards.

1.3 Thesis Structure

This thesis is divided into 10 chapters including the introduction. The structure of the thesis is as follows:

Chapter 2 – Project Methodology

Chapter 2 outlines the research methodology use to carry out the research

Chapter 3 – Introduction to CDN

This chapter gives an overview of the sponsor company, it's work, clients, competencies and methodologies.

Chapter 4 – Literature review

Literature about sustainability in business and design, tools and implementation is reviewed.

Chapter 5 – Implementation

This chapter presents the findings about the understanding and knowledge of sustainability in CDN, and describes the process of change towards implementation that occurred during the project.

Chapter 6 – Business and Context for Sustainability

Reactions from CDN about the business issues for sustainability are described, and further issues in context are explored.

Chapter 7 – Design Space

This chapter presents issues for design space and early action for sustainability.

Chapter 8 – Discussion

Chapter 8 discusses the project findings and places them in the context of previous research

Chapter 9 – Conclusion

Conclusion to the thesis

Chapter 10 – Future work

The future work needed in CDN and further research areas are identified

1.4 Project Aim and objectives

CDN's CEO and Innovation Team Leader have recognised the increase in debate about sustainability, that is beginning to become a business issue, and with this insight sought to begin the learning process of the new 'knowledge pillar' of sustainability within CDN.

This project forms an empirical case study of introduction and possible implementation of sustainability into a design consultancy.

Project aim

To understand and direct the process of introduction of sustainability in CDN and to draw out the lessons for other design consultancies.

Research aim

To better understand how design consultancies might introduce sustainability to their business.

Project objectives

1. 'Know CDN' – a process of acquainting with the company, it's history, methodologies, and future aspirations

2. Recommend a process and educate designers about EcoDesign for the Flores Valles project

3. Design and deliver internal seminars on Sustainability and EcoDesign

Chapter 2. Project Methodology

This chapter outlines the research methodology selected for this thesis. It justifies the type of research carried out, the data collection, workplan and activities.

2.0 Research type

This project has been *qualitative* in nature, and a *flexible design* of research that has been particular to the activities carried out. The research characteristics are:

Case study based – it has been within one company (CDN), to provide insight about a particular subject.
Exploratory – it has been an exploration into the current state of affairs, asking questions, and seeking insights through being in the situation where it is happening.
Action research – which is characterised by the researcher intervention throughout the project, and subsequent evaluation of responses generated.

This *case study action research* has been carried out on a permanent basis within the company, and it purports not only to contribute to existing knowledge but also to help the practical concerns of people who are trying to deal with problematic solutions of the subject. (Bhamra 2001b) It is concerned with change within the organisation, and the increase in understanding of both parties.

2.0.1 Why this research type?

Both parties considered this research type as being the most appropriate:

- For Cranfield University and the author it was a unique opportunity to be assimilated into a company to gain a high level of understanding of the real life situation. It allowed for continuous and efficient data collection, as well as the opportunity to react to situations and events that occurred.
- For CDN it was essential for the author to understand the company processes and culture to be able to introduce any new subject areas effectively. A continuous

presence in the company encouraged interaction and increased the reputability of the subject.

2.0.2 Strengths and weaknesses of the research type

The strengths of case study action research in the context of this project are as follows:

- It is real life (not simplified)
- It creates a deeper understanding of the company processes and culture
- Trust can be formed through greater familiarity between parties
- Change can be facilitated through quick responses and interaction
- Observations are easier

The weaknesses are:

- It is only one company so may not be fully representative
- It is conducted by only one observer/researcher
- The length of time allocated to the project was a limiting factor

Due to the research type and mode of conducting the research (one person only) there is an acknowledgement of bias and subjectivity. This was avoided where possible by observing from a distance and providing adequate information to allow perspectives on the subject to be formed independently.

2.1 Data collection techniques

The data to be collected in this thesis consisted of the opinions, approaches, knowledge, understanding and feedback about EcoDesign and Sustainability. This was conducted through a process of:

Observation – participant observation in activities and simple observation from a point of distance

Interviews – semi-structured were carried out to gain qualitative information from specific personnel within the different departments. These questions were flexible in nature, which allowed for alterations to the questions, which was done either to tailor

to the individual interviewee, or to respond to comments after having sent the questions before the interview. The awareness of bias lead to a careful consideration in constructing the interview questions, however as the interviews were semi-structured it allowed for some discussion to occur in the interview. In these conversations biases are difficult to rule out completely, (Robson 2002) but it was seen as constructive to the discussion through allowing interesting avenues to be further developed.

Active participation – much of the data collected was through daily involvement and discussion within the company, to understand the company culture and individuals within it. This perhaps made up the most valuable of data, (even though it cannot be quantified, as such) through understanding in what way to approach the problem.

The main tool for analysing the data collected was comparison, forming correlations, experience and intuition.

2.2 Research questions

The main research question is specified as:

What does CDN need to do to become more sustainable?

From this two more sub-questions are specified:

- **What are the barriers and opportunities for CDN to be more sustainable?**
- **What is CDN's current knowledge and understanding of EcoDesign and sustainability?**

2.4 Activities

The scope of this introduction project remained with the four activities outlined above. It was decided that the development of specific tools for implementation would lie outside the scope of the project.

1. 'Know CDN'

The 'Know CDN' activity was to gain an understanding of the history and current developments of the company, as well as their future aspirations. It was important also to discover attitudes, knowledge and understanding of EcoDesign and sustainability.

The information sources of this task were:

- CDN project magazines and website
- CDN methodologies
- Semi-structured interviews of management and Team Leaders
- General involvement in the company

2. Flores Valles

This provides a live case study of a CDN project and their understanding, approaches and methods towards EcoDesign and Sustainability

3. Seminar delivery

The seminars were to raise the level of understanding in CDN of sustainability and EcoDesign, evaluate reactions to the subject, and start discussions to examine whether, what or why CDN would consider the change towards sustainability.

Chapter 3. Introduction to CDN

3.1 Description of CDN

CDN International was established as Flores & Associats in 1990, changing its name to the current name in 1997. The company has enjoyed many successes with over 1000 projects launched into the market, and has expanded rapidly from the two founders Antoni Flores and Alvaro Quintanilla to the current number of over 80 employees.

CDN has functional offices in Paris and Portugal as well as their main office in Rubí just outside Barcelona. The Paris office is international contract management, and the Product Optimisation service is based here. The Portugal office's function is of plastics moulds expertise, project management and supplier selection.

CDN offers a full service of product development, and describes itself as:
A multi-disciplinary structure specialised in product creation. A structure that gives high priority and importance to the end user's needs and ***perceived quality*** *of the product.*
CDN aims to be a supplier of competitive advantages in the turbulent product environment of its clients; CDN is a product strategist.

3.2 Sectors of work

CDN's sectors of activity have a broad scope, which has been built over the 12 years experience. Their reasons for having such a wide scope is that it "*allows for a broad knowledge base on market, social and technology trends and related perceived values. Moreover it allows for cross fertilisation of ideas between sectors*" (CDN 2002)

Figure 1. CDN Sectors of work

So far products include office furniture, ticket machines, pens, irons, toys, printer casings, air traffic control panels, tools, internet connection booths, domestic appliances to name a few.

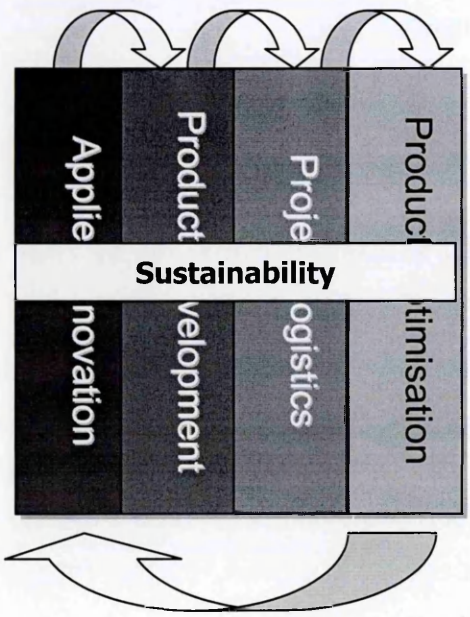
Despite the appearance of perhaps a seriously diverse range of design projects, CDN is a highly specialised firm. It does not do projects in interior design, graphics, or architecture, but only in product design and development.

3.3 Clients

Originally CDN's clients were chiefly companies based in Spain, where in the Spanish market, CDN represented a different way of doing design, as a team based total process. (CDN 2002) After having worked with international firms in Spain, they realised they could be competitive abroad. In around 1996 CDN began to take its international expansion very seriously, particularly in the Mediterranean countries like Spain, Portugal, France and even Italy. It is these countries where CDN feels there is no predominant style, design team, or strong competitors. Therefore, as the image below demonstrates, the client base is increasingly international.

Figure 2. CDN client list

3.4 CDN Company structure



In order to be able to offer competitive advantages to its clients CDN has based its service offer on 4 knowledge pillars that are interrelated. The competitive force of the CDN services lies exactly in the interrelation and the creation of synergies between the different knowledge pillars. A project can be started in any of the knowledge pillars and go through the whole of the four pillars or just be executed in one. The process is always iterative as is indicated in the figure below.

Figure 3. Four pillars for product competitivity (CDN 2002)

The 4 pillars cover the whole value adding chain for product creation and therefore CDN is able to support the company in the development of its product strategies:

- The Applied innovation knowledge pillar supports the company in defining new product strategies and guarantees the creation of new competitive products in order to keep the company competitive in the future.
- On the other side the Product Optimisation knowledge pillar concentrates on optimising existing products of the company and therefore to increase margins and benefits on the existing product range of the clients.
- The two pillars in the middle are focused on increasing time to market once the product briefing is decided: Product Development integrates industrial design in all aspects and engineering of the product. CDN puts a special effort in ergonic design both in the traditional physical ergonomics as in the cognitive ergonomics addressing the increased incorporation of electronics and software interfaces in the products.

Project Logistics considers all the mould supplier handling and general management of the industrialisation of the product.

3.5 Core Competencies

In the early 90's CDN was recognised primarily for their expertise in industrial design and engineering. Their projects reflected this: the design of exterior casings of Hewlett Packard large format printers as one example. In the last few years with the expansion of the business, came additional departments such as the innovation department in 2000, which has added to the services offered by CDN by offering directions and strategies for product development.

CDN, having been established by designers means that the core competencies of CDN remain in industrial design, for which they are widely recognised. However, with the expansion of the new departments such as innovation, the core competencies are beginning to shift to a broader range throughout the service of product development. In the future more of the design work may be sub-contracted out, and CDN's influence that of overseeing the product development process, as product strategy consultants. CDN's advantage over it's Spanish competitors is the complete service that it can

offer...from innovation to design to engineering, to Product Optimisation to project logistics.

In the early nineties the clients mostly approached CDN for the design service, and many have remained clients since. There is a difference in the clients in that some can be 'static', some 'dynamic'. Some of the older clients are viewed as more 'static', so they return for more of the same type of services, and are more difficult to change. The 'dynamic' clients can be more open to suggestions for change and to use CDN newer services. These are often CDN's more recently acquired clients.

The key strength of CDN is in the integration and multi-disciplinary nature of the business, which has the advantage of being able to develop products that are fast to market.

3.6 Competitors

The CEO, Antoni Flores is well known within the design community in Spain, and CDN considers itself to be the leading design consultancy in Spain. There are no other design companies of a similar size or format in Spain that offer the same kind of product development service. Competitors tend to be of a smaller scale offering pure design services. CDN considers itself not to have direct competitors in the geographical area. However, as CDN is expanding in size, services, geographical locations and a growing international client base, it identifies international competitors such as IDEO, Frog Design and Pentagram. These international competitors become increasingly important the more the consultancy side of CDN grows.

3.7 Future aspirations

CDN is in the process of change that will result in a change in emphasis for the business. CDN's aspirations are to remain ahead of the field particularly in Spain, but also to challenge the competition internationally by becoming a well-known product development consultancy. These are reflected in the following quotes from their externally published Project Magazines:

"Our evolution for the coming years will be guided by our will to identify all these aspects (new ways of consuming – impression generated by use of products 'intuitive', 'restful', 'accessible' etc) and understand their contribution to a better quality of life."

CDN Project magazine #3

"Nowadays, our society does not behave like manufacturers still believe. We need to understand that notions such as friendship, autonomy, nomadism, humanism, need to enjoy life, to find one's way, to understand at first glance, to experience emotions and pleasures have superseded ones of possession"

CDN Project magazine #4

In the future CDN aims to become a product strategy consultancy, based on its initial core competence of industrial design, integrated with the other three knowledge pillars of applied innovation, product optimisation, and project logistics.
Furthermore CDN is currently developing a 5th knowledge area that could be considered horizontally: sustainable product development. This knowledge area should support the other 4 knowledge pillars guaranteeing a sustainable development of all product concepts at CDN. Sustainability of the products is considered to be an important competitive factor for the competitiveness of the clients in the future.

CDN furthermore tents to expands in Europe and in a second phase globally to convert itself in one of the leading product strategist on a global level.

3.8 Communication and marketing

Considering the reputation of both Antoni Flores and CDN in the Spanish design community, the majority of CDN projects are initiated through reputation and 'word of mouth', rather than by big efforts in marketing or advertising.

The channels of communication that have been utilised so far have centred around media articles in local and national newspapers, but also the CDN Project Magazines which are published three times a year, and had a wide readership with existing clients. This was successful at keeping existing clients informed (and reminded) about

CDN's latest developments, services and projects, but did not extend into the readership of potential future clients.

The website has provided another channel of communication with a slightly different function. It is better at reaching potential clients, but also provides more information to competitors, and less to existing clients. However, the website is effective for communicating the company image to a wider international readership.

Other interfaces between CDN and their existing clients are through workshops and seminars. These are organised in different economic regions in Spain, in France and in Portugal. These seminars intend to explain the different knowledge pillars of CDN, projects executed and experiences gained. CDN is not currently recognised by the public or actively marketed to, as the projects that CDN undertakes are Business to Business projects.

3.9 CDN product development methodologies

Within the 4 knowledge pillars outlined in 3.4, methodologies have been developed so that a professional process can be followed for each client. Clients can opt for all, some, or parts of services. There is currently not one overall product development methodology that covers the process across all the functional areas, but each department has their own, which crosses over to the next department. The two methodologies most applicable to this thesis are the innovation, design methodologies which are explained below.

3.9.1 Applied Innovation methodology

The CDN innovation methodology has been developed since 1999 and is used within innovation department for projects that begin with the service of innovation. The client company can decide what level of innovation they need and can enter at whichever level is most appropriate:
The higher the company enters into the triangle, the more the innovation process will move from product attribute decisions to strategic directions, and the higher the impact of the decision taking is in the company.

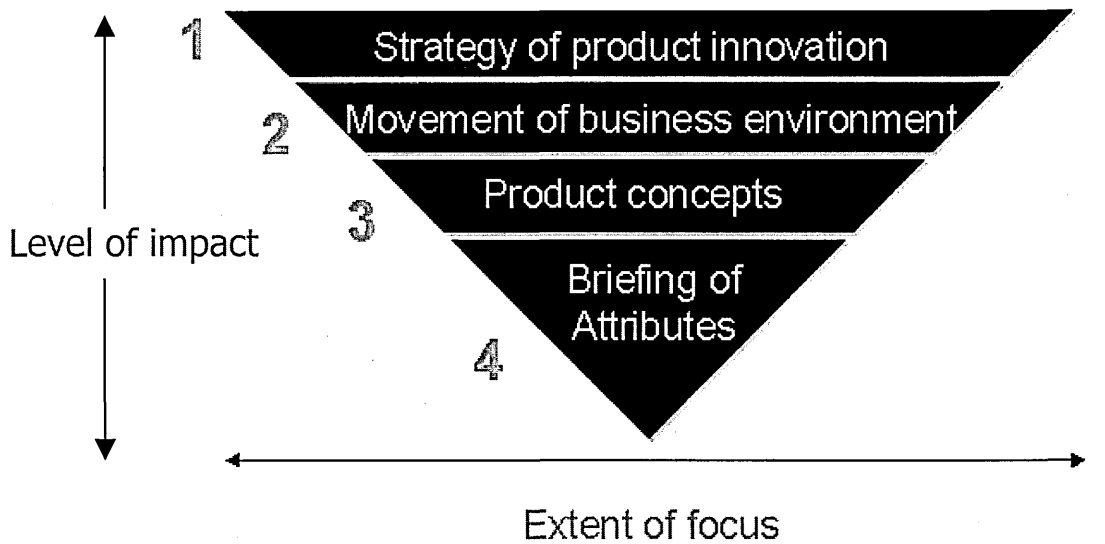


Figure 4. Innovation levels (CDN 2002)

Level 1: Strategy of Product Innovation

The questions that CDN encourages the clients to ask of themselves are:

What guarantees the success of my company?

What is innovation and why innovate?

Do we have strategies for new products and new units of negotiation?

What would I do to get myself out of the market? (a question the competitors ask constantly...)

Level 2: Movement of the business environment

How can we anticipate the movements of the market?

Do you have an idea of what will be the next change in the market?

How can I attack my own market?

How can I convert an idea into a product concept and strategy?

Level 3: Product Concept

How can I minimise the risk of innovation?

How can I place the strategy into the product idea?

Level 4: Briefing of attributes

What attributes should the new generation of products have?

What are the buying criteria of my consumer group?

The internal process that is used in innovation is split into three phases:

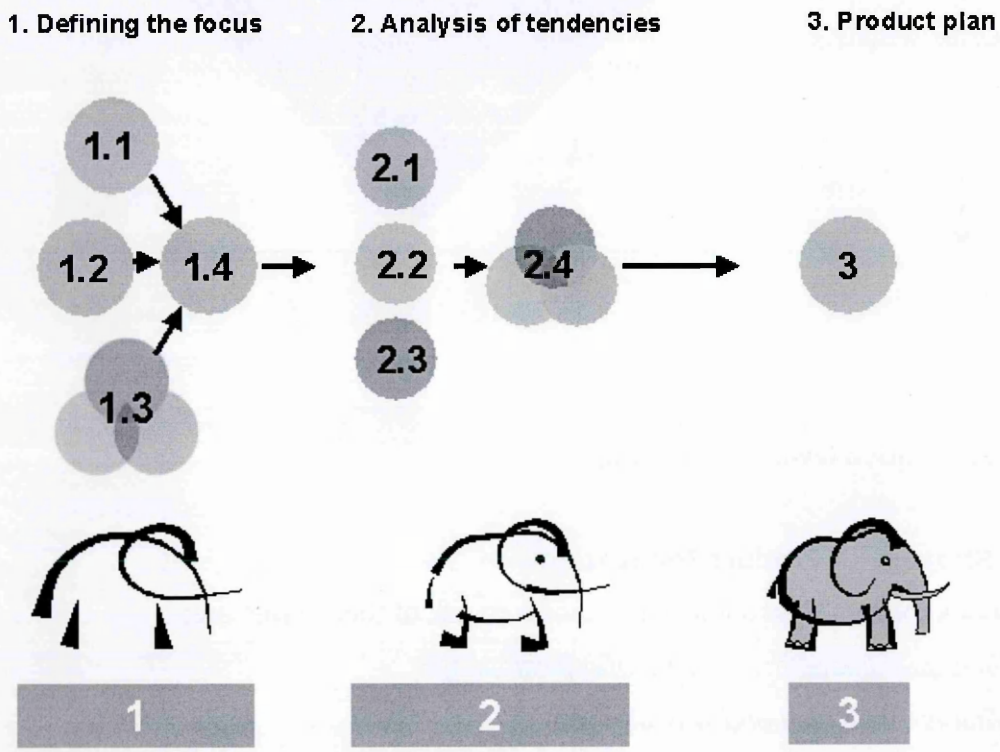


Figure 5. Innovation methodology (CDN 2002)

Phase 1: Defining the focus points

1.1 Abstraction

1.2 Knowing the client and market

1.3 Knowledge stock

1.4 Finding focus

Phase 2: Analysis of trends and definition of scenarios

2.1 Technology and science

2.2 Society and culture

2.3 Market and economy

2.4 Interaction and trends

2.5 Defining product scenarios

Phase 3: Plan of product (concept)

Throughout this process four variables are considered: Actors: which players are their in the added value chain and what are their interest?; Needs: what "holes" are there in the market, what do market trends tell us on the necessity of a product idea?; Context of Use: when in which place would the product be used and what is the real added and perceived value when it is used (by all of the actors in the added value chain) and solutions: what (existing) technical solutions can be applied to the product concept?. Throughout the three phases of the methodology these four points are revisited as inspirations and directions for the developing ideas and focus areas for the innovation. The figure below indicates that the process is an iterative process where all the 4 variables are reconsidered with every iteration made. The more iterations are made the clearer the product concepts scenarios and concepts are becoming which is indicated with the elephant metaphor.

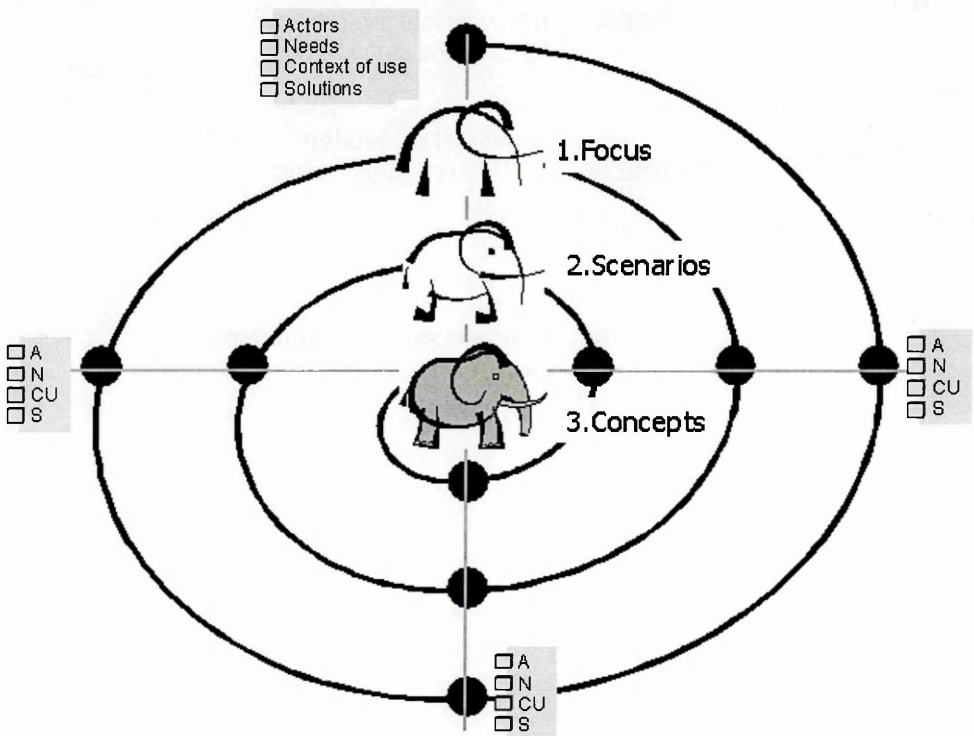


Figure 6. Innovation cycle (CDN 2002)

Currently there is discussion about adjustments that need to be made to the methodology that have been learned from previous project experiences, so it appears the need for continuous development and adaptation of the methodology will be necessary for the future.

3.9.2 Design and engineering methodology

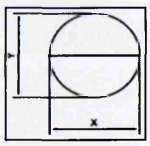
The design methodology is divided into 8 phases, from the point at which innovation has passed the project to design, right through engineering design and logistics:

Preparation of the project.
Analysis of product details.

PHASE 1
1.1 Collection of data and defining the product
1.2 Analysis of the product details and general tendencies

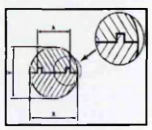
Conceptual Design

PHASE 2
2.1 Conceptualisation
2.2 Materials and viability of production
2.3 Construction of a formal model



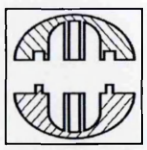
Design development

PHASE 3
3.1 Perfectioning form and function
3.2 Formal model
3.3 Applied graphics



Technical pre-projection

PHASE 4
4.1 Technical pro-projection
4.2 Detailed viability study

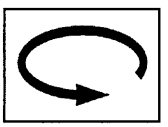


Technical projection

PHASE 5
5.1 Detailed engineering

PHASE 6 **Production of functional models (prototypes of use)**

PHASE 7 **Test, prove and validate**



PHASE 8 **Follow-up**
8.1 Search for suppliers
8.2 Assignation and launch of mould making
8.3 Quality and dimensional validation of the first pieces

Figure 7. Design/engineering methodology (CDN 2002)

Chapter 4. Literature Review

4.1 Chapter introduction

This literature review explores the current knowledge of the subject through three areas of literature:

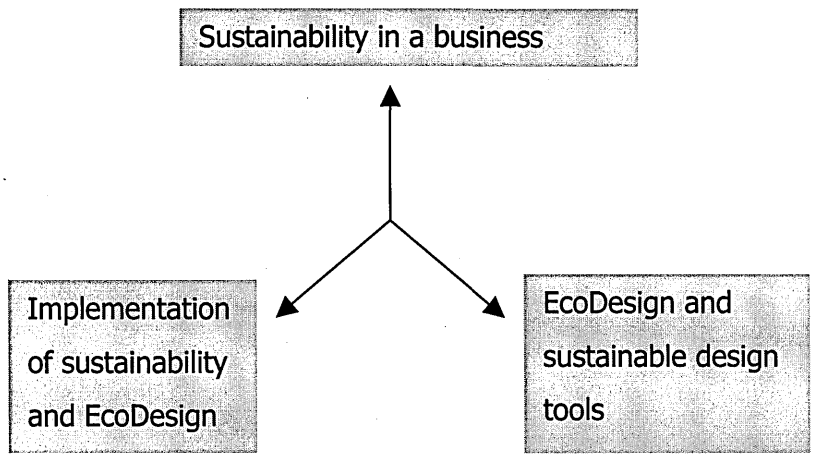


Figure 8 Literature focal areas

It reviews the research already carried out in the areas of sustainability in business, and the issues for design in terms of tools and implementation. It concludes that there are currently gaps in the literature and research area, which remain to be developed, in particular empirical examples of implementation into design consultancies.

4.2 The concept of sustainability

The most widely known definition of sustainable development is given by Gro Harlem Brundtland (1987) - the then, Chair of the World Commission on Environmental Development (WCED) and previous Prime Minister of Norway, as:

"...development which meets the needs of the present without compromising the ability of future generations to meet their own needs"

This concept of *sustainable development* or *sustainability* first gained widespread acceptance by politicians, non-governmental organisations (NGO's) and business leaders in the 1992 Rio Earth Summit (Dyllick, 2002) due to concerns over the effect of unlimited economic growth on the environment and world communities.

The Earth Summit saw the gathering of representatives from 176 different countries, including more than 100 heads of state. This meeting agreed upon voluntary global action designed to deliver sustainable development (McLaren, 1998). Subsequently, we have witnessed many plans and strategies to progress toward sustainability - predominantly through environmental initiatives.

Since then, the concept of sustainability has developed and can be elaborated further to encompass the 'triple bottom line' concept (Elkington, 1997) which includes three domains: economic, social and environmental. This idea suggests that these domains are interrelated (and may influence each other in multiple ways) and society will need to account for all three in moving toward sustainability.

A model presented in the book Tomorrows World (McClaren, 1998) describes these three domains and their interrelations using three overlapping circles, with *sustainability* sitting in the heart of the three overlaps. Each overlapping area can describe these interrelationships:

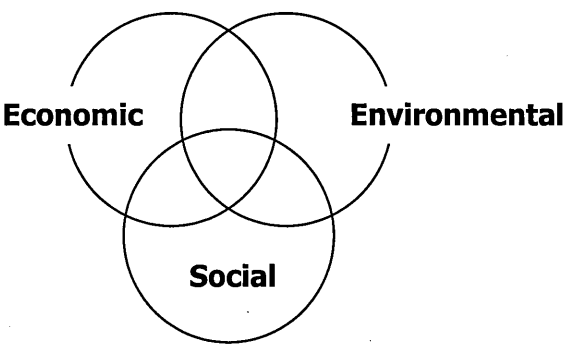


Figure 9. The domains of sustainability (McClaren, 1998)

4.3 Sustainability in business

Whereas in the mid-1990's local authorities were probably the most active players trying to implement sustainable development, the focus has recently shifted strongly towards business as a major actor. (Dyllick 2002 p131) This has been echoed by the sustainability literature, which in recent years has focussed the heaviest on industry. There has been recognition of the influence and potential of industry to change, and to think beyond the imperatives of the 'bottom line' measures of profit, towards the 'triple

bottom line' (Elkington 1997), by considering environmental, social and economic improvements.

In the Sustainable Vision Project for Philips a more detailed model of the business influences for sustainability in each area was developed:

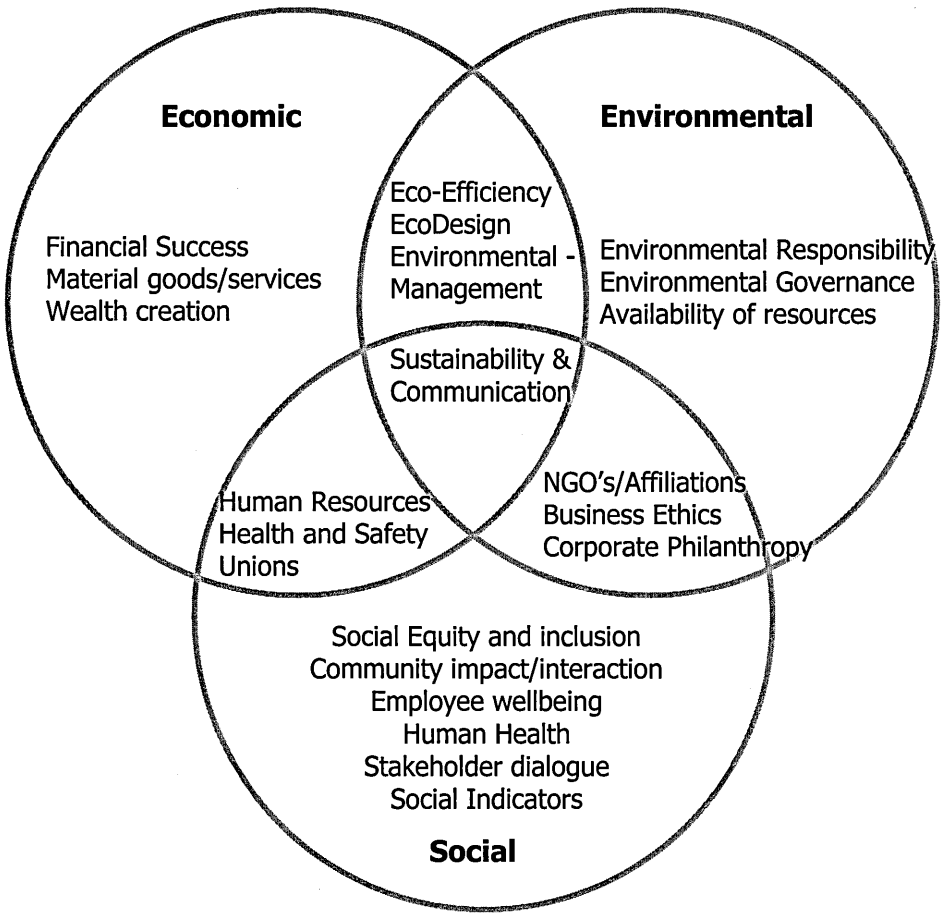


Figure 10.Three Circles of Sustainability (Blofeld et al 2002)

The elements considered within the model constitute the actions that could be taken within a company and the framework around which indicators for performance can be developed. As one of the key considerations within this study, EcoDesign is seen an environmental and economic consideration for a company.

4.3.1 Sustainability – the business case

In essence, globalisation has created companies that are much bigger than the majority of countries in the world. (48 of the world's 100 largest economies are businesses (King 2001)) This has potentially major threats and also great opportunity in shifting the current situation toward sustainability. However, economic issues have

dominated globalisation leaving the other domains of sustainability relatively unchecked. This has generated a growing focus on business to take responsibility in all domains of sustainability. Pressure to move in this direction is coming from increased public scrutiny, legislation, voluntary initiatives and growing interest in ethical investment.

For example, some global businesses are finding that their overseas operations and activities are coming under increasing public scrutiny, Such as the Shell Brent Spar incident and other high profile cases that have raised general awareness. As a result, business is being required to show increased responsibility, otherwise face the threat of damaged corporate reputations.

There is a clear and obvious reluctance by business to shift focus into areas outside the economic domain because this may result in inferior performance in the marketplace. However, research conducted by PriceWaterhouseCoopers (King, 2001) investigated whether companies could deliver across multiple objectives, (i.e. the three domains of sustainability). The study concluded that the aggregate performance of the 'sustainable' companies (using the DowJones Sustainability Group Indexes) is better than their peers and relevant market indices over a five-year period. King (2001) suggests that a sustainable company can increase shareholder value through more favourable returns and reduced risk. He states that sustainability *may* be a proxy for good management (and imply a better ability to identify, manage and deliver value on opportunities), whilst reduced risk may result from their stakeholder management processes.

Some literature suggests that a single minded focus on economic sustainability can succeed in the short run, but action for the three areas of sustainability will in fact be a business imperative due to the inter-relatedness of the three dimensions. It is considered that the three dimensions they may influence each other in multiple ways. (Dyllick 2002)

SustainAbility, a consultancy based in London UK, mapped ten dimensions of corporate sustainable development against ten indicators of business success, covering both financial and intangible assets. It found that in the vast majority of cases there was a

'weak' to 'moderate' positive link between management of sustainable development and business performance, and in some cases there was a very strong correlation. (ENDS report 2002)

The matrix below has the business success factors along the vertical axis, and the sustainability factors along the horizontal.

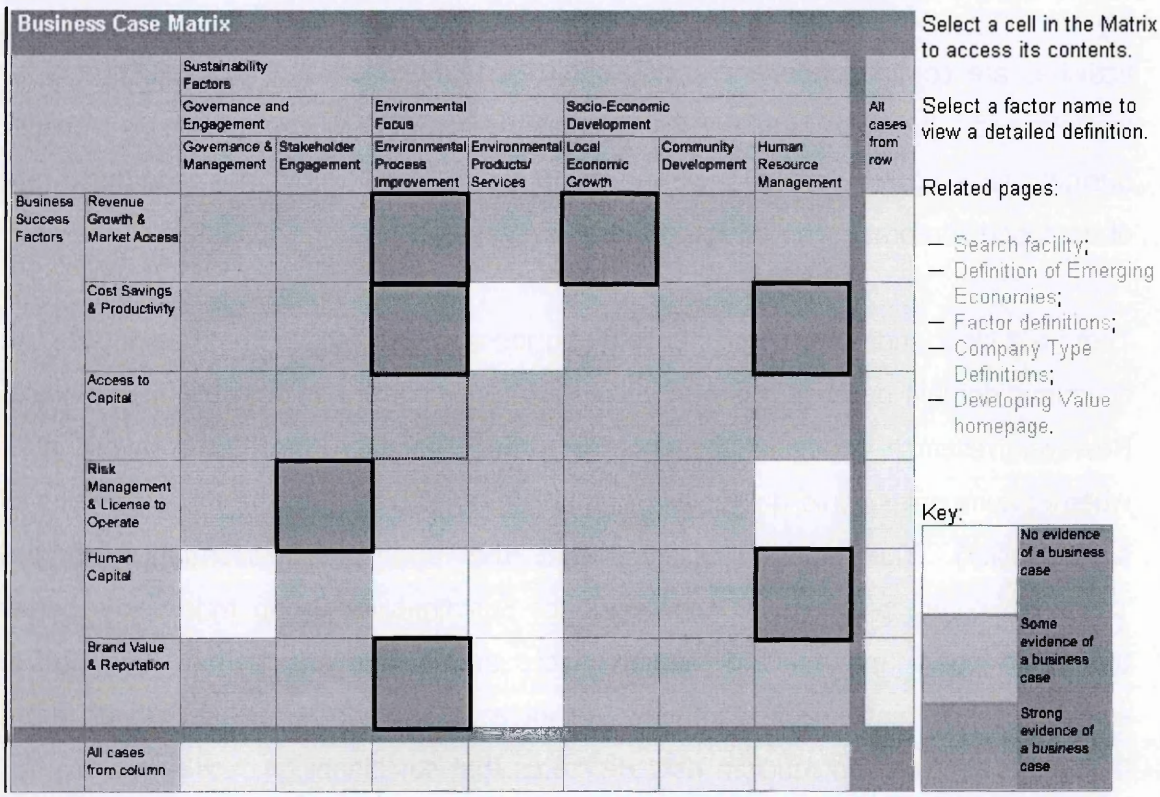


Figure 11. Business Case Matrix (SustainAbility 2002)

The matrix demonstrates that the strong correlations between sustainability and business success are through Environmental Process Improvement, Human Resource Management and Stakeholder Engagement and Local Economic Growth.

The increase in the recognition of sustainability as a viable corporate concept can be seen through the increase issues to do with corporate reporting, marketing through Non-Governmental Organisations such as the World Business Council on Sustainable Development and Global Reporting Initiative. Through such organisations can also be found the documentation of case studies of companies who have adopted sustainability. The Dow Jones Sustainability Indexes also measures corporate

performance for sustainability, which includes further issues than just the imperatives of shareholder value.

4.4 Transitions towards sustainability

This section discusses the process of changes that business makes towards sustainability.

4.4.1 Change in enterprise direction

Transitions towards sustainability for business often mean a review of direction and a definition of what it means for a business.

Dyllick and Hockerts (2002) define corporate sustainability by transposing the Brundtland definition to a business:

"...Meeting the needs of the firm's direct stakeholders (such as shareholders, employees, clients, pressure groups, communities etc) without compromising its ability to meet the needs of future stakeholders as well."

Sustainability in business literature often suggests a management level focus, a new vision, and strategic change of the entire enterprise.

William McDonough and Michael Braungart suggest the initiation of the new focus of direction in a process described as:

1. **Signal your intention**- committing to the new paradigm of the sustainable enterprise
2. **Enrich investment criteria**- add new investment criteria in environmental technologies
3. **Innovate**- thrive and do not simply survive
4. **Rematerialise**- make products non harmful and recyclable
5. **Accrue Wealth**- become wealthier in natural and industrial materials
6. **No regulations, but good economics, good sense and good fun**- using sustainable products should be free of guilt!

(sourced in Keijzers 2002)

This process and other literature about change towards sustainability discuss the entire processes of the company, with respect to the interface with the natural, economic and

social environment. These suggest that the most influential way for a company to advocate sustainability would be to alter their entire company vision and processes, described by one of the leading case study 'sustainable' companies:

"At Interface, we are completely reimagining and redesigning everything we do, including the way we define our business"

(Interface Inc 2002)

There is a proposed literature gap, which discusses the effectiveness of other business strategies towards sustainability other than the transition of the entire enterprise.

4.4.2 Material based industries

Literature about the change towards sustainability often presupposes that the currency of the business is material rather than non-material, and the concern is about the inputs and outputs of these materials. As one example, the concept of Industrial Ecology has its focus on the cycling of resources rather than their extraction and eventual discard following use. (Graedel and Allenby 1995) It emphasises, for the sustainable development of the planet, the need for a systems view and zero-waste economy, where one waste material from one process is used as raw material for another process, in a fashion that emulates natural processes in a closed cycle:

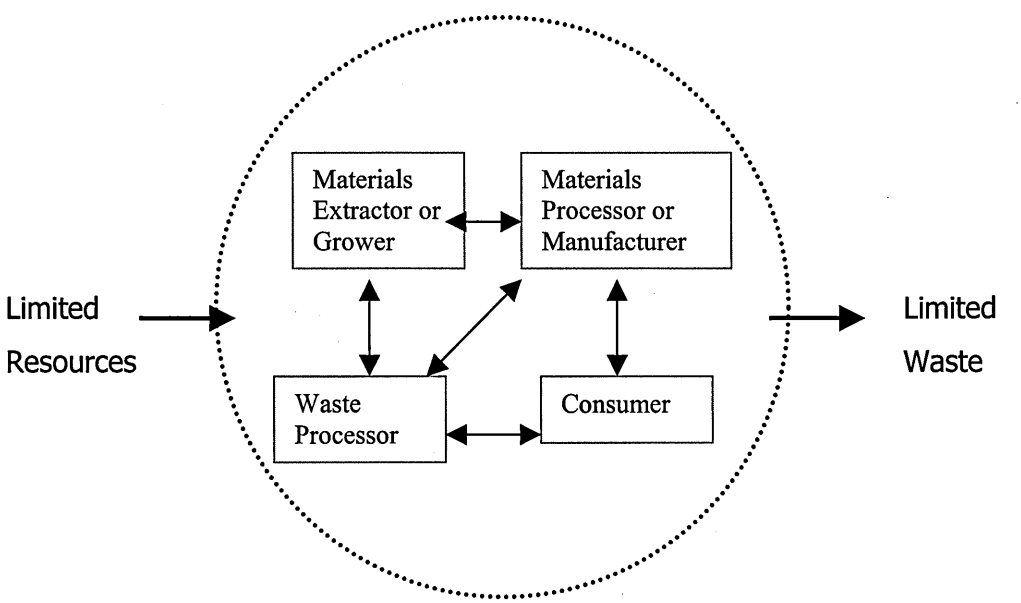


Figure 12. Model of the industrial ecosystem (Bhamra 2001a)

Here issues are to do with the management of resources, and controlling the material inputs and outputs of the enterprise via a process of stakeholder dialogue. (e.g. communication along the supply chain)

Multi-nationals, due to their size have to consider strategies for change that works with their current structure in terms of both top-down policies and strategies, and bottom-up practical tools and methods (Philips Environmental Services – Blofeld et al 2002).

However, in the changing business environment of our digital age, not all companies manufacture goods or have significant material inputs and outputs. Much of the inputs and outputs of the enterprise are based on 'knowledge'.

At present there is a lack of literature about knowledge based companies whose most effective influence for sustainability may be different to the focus on materials throughput.

4.4.3 Large organisations

The more documented companies in Case studies and discussion about the implementation of sustainability are often the multi-nationals rather than SME's. The World Business Council for Sustainable Development has over 60 case studies documented via their website of companies who have developed initiatives for working towards sustainability. These are almost exclusively large or multi-national companies. The suggested reasons being that multi-national companies...

- have to be more accountable through the level of publicity (and criticism) they receive
- can have an influential effect
- are more likely to be able to be rated through Dow Jones Sustainability Indexes
- have the resources to take action
- need to keep up with global competitors.
- have more reputability to promote the debate

From the literature reviewed, there is much less or almost no documented case studies about SME's who are making a change towards sustainability, or processes that have

been used in these situations. The closest case studies that exist are through programmes such as the UK government's Envirowise initiative (2002), who have documented cases of best practice in SME's for issues such as waste minimisation, reducing water use, reducing packaging use, and cleaner technology. Hence the case studies are for specific environmental improvements within the SME's rather than the more radical change to sustainability within these companies.

Similarly, EcoDesign appears to be "*still only something carried out by a small minority of companies, and usually this is limited to large trans-national companies who have the resources*" (Lofthouse 2001). Therefore the impetus for change towards sustainability appears to be coming from the larger establishments, who may be more affected by legislation, have more concerns with public perceptions of their corporate image, and more resources to implement it effectively.

Previous literature has also identified the need for research into the environmental achievement of small to medium sized enterprises, possibly as a result of the greening of larger organisations. (McAloone 2000)

4.5 Definitions of design for sustainability

The literature presents some definitions of the issues for design in the move towards sustainability. There appears to be no consensus on definitions but the types of concerns for design can be divided into three levels of increasingly comprehensive issues. Figure 13 adapted from the EcoDesign Navigator considers one level of design being a part of, or informing the next:

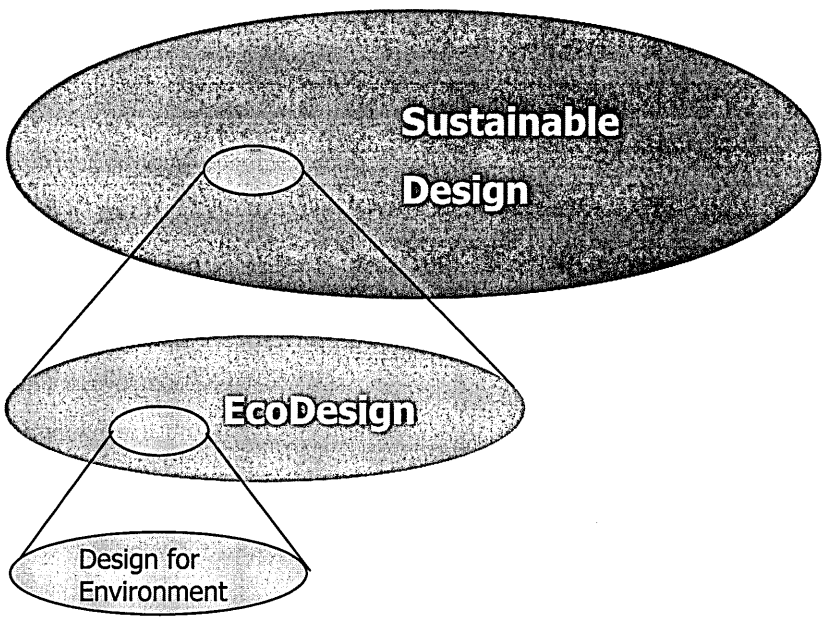


Figure 13.Levels of Design for Sustainability (Adapted from Bhamra et al 1998)

Design for Environment is concerned with single issues, which focus on one element of the product lifecycle. It is often *"...concerned with Design for Disassembly and recycling at the end of the life of the product."* (Bhamra et al 1998)

This area of concern was often the focus of research in the early 90's, with publications such as Dorothy MacKenzie's 'Green Design' which raised issues of recycling and design.

EcoDesign considers the whole lifecycle of a product: *"Design of a product, system or service with the aim of minimising overall impact on the environment over the whole lifecycle."* (Bhamra et al 1998) Other definitions, as well as the lifecycle impacts, include the importance of not compromising other design criteria such as function, quality, cost and appearance (ECO2irn-1994)

Sustainable Design is a generally considered to be a much broader concern which goes beyond pure environmental considerations such *"developing concepts within whole systems, that provide a service or function to meet human needs."* (UNEP Working Group-Sustainable Product Development 1995)

Furthermore, the attributes of sustainable products could be defined as 100% cyclic, solar and safe and efficient and also is made by a company that actively seeks fairness for its employees and suppliers" (Datchefski 1999)

Design research and development issues have paralleled those with business responsibility in that the emphasis has moved from environmental actions to the much broader and all encompassing debate about sustainability.

4.5.1 Types of design improvements

The levels of design for sustainability can be seen to achieve certain factor of improvement depending on the level of innovation, as demonstrated in the model in Figure 14

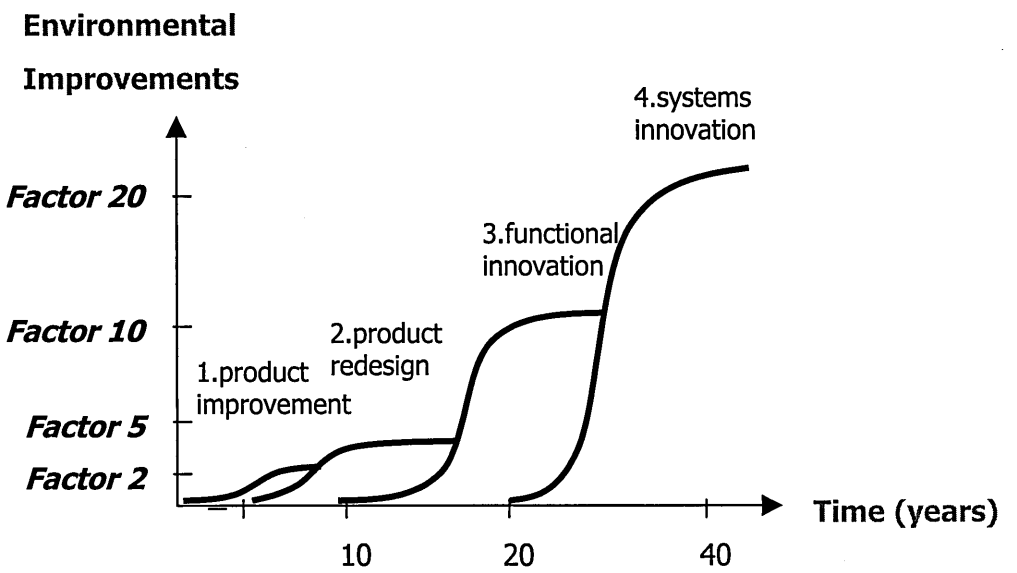


Figure 14. Four types of design-environment innovation (Brezet 1998)

In order to achieve the reduction targets for sustainable development improvements have to be made on four increasingly challenging levels. (Fussler and James 1996)

These four types are similar to the three levels of design described in the previous section. The lower levels, particularly level 1 indicate incremental improvements, or single-issue focus such as the type described as Design for the Environment. In recent years research and practice has moved towards level 2 where environmental

considerations are taken into account in the design process. (Dewberry and Goggin 1994) Moving further up this model through type 3 or 4, it requires more radical improvements of function and systems, which is what sustainable design should be aiming to achieve.

4.6 Review of EcoDesign tools

In the EcoDesign Navigator (Bhamra et al 1998) review 54 EcoDesign tools that existed at time of going to press in 1998. These were grouped into eight areas as in Figure 15

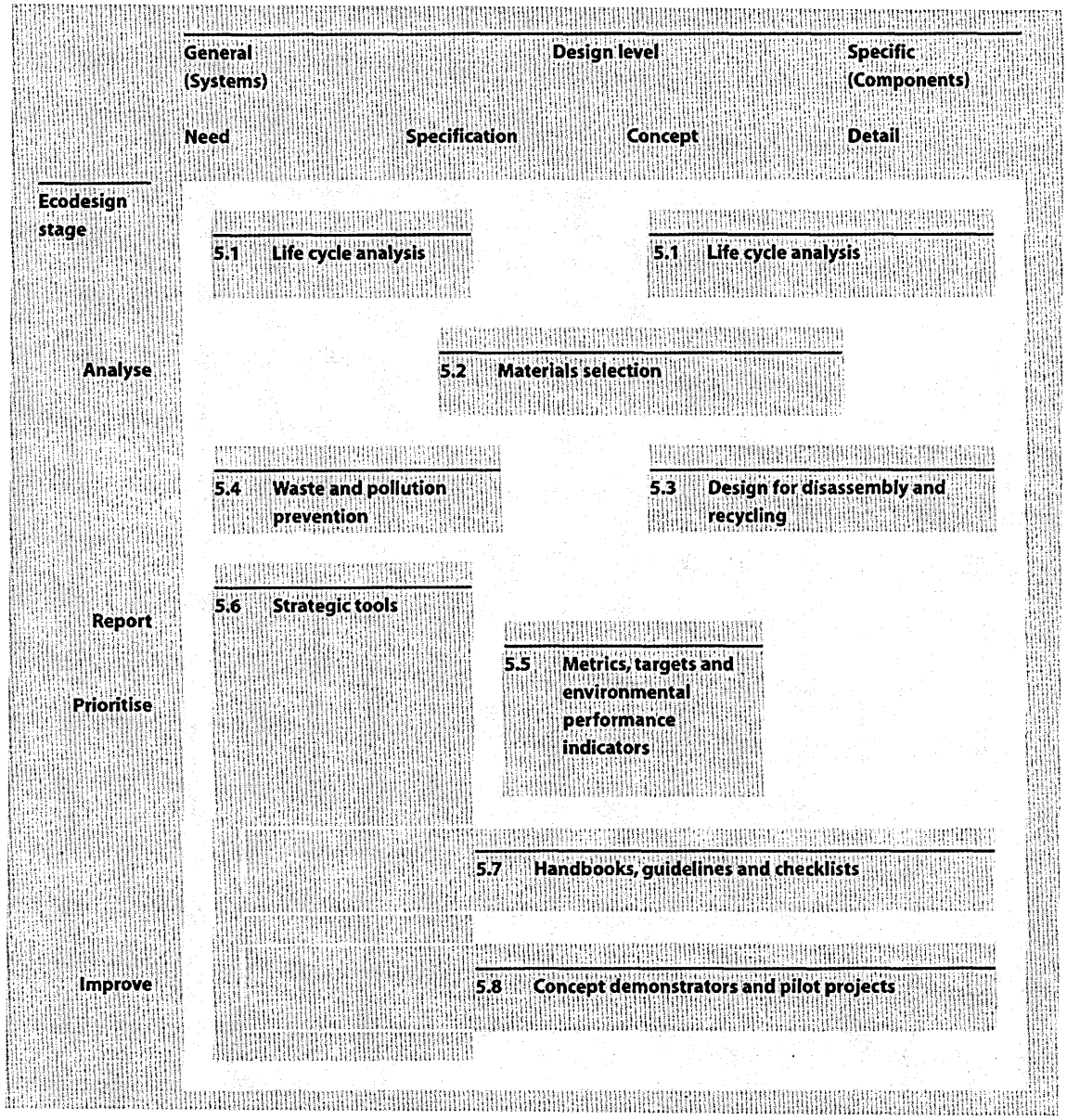


Figure 15. EcoDesign Toolbox (Bhamra et al 1998)

The tools effectively cover the design process at all stages. They range from very detailed technical tools such as LifeCycle Analysis (LCA), to more strategic tools that offer indications for improvements for current and future product designs e.g. the EcoCompass. (see figure 20) Some tools are software based, some visual and some manuals and checklists, and have all been created with the intention of being used in the design process. Some need a specialist or training to be able to operate them, others are extremely simple to use.

4.6.1 Lifecycle Assessment Tools

The tools initially developed were often based around assessing the lifecycle impacts of the product. These Lifecycle Assessment (LCA) tools and software to complete them are extremely complex and demanding processes if embarking on a full-scale assessment. It has been found in previous studies that presenting these assessments to non-specialist is often non-constructive:

"Environmental specialists regularly try to make the situation clear by showing results of LCAs and the environmental impacts (in terms of damage) of products and processes. However results of an LCA are complex and hard to understand."

(Vögtlander et al 2002)

4.6.2 Eco Indicator 95

In 1995 the Eco-Indicator tool (Delft Technical University) was developed to facilitate the understanding and use of the tool for designers, as a more user-friendly version of LCA. The Eco-Indicator purports to be *"...an easy to use instrument that enables the designer to analyse a design solution and to select the most environmentally friendly of the various options".* (Technical University of Delft 1995) There have been some criticisms of the EcoIndicator that it is still too complex to be accessible and usable. (Lofthouse 2001) Another criticism of tools such as the Eco-indicator is that it is *"damaged based"* (Vögtlander et al 2002) so reports the negative effects of the design, not the positive or beneficial value offered by the product, or indeed how these considerations are balanced. In this way, a design for a new wheelchair design, for example, that considerably increases the independence and functionality for the user might score lower with Eco-indicator. So the negative score is discouraging, and may even just be dismissed as unimportant in comparison to the benefits achieved through the new improved model.

4.6.3 Eco costs/value model

Vögtlander attempts to address this oversight of the value added during by the design, by virtue of the 'Eco costs/value model'.

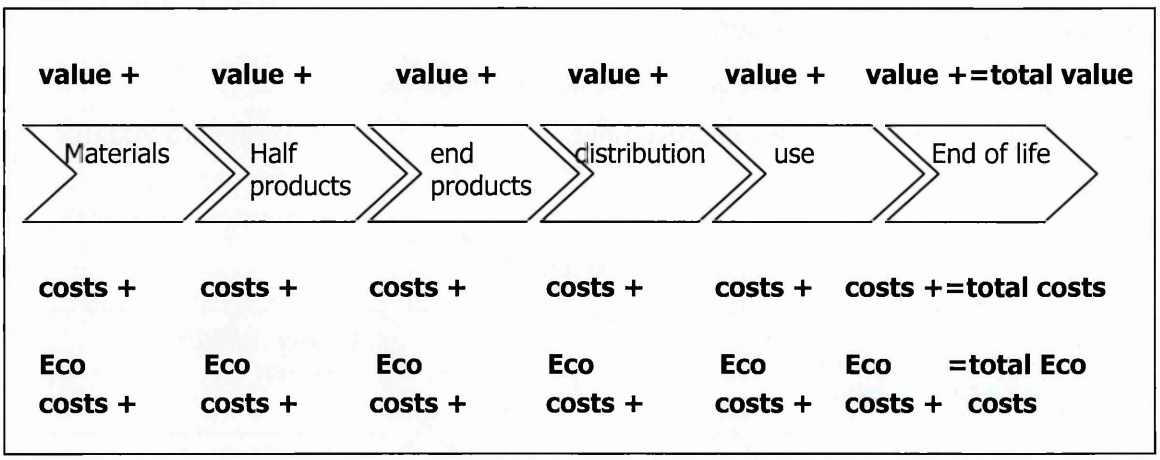


Figure 16. The basic idea of combining the economic and ecological chain (Vögtlander 2002)

This begins to show correlations between the environmental and economic fields, justifying it in business terms. However, the value considered here is in fact the economic value, and there is no account taken for the usability value, the consumer interface, or other considerations which make successful sustainable products, ie...social issues.

4.6.4 Philips Five Focal Areas

A more simple tool which addresses the concerns about the user interface is the Five Green Focal Areas which were developed by Philips Environmental Services. These tools are used to focus on improvement areas in the design of their products, but also as visual indicators to communicate via their reports and other published material.

Figure 17. Philips Five Green Focal areas. (Royal Philips Electronics 2000)

Nevertheless, the simplicity and non-relatedness of the focal areas could be suggested to have more risks in compromising or not providing full information for the proposed improvements.

4.6.5 EcoDesign Strategy Wheel

Brezet and Van Hemel (1997) developed the EcoDesign Strategy Wheel to help organisations choose which EcoDesign strategy to tackle. The tool can provide can

- Stimulate the creative design process
- Assist in visualising current environmental performance
- Highlight opportunities for improvement (Bhamra 2002b)

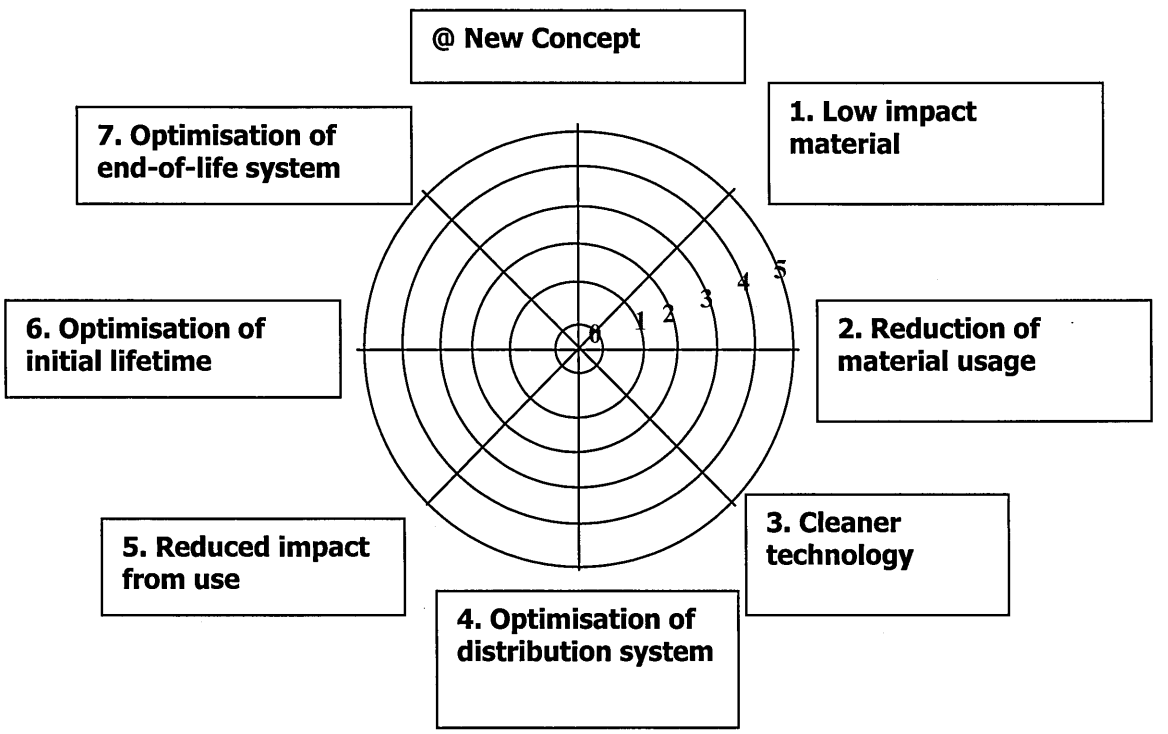


Figure 18. The EcoDesign Strategy Wheel (Brezet and Van Hemel 1997)

The tool is useful in comparison of an old product with a new proposal, so that it is clear where the areas of improvement have been, but also areas for further improvements in the future. Product impacts can be mapped onto the wheel for a visual reference:

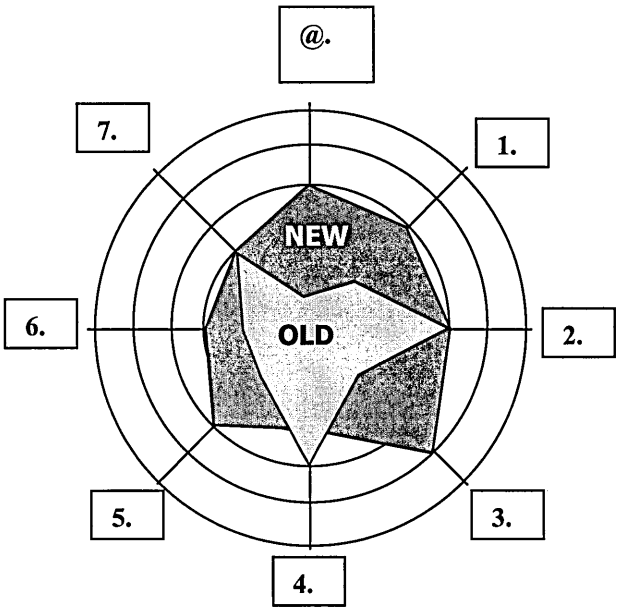


Figure 19. Example Ecodesign Strategy Wheel mapping

However, to compare two products there would need to be two alike to be able to offer a true comparison, and to begin to utilise the tool it requires a reference point from which to score.

4.6.6 The Ecocompass

The Eco Compass tool resolves some of the problems with scoring by rating the existing product always as a level rate of 2. The new product is then scored comparatively against this.

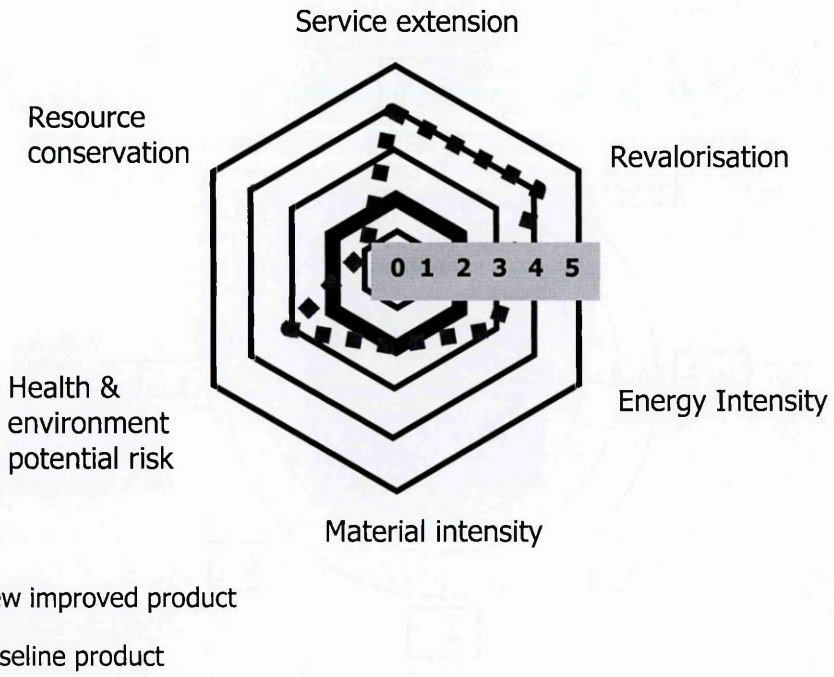


Figure 20. The EcoCompass (Fussler and James 1996)

The EcoCompass is used as a creative method to envision a sustainable future and back cast from it, and to identify the necessary innovations that will move towards sustainability. (Fussler and James 1996) Nevertheless it still relies on quantitative information such as LCA or EcoIndicator information to make it reliable. It could be also suggested that for sustainable design as well as many of the other EcoDesign tools reviewed, it is missing a breakdown of the social area of sustainability.

4.7 Sustainable Design tools

In view of the relatively recent maturing of design to sustainability issues rather than ecological, the number of tools for sustainable design is fewer and less developed. Some existing sustainable design tools and processes will now be reviewed:

4.7.1 UNEP Sustainable Product Development 'characteristics'

The United Nations Environment Program - Working Group on Sustainable Product Development suggest that 'sustainable products' might be defined by the following seven characteristics:

Services as SPD-e.g. transport 'pool', delivered nappies, rental products etc

Strategic Design for SPD – holistic design and planning that meets the need and considers all the interrelated environmental impacts e.g. logistics, space planning, resource use planning, relevant policies towards sustainability.

Optimised Design for SPD – modular, multi-functional and upgradable products that enforce SPD e.g. all-in-one printer, fax scanner and photocopier

Dematerialised for SPD – virtual libraries, digitised video, software products that replace physical products, Tele-working systems that allow people to work at home e.g. reduces impact from transportation

Life cycle design for SPD – a physical product that is sustainable through every stage of it's life cycle

Longevity for SPD – products and component parts that are designed to have an optimal lifespan

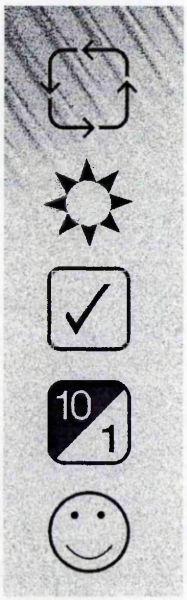
Positive Aspects for SPD – a product that has negative aspects, which are totally outweighed by the positive ones e.g. photo-voltaic cells which harness renewable solar energy but have some negative environmental impacts in manufacture.

(UNEP1997)

Once more, even though titled Sustainable Product Design, many of these characteristics are based on environmental credentials, rather than others for sustainability.

4.7.2 Biodesign principles

Edwin Datchefski's Biodesign principles (1999) attempt to take into account sustainable design rather than purely EcoDesign by providing user friendly and easily recognisable symbols:



CYCLIC The product is made from compostable organic materials or minerals that are continuously recycled in a closed loop.

SOLAR The product in manufacture and use consumes only renewable energy that is cyclic and safe.

SAFE All releases to air, water, land or space are food for other systems

EFFICIENT The product in manufacture and use requires 90% less energy, materials and water than products providing equivalent utility did in 1990.

SOCIAL Product manufacture and use supports basic human rights and natural justice

Figure 21. BioDesign Principles (Datchefski 1999)

Here these suggest attributes for design, with the additional feature of the social element, but still the social element is difficult to segment into manageable concepts for design.

4.7.3 Sustainability Circle

Peter James co-author of Driving Eco Innovation (1997) suggests another tool for product development and design called the Sustainability Circle. This he suggests *"complements more quantitative approaches such as the 'Eco-Compass' or 'Eco-Points' ...and provides a simple, but effective, means of assessing them..."* (James 1997)

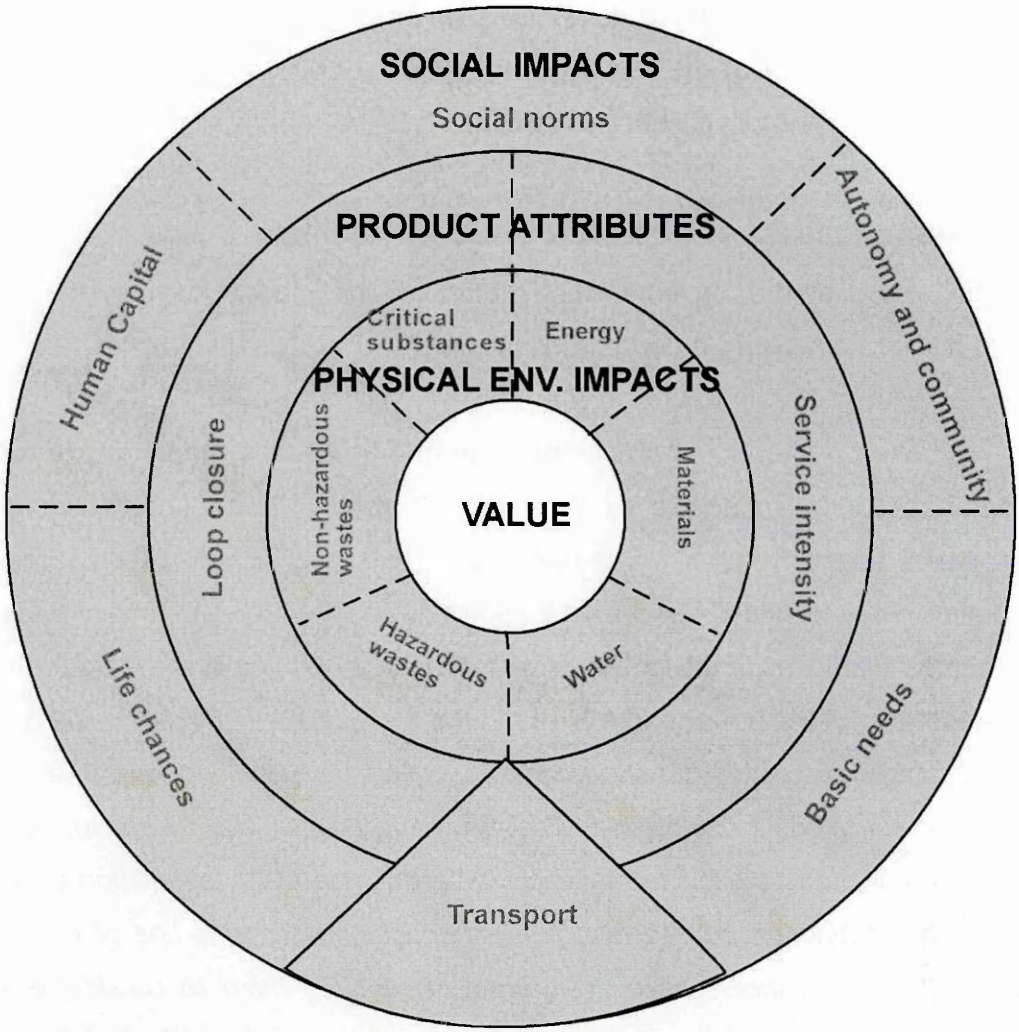


Figure 22. The Sustainability Circle. (James 1997)

Another issue that was addressed by this model is the identification of the need for *"assessments which present information in terms of a few states rather than in highly complex forms or ones that are summarised into a singly number"*. (James 1997) So moving from the numerical to a visual format.

The Sustainability Circle tool also breaks down the social elements for design further than most other tools for sustainable design so far.

The DEMI website, was established as a resource and guide for designers identifies 6 principles for design for sustainability such as **Equity, Sufficiency, Systems, Efficiency, Appropriateness, and Scale.** (DEMI 2001) Of these principles most can be equally applied to both environmental and social areas, which suggests that they

are more macro concepts for consideration. Another author tackles the social issues by suggesting the **Enabling potential**, **Minimising the need for mobility**, and the encouragement of **Integrating and sharing.** (Manzini 2002) However the practical application of these concepts is not clearly explained.

4.8 Implementation of design for sustainability

This section looks at the implementation of the design models such as the ones discussed earlier, particularly in design consultancies.

4.8.1 Understanding and use of appropriate tools

In a literature survey conducted by Baumann, Boons and Bragd (2002) over 650 articles were taken from a cross-disciplinary database about Green Product Development. They identified several 'white spots' in the literature, the main areas of which are particularly important for this project. What was missing in the literature was the understanding of the use and role of tools on a micro level (within companies), the practical industrial application of tools for 'green product development', and a strategic orientation on the product development process within companies. (Baumann, Boons, Bragd 2002) The authors explain the reason why this gap in understanding may be that *"Environmentally conscious design and manufacturing presents one of the most difficult challenges engineers have ever faced. It requires them to consider issues outside their area of expertise, far beyond the boundaries of the individual firm and over time periods much, much longer than the typical product-planning horizon"* (Baumann, Boons, Bragd 2002. Sourced in Thurston 1999) Another author presents reasoning for the low levels of implementation in industrial design as being the lack of **appropriate** tools for industrial designers, and little understanding of the criteria required to develop tools that are more appropriate. (Lofthouse 2001)

It is presumed that Baumann, Boons and Bragd use the word 'engineers' as a wider term used for any of those involved in the product development process. But, should those who are developing tools consider the influential actors in the system to only be **engineers**, then this presents another problem with implementation. Lofthouse identifies that ecodesign tools are not suitable for industrial designers, because the tools were originally developed for engineers. (2001)

In their literature survey Baumann, Boons, Bragd (2002) found that literature of the application and effectiveness of tools in the design process is also poorly researched: *"Unfortunately...the number of publication reporting on user aspects and on the **effectiveness of tools** is far lower than the numbers of publications that (conceptually) describe tools."*

It is evident that more effort has been placed into the creation of tools rather than paying attention *"to the way in which the environmental tools and techniques should be integrated into the design process"* (Mc Aloone T chapter 1 page 6). Some literature even suggests that tools may not be the single most important element in comparison to the management and organisation needed to ensure effective implementation. The existence of tools is not sufficient and perhaps not even necessary, but the **process** of implementation is. (Baumann, Boons, Bragd 2002)

However, Baumann, Boons and Bragd (2002) conclude their extensive literature survey with 5 characteristics of this research field:

1. *Too many normative suggestions, with little practical relevance or testing*
2. *Too much tool development*
3. *Too little linkage between strategic intent and content*
4. *Too little about the larger context of product development*
5. *Too little recognition of the system's perspective in policy making.*

4.8.2 Levels of implementation into design

Documented examples of implementation of EcoDesign once more predominantly feature the design activities of larger manufacturing organisations. Charter (2001 p232) documents 5 case studies of EcoDesign that have been implemented within Hewlett Packard, IBM, Kodak, Electrolux and Body Shop International. These outline the main implementation considerations with reference to such things as the management structure of the organisation, and the issues that affect large departmentalised companies.

However, to date there is a lack of case study documentation of implementation into design consultancies. Dewberry (1996) noted that *"in UK based design consultancies, ecodesign is rarely (if at all) integrated in a systematic way"* and Lofthouse (2001)

discovered that neither the industrial design nor EcoDesign literature demonstrates a clear understanding of the industrial designers role in EcoDesign.

4.8.3 EcoDesign Implementation processes

Charter (2001) suggests a seven-step implementation process. This process moves from awareness raising, selling business benefits, R&D pilots, integration and strategy within a company:

- ***EcoDesign ignorance***
- ***EcoDesign starter***
- ***Green R&D projects***
- ***Technical integration***
- ***Semi-ecodesign integration***
- ***Total ecodesign integration***
- ***Green Strategism***

(Charter and Tischner 2001)

This process is discussed in more detail in chapter 5, but it is noted that this process offers a step-wise progression, likewise in the Australian Implementation process that identifies the 7 stages of EcoDesign implementation and who is involved:

Stage	Who involved
Analyse opportunities	Managers, designers, engineers, accountants and marketers
Promote EcoDesign within company	Managers
Set goals and identify strategies	Managers
Apply ecodesign tools	Designers, engineers
Develop the product	Managers, designers, engineers, accountants and marketers
Market the product	Marketers
Evaluate	Managers, designers, engineers

Figure 23. Australian Implementation Process (Bhamra 2002a)

Examples of the actual implementation of these processes are not evident from literature, which again highlights the lack in case studies.

4.8.4 Drivers and Barriers for EcoDesign in SME's

One of the key drivers for EcoDesign is the oncoming environmental legislation such as the Waste Electrical and Electronic Equipment Directive, which means *"producers will be responsible for taking back and recycling electrical and electronic equipment. This will provide incentives to design electrical and electronic equipment in an environmentally more efficient way, which takes waste management aspects fully into account"* (Europa - European Union Online 2002). This means, therefore that economic drivers are in force for companies who are affected, and *"design can therefore play a key role in reducing the costs of recycling"* (McAloone 2000)

Van Hemel and Cramer (2002) carried out a study of 77 Dutch SME's in order to learn which factors stimulate SME's towards greening of their products, and which factors hamper them: Their conclusions are summarised as follows:

The most cited internal drivers, (with the most frequent and significant indicated in bold) were:

- **Need for increased product quality**
- Image improvement
- Need to reduce costs
- **Innovation opportunities**
- Employee motivation
- A sense of responsibility
- **Recognition of new market opportunities**

The most cited external drivers were:

- **Government Policies**
- **Customer demands**
- Market demand/competition
- **Industrial sector initiatives**
- Waste charges
- Environmental requirements for design awards

Van Hemel and Cramer (2002) concluded that *"internal stimuli are a stronger driving force for EcoDesign than external stimuli."* Which indicates that initiatives with in companies may be a much more powerful force for change than responding to external conditions.

The most cited barriers by Van Hemel and Cramer (2002) were:

- ❖ Not perceived as their responsibility
- ❖ No clear environmental benefit
- ❖ No alternative solution available

It is apparent that the most significant barriers above are also internal barriers.

4.9 Organisational change

Previous literature has explored the relationships between organisational change research and 'environmentally conscious design' or ECD (McAloone 2000). It establishes that processes of change are important for integration or implementation of design with considerations for environmental issues, as in Figure 24.

Model of ECD integration	Kotter's eight phases of organisational change
Positioning in the world	1. establishing a sense of urgency;
Initial/sustained motivation	2. forming a powerful guiding coalition; 3. creating a vision;
Communication/information flow	4. communicating the vision; 5. empowering others to act on the vision; 6. planning for and creating short-term wins;
Whole-life thinking	7. consolidating improvements and producing still more change; 8. institutionalising new approaches.

Figure 24. Relationship between model of ECD integration and Kotter's model (McAloone 2000)

Authors of change literature identify factors that are seen to influence the successful transformation within the company for product development. They are identified as:

- Change Champion
- Improving Communications
- Improving customer focus
- Building a cross functional team and co-location

- Overlapping processes
- Developing a vision of success
- Building the necessary infrastructure
- Incremental implementation
- Product strategy
- Learning through doing

These factors are considered important when approaching practical change of an organisation as undertaken in this project.

4.10 Sustainability as a driver for innovation

It is recognised that innovation is a key factor in the development towards sustainability and *"the agenda is now being set for Eco-innovations in sustainable products, services and lifestyles."* (Bhamra, Evans, Sherwin 1998) The literature also discusses the role of environment as a potential business driver, and opportunity for innovation (Manzini 1998), a way to be proactive and create new markets for products and services (Bhamra, Evans, Sherwin 1998), or an opportunity to propose new win-win solutions. (Manzini 1998)

Vollenbroek (2001) also cites that sustainable development requires a different approach to innovation thinking, which requires the involvement of those outside of the usual actors for innovation:

"...the strive for sustainable development needs an approach towards innovation that can be characterised by society pull: the society has to decide which (balance of) economical, ecological and social goals are to be met"

The literature discusses that sustainability provides and requires a direction for innovation in that it requires a strategic, holistic view, which can in turn lead to new market direction. However, what is not often discussed is why and how businesses can be encouraged to innovate to make such radical changes. One argument is the development of new markets, but there is an act of faith about radical innovation (Fussler and James 1996) and for many this is also connected to high risks.

Interestingly there is discussion about the importance of innovation for sustainability, but not so much about sustainability for innovation, or at least not in direct references...they tend to refer back to the broader ideals of sustainability in business.

e.g. *"We use (the eco-compass) to identify and evaluate improvement projects and as a creative method to envision a sustainable future and back cast from it. We can then identify the necessary innovations which will move us towards sustainability."*

(Fussler and James 1996)

4.11 Chapter conclusion

This literature review chapter has explored the three areas of literature described in Figure 8. Sustainability in business has been explored through the recognition of sustainability as a viable business concept. The transitions of businesses towards sustainability have been so far primarily documented for large manufacturing organisations. Design tools that have created and researched so far have been described and evaluated as to their appropriateness, usability, and implementation into design. It has been identified that there is a recognition of sustainability being a driver for innovation, but what is most apparent from the literature survey is the lack of implementation examples of sustainability or EcoDesign into design consultancies

Chapter 5. Implementation

This chapter outlines CDN's initial understanding of the subject, describes the process of change through the case study project, and identifies the factors that facilitated the learning process.

5.1 Initial reactions in CDN

The knowledge and understanding within CDN of EcoDesign and Sustainability at the beginning of the project was mixed. There was evidently enough insight through the CEO and Innovation team leader for this thesis project to take place, through their recognition of future importance, as explained above.

5.1.1 Knowledge and understanding of EcoDesign

Semi-structured interviews were carried out with four Team leaders. The content of the interviews was firstly questions about the CDN business for some knowledge about future aspirations. The second part was an enquiry into the personal levels of knowledge and understanding of the subject. (See Appendix A)

Through the interviews carried out and through general observation, it appeared that the understanding of EcoDesign ranged from nearly comprehensive to almost none. Moreover, even those with a very good understanding of EcoDesign felt powerless or did not have the understanding to be able to use it in their everyday work, or transfer elements to their projects.

The individuals who had higher levels of understanding tended to either have a personal interest, or had had courses during university. It was observed that those who had had education in EcoDesign were from France, not from Spain, which was a sign of cultural differences and possible level of development of the subject area between countries.

Even those with a good understanding of EcoDesign felt powerless, or did not have the understanding to be able to use it in their everyday work

When asked to describe EcoDesign most identified environmental issues such as:
".something to do with the environment"
"...making a product thinking of the environment. It's not only the waste at the end of the product's life, but also the suppliers, users and clients influence"
"...taking into account ecology"

Some identified where in the design process it might need to be considered:
"...in the concept not so much in the materials"
"...about analysing the life of the product and its environment. Materials, fabrication, distribution, transport, packaging, storage, use, waste, reuse."
"...could be involved in the Redesign methodology"

The external influences were mentioned:
"...the responsibility of the clients as well as CDN"
"...part of an ISO standard"

And others had rather negative connotations to the subject:
"...not important"
"...difficult to apply"

Even though the importance of generally looking after the environment was recognised, most did not see what the connection to CDN 's business would be.

5.1.2 Motivations and drivers for EcoDesign

Motivations for 'doing' EcoDesign were mostly low, apart from the few individuals that had a personal interest. There appeared to be no internal pressures for change internally apart from the fact that the author was present! The external pressure from clients was also low, particularly with regards to Spanish clients. Even so, there were case studies of four CDN projects that had had some elements of ecology as criteria outlined by clients within the project brief. These were often single issues focus, such as for recyclable materials, or reduced volume. However there was recognition that in the future, particularly with the increase of international clients, and legislation, that there may be increased pressure for change. It was identified that there may be

indirect pressure from legislation via large companies who are faced with stronger compliance issues, and consequently larger penalties. Therefore there was the desire to know how to meet future customer expectations.

5.1.3 EcoDesign concerns

The concerns about EcoDesign were that it is firstly not clear why or how it would feature in everyday work.

"People in CDN have an understanding of the problem, but are not used to involving it in the projects....some think 'it's not my problem' "

There was also the concern that the value it gives to the customer is not clear, and ecological issues have the conceptual image of lower quality, low technology and 'worthiful' living styles. The cost imperative was also identified as a difficulty, with which EcoDesign was considered to be extra cost, both for CDN and consequently the clients. If the client motivation were not there, and EcoDesign was proposed to them, then any limitations of the clients manufacturing technology would be a hindrance, or CDN's EcoDesign achievements may be compromised:

"It is useless without the clients technology to carry it out"

Combined with this, the concern for the lack of importance of ecological issues within Spain was seen as a barrier for current work, even though some recognised future significance:

"It's a big change of mindset for out clients and for us. In Spain ecology is not important, but will be in the future"

5.1.4 Knowledge and understanding of Sustainability

Sustainability, as is often the case with this newly developing subject, was initially not understood well in CDN. After the introductory email sent to all personnel, some asked for descriptions and definitions, many were initially suspicious of its intentions, or failed to see any relevance to CDN's business. It was generally identified that environmental issues would be part of the concept of sustainability, but further issues were not often

articulated. In some cases sustainability was viewed more as a separate methodology in itself like CDN's Redesign to Cost service, which is applied at intervals rather having implications for the whole product development process including product strategy.

When asked to define sustainability, some had no idea:
"...can you give me a definition please?"
"...don't know"

Some connected the idea to EcoDesign:
"...the result of EcoDesign. You do EcoDesign in order to be sustainable"
"...the same as EcoDesign, but more about the end of life"

And some characterised it through long term issues:
"...about doing things thinking of the future"
"...something about the long term"

None had a comprehensive definition or concept, and again the connection to CDN business or to design in general was not clear to most personnel.

5.1.5 Motivations and concerns for sustainability

Sustainability was generally not understood to the level where there would be any clear concerns or motivations. However, the fact that the CEO and innovation team leader had agreed to the project, shows that the top down approach provided the first motivation.

5.1.6 Section conclusion

Therefore, the main findings from the interviews and initial involvement within CDN were that their was generally a low level of understanding of the subject. There were more barriers than opportunities identified by the personnel, and there was a lack of understanding about what it would mean for direct CDN business.

5.2 The Flores Valles Case study project

At the time of joining CDN, a project for a company called Flores Valles was being carried out. Flores Valles manufacture furniture for scientific laboratories, and had identified the need for improvements in their range, both in terms of innovative possibilities and the design. The current products they manufacture tend to last up to 30 years, therefore are not replaced frequently. Flores Valles was interested in the innovative possibilities that might increase the business made through single clients, as well as looking to compete with other companies by virtue of design advantages.

5.2.1 Project progress at point of joining

Flores Valles had opted for the full process of innovation before design, to identify new areas of markets and a product strategy for the new range. At the point that the author joined the project, it was at Phase 2 of the design process, which is where aesthetic concepts are designed. At the close of the innovation phase a set of product attributes had been identified and three themes for the design proposed. One of the key themes was the 'ecological manufacturing'.

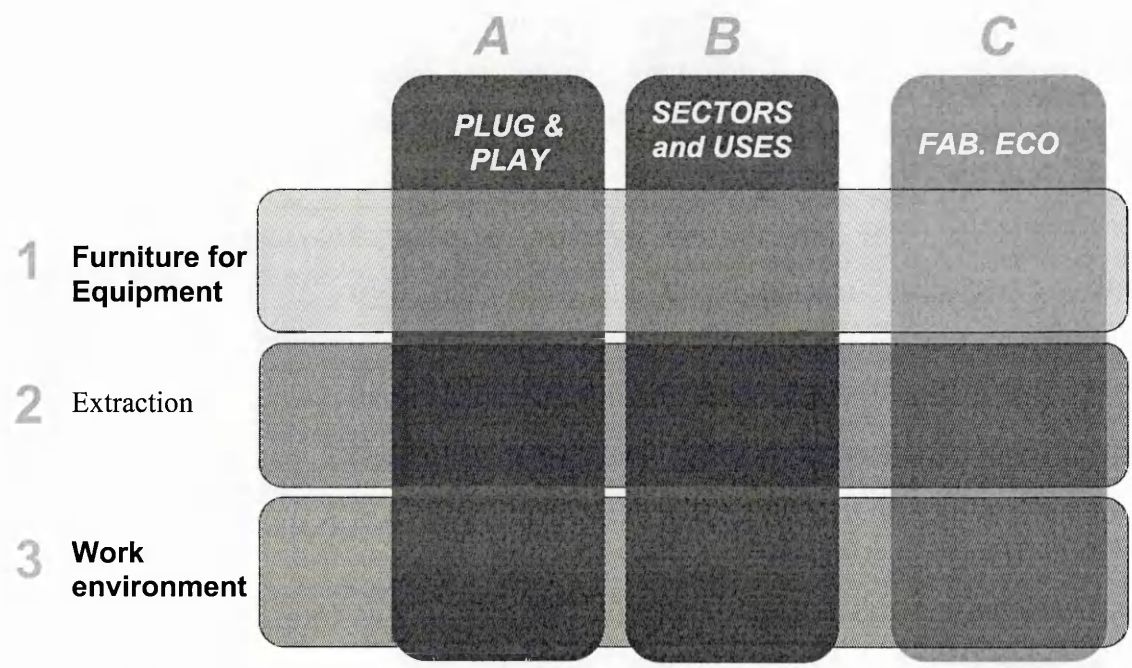


Figure 25. CDN's proposal to Flores Valles

So the ecological element had already been proposed to the clients, even though CDN were unclear what that would actually mean in the design process or as a product, and had not explained it in detail to Flores Valles. At this point however, many of the decisions about product strategy, focus areas, and design attributes were already made. The work to do from this point onwards consisted of designing three concept proposals, which would be concerned with different aesthetic forms, as well as a limited variety of functional attributes. Basic materials should be proposed with approximate costings in the next presentation to the clients, until which there was a relatively short timescale. Therefore the designers needed guidance as to the content of the ecological part.

5.2.2 Initial information given to designers

The designers working on the project, including the Design team leader, were presented with a general background to Design for the Environment, EcoDesign and Sustainable design with examples of design attributes and foci for each level. (See Appendix B) It was felt that an overview of the macro issues was essential as part of the information. They were also presented with the Eco Design Strategy Wheel with the aim of assessing the proposal so far, and to prioritise areas for improvement in the design phases to come. However, time was a constraint, so 8 attributes were prioritised beforehand by the author, so that the information for them to work with would be as concise and practical as. These were as follows:

1. Making the furniture easy to disassemble and separate materials
2. Have a series of components that are transferable between the furniture 'team' that can be reused or rearranged in new modules. E.g. interior structures
3. Think about the recyclability of the other parts that are not transferable.
4. Try to avoid toxic coatings and materials where possible
5. Make the materials the most appropriate for the purpose and the expected lifespan of the product
6. Design the products to fit together / stack or be transported efficiently in large quantities
7. The product should be adaptable by the user for their needs
8. Can you use already recycled material?

These were considered to be a minimum for a genuine attempt at tackling the issues that had already been 'sold' to the client, and moreover the most applicable considering the progress of the project so far.

5.2.3 Initial reactions from the designers

The initial reactions from the designers were as if they had been presented with yet another problem to resolve, (given to them by the Innovation department!) and that they feared for the time allocated to them that they would not be able to achieve it within the time frame. Another reaction was that they felt that the 8 prioritised areas were still not specific enough and they needed more detailed information about materials, costs, and exact answers to questions and comments such as *"Should I use steel or aluminium here?" "Screws aren't ecological are they? What can we use instead?"*

The author perceived that they expected a one way conveying of information that provided them with all the answers. Education and two-way discussion was needed to be able to educate the designers in the most appropriate way for the task.

It was observed that ecological issues were being perceived by the designers as a separate issue to their design process, and yet another set of criteria to fulfil. What was <u>not</u> recognised by them was the 'Eco-potentials' of the project that had been completed so far.

5.2.4 Shift in perception

After this initial rather negative reaction, and a weekend of digesting the information, the Design Team Leader altered his position and appeared to have understood the information well. He had become enthusiastic to learn and understand more about how to bring this into the project, and into the design. The importance of two-way learning between the author and the Design Team Leader was understood. And a more co-operative approach followed. At this point he also suggested presenting the 'Eco' information (be-it in a more visual format) to the clients at the next presentation... *"As something we should have presented to Flores Valles earlier on in the project"*

This was a key realisation by the Design Team Leader, that less could be achieved at that point in the project progress.

...it was also suggested presenting the 'Eco' information to the clients at the next presentation... *"As something we should have presented to them earlier on in the project"*

5.2.5 Progress in Design

The designers developed three concepts that involved different aesthetic and functional features. After an initial period of difficulty and discussion, and a time for reflection, the Design Team Leader reported to have been able to include at least some of the 8 attributes. The key element of the designs (encouraged by the author) was the 'Plug and Play' modularity that would allow the updating, replacement and potential reuse and recycling of parts. This was considered primarily as the element that would have the most potential effect should Flores Valles decide to adopt such a system, and also the most potential negative environmental effect should there not be an element of environmental responsibility also coupled with the system. The design of this type of systems appeared to be manageable for the designers and engineers, with their level of experience. This modularity had already been proposed as part of the 'Plug and Play' concept, but the 'Plug and Play plus Eco' concept has the additional feature of being able to be reused or recycled, retaining the value of the components.

Therefore the designers concentrated on making as many interchangeable elements such as internal structures as possible.

5.2.6 Presentation to the clients

A presentation of the ecological considerations in the project was developed for the Flores Valles. It included a general background to the subject, attributes of products, but most importantly, an addition to the 'Plug and Play' concept that had been proposed earlier. (See Appendix C) This involved the consideration of retaining a high service with the customer whilst also making use of the value of raw components and materials...which can be designed to be more reusable/recyclable, should Flores Valles opt for this. The Design Team leader requested, after having understood the concept of sustainable design, that the presentation should actually be named 'Sustainable Manufacturing', not 'Ecological Manufacturing', as he considered it to have a better

image, and would communicate better with the clients. He also considered that the cyclic system proposed as part of a more sustainable system would be more attractive to Flores Valles than simply considering materials and recycling. It was requested that the presentation should involve some of the elements of the information presented to the designers, plus more visual and company examples, which would explain the business case to the client more efficiently.

There were doubts about what they could reasonably achieve, but client education was considered important.

The time period between having no knowledge of EcoDesign and presenting it to clients was a matter of weeks.

The 'Sustainable Manufacturing' presentation was to be printed rather than screen based, and would be given to Flores Valles. It was for them to take away and consider as part of the proposal, to give their reactions at the following presentation.

It was observed that CDN and the Team Leader had no doubts about educating their clients about a subject so new even to themselves.

5.2.7 Reactions from Flores Valles

The Design Team Leader expressed some concern about the receptivity of the client to the 'Sustainable Manufacturing' presentation. He expressed concern about the type of company and personnel, that they may not be innovative enough, or receptive enough to change for these quite 'radical' (to them) ideas. So, much as the intention of educating clients may be well placed, there still remains the initiative from the clients to accept the reasoning, have the foresight to be able to see the potential benefit, and then to commit to action. At the time of writing, the reactions from Flores Valles are still pending.

5.2.8 Conclusions/observations from Flores Valles case

An observation of the aptitude for change within CDN is that it is evident that admitting error or tardiness with ideas to the client is not considered to be a 'faux pas'. This suggests that they are more open with clients to discuss issues in a two-way situation.

There was a very quick leap from internal learning about EcoDesign and sustainability to external education of clients.
For EcoDesign most attributes such as the 8 prioritised, are project specific, so presenting the same material to all clients may not be advisable, so a process to deal with the variety needs to be suggested. There may be general information about sustainability for all clients, followed by a document more tailored to the clients and products.

There were some concerns about the amount of change suggested for the clients, that they are not prepared for such changes, so may not accept the ideas well. However Flores Valles react eventually, it is still considered to be an achievement to have brought to the issues to the attention of the designers, and to begin a dialogue with clients for future projects.

5.3 Post Flores Valles

The Flores Valles project had the effect of introducing the subject and increasing the enthusiasm about the subject with the Design Team Leader. Soon after the presentation of the 'Sustainable Manufacturing' document to Flores Valles, he proposed that he should also present it to another client who produces surgical equipment. The presentation was adjusted slightly to fit the products attributes section closer to the perceived possibilities for this type of product.
It was felt by the author that despite this alteration, a more detailed assessment of the actual possibilities, strengths, weakness and potentials for this product type would have been more advisable to be able to pitch the presentation in the most appropriate way. However, it served also as an educative introduction to the client, and they are considering the possibilities.

5.3.1 Catching the enthusiasm

It was felt that the enthusiasm of the Design Team Leader should be further encouraged with more selective information about the subject. Selective because it seemed ill advised to give information overload, so information was selected according

to appropriateness at that time and person targeted. What was needed was inspirational visual examples so that he could see the design outcomes of such an approach, as well as giving a little more depth of background. The information chosen to be the most appropriate was Edwin Datschefski's 'The Total Beauty of Sustainable Products' (2001) which not only has visual examples, but also a simple set of icons that can be considered within design. It was decided that this was far more appropriate than presenting another assessment tool, which had not been well accepted beforehand. In the initial information given to the designers, it was established that these did not instil motivation or inspiration.

The Datschefski book appeared to have the desired effect in that it began to infiltrate the design office, and feedback showed more than one person's enthusiasm. Comments such as *'this is the future for CDN'* were made, and even from another Team Leader who had initially been very disinterested and sceptical about the subject.

"This is the future for CDN"

Datschefski's website, which helpfully has a Spanish translation, was then posted to the Design Team Leader, who subsequently forwarded it to the whole company. This resulted in a few mostly positive comments about its relevance to CDN, including even someone from Information Technology, who commented on future importance.

The result was that the awareness about Sustainable Design was beginning to be raised, and there appears to be some enthusiasm, (although not with all personnel) even though it was not clear to them exactly what actions CDN would have to take in order to do it successfully.

5.3.2 A further driver for change

At the outset of the project in CDN, one of the barriers for change towards sustainability was expressed as being that most clients were not currently interested, or indeed asking for any elements of sustainability in the project brief. There was however, the view that this may well be important in the future for clients.

This occurred much earlier than expected, as a new client approached CDN with a furniture project in which one of their criteria was sustainability.

A new client approached CDN with a furniture project in which one of their criteria was sustainability.

This project was to start at a later date, but another adapted version of the presentation made to Flores Valles was presented to the new client to indicate the awareness of the subject in CDN.

The effect of the timing of this new project serves as another motivation for the change within CDN towards sustainability. Once there is the realisation that more clients will begin to ask to for it, there is a powerful driver for change.

5.4 Design Tools

In this section tools for design will be discussed in the context of CDN. The tools described are often EcoDesign rather than sustainable design due to the level of development, research and appropriateness of tools

5.4.1 Properties of design tools

During this study in CDN it became apparent that the properties of design tools for sustainability appear to be extremely important in the motivation of designers, likewise identified by Dr Sherwin:

"As the 'culture of designing' was so dominant, designers showed most interest in ecodesign tools and methods that 'generate' ecodesign innovation, rather than managing, evaluating or assess them ('pre-ecodesign' rather than post-ecodesign' tools)" (Sherwin, C. 2000)

The existing EcoDesign tools are predominantly assessment based, or rely on some form of comparison with existing designs. So these tools do not suggest action points to designers before they begin, but merely function as correcting or suggesting improvement areas once the design is underway or almost complete. (By which time

there is often very little time to alter designs) The Ecocompass (Fussler and James 1996) suggests areas for improvement for which a designer about to begin deciding the functional and aesthetic details is very difficult to manage. These concepts are often too large or too macro to manage directly in detailed design.

A similar reaction was identified with the designers in CDN, who after being presented with tools such as Ecocompass, EcoDesign strategy wheel, and simple tools such as 'Reduce, Reuse, Recycle' found that these did not suggest to them product attributes or inspirational starting points.

In CDN the final responsibility of the innovation department when passing the project to the Design department, is to have a set of product attributes such as 'plug and play modularity'. It was identified that this would be the best approach in which to suggest to the designers what to consider. Product attributes are what CDN's designers are familiar with as starting points for their part of the project.

What was needed at this stage were easily understandable, quick, inspirational, and visual tools.

The Eco-indicator manual was not even considered by the author to be of any value at this stage considering the volume of information and non-inspirational format. If the document produced for Flores Valles had not been specific enough, for the designers, then it was considered that the Eco-indicator would not be of assistance for progressing further at this point. What was needed at this stage were easily understandable, quick, inspirational, and visual tools. This is a common finding from other similar research has found that, *"due to this diversity of skills and to the time constraints placed upon the design team, detailed and technical environmental analysis tools were not favoured. Instead, qualitative tools that were quick and simple to use were discovered to be popular among designers, who were keen to make some environmental changes in the short amount of time they had available."* (McAloone 2000)

The designers however, did relate well to two particular tools: Edwin Datchefski's Biodesign principles and also to the Philips five focal areas, both of which not only can

create a way of assessing the product's improvements, but also identify attributes to consider whilst designing.

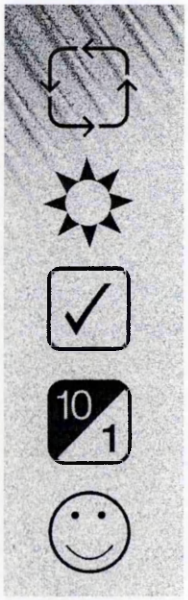


Figure 25. Datschefski. E. (1999) Biodesign principles and Philips five focal Areas

Philips Five focal

5.4.2 Visual stimuli

A similar feature of the Biodesign and Philips tools is their appearance. The fact that they appear simple, attractive and understandable is an immediate advantage for communicating with designers. If this is also coupled with examples of successful design projects facilitates communication and understanding. Coincidentally, both of these tools did also have practical and visual design examples, whereas other tools did not.

5.4.3 Future use of tools

It would appear that assessments for reflection as to whether improvements in design have been made for sustainability might be necessary as a validation of action and investment. This quantitative assessment of EcoDesign improvements is documented and researched in the form of LCA assessments, EcoIndicator. However, these tools

themselves would appear to 'have a time and a place', and are generally unsuitable for use in the design process itself due to the ineffective interface with designers.

However, should tools such as Biodesign principles be adopted, it could be suggested that the qualitative assessment could be made with the scoring system already proposed by Datschefski:

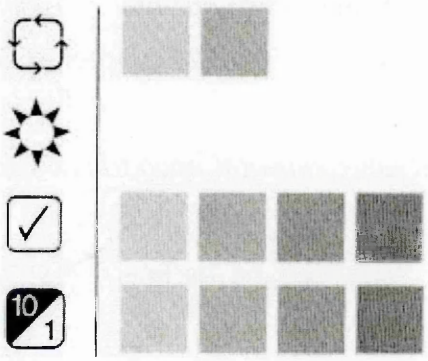


Figure 26. Biodesign assessment tool (Datschefski 2001)

It could be that there is a double level approach to the utilisation of tools, which begins with the designers' toolbox of tools with attributes for design. The second level then comprises of assessment tools and reflection tools, which would point firstly to improvements for future projects, but also to assess the effectiveness of the 'attribute' tools.

Any tools that are utilised in future would need to be ones that fit or adapted to the CDN methodologies for smooth implementation and continued use.

5.5 Implementation Processes for Design

The initiation of the implementation process observed in CDN through the Flores Valles case and throughout the project is an unexpected process of implementation of Eco or Sustainable Design. Processes for the implementation of EcoDesign is often slower, gradual process or developing the idea internally before finally marketing it externally. (N.B. EcoDesign rather than Sustainable design examples are utilised due to the perceived similarity between the implementation processes, and the lack of literature specialised particularly in sustainable design implementation)

Martin Charter of the Centre for Sustainable Design's approach to implementation of EcoDesign into design is as follows.

- ***EcoDesign ignorance**: company unaware of ecodesign issues*
- ***EcoDesign starter**: Environmental manager is in process of selling business benefits of ecodesign within the company*
- ***Green R&D projects**: pilot project being developed in R&D*
- ***Technical integration**: environmental criteria built into engineering procedures*
- ***Semi-ecodesign integration**: Company integrated environmental consideration from idea-generation in one business unit of one product family*
- ***Total ecodesign integration**: Company integrated environmental consideration from idea-generation throughout complete product development process across all products*
- ***Green Strategism**: Business has integrated environmental opportunity searches into corporate strategies*

(Charter and Tischner 2001)

Again, this appears to be an example of a large company that manufactures, with design as a department, as referred to in the literature review. Comparatively, CDN's process, via the Design Team leader was as follows:

- **EcoDesign ignorance** on the most part, but recognition of future significance
- **Proposing an EcoDesign element to client:** recognition enough to cite as important for a project
- **EcoDesign learning:** very fast uptake of information and increased understanding
- **Semi-EcoDesign integration:** EcoDesign considerations integrated into design phase of one project
- **Client education:** Communication of information and selling the business benefits of EcoDesign

The future process potentially may include some of these steps suggested by Charter.

The process in CDN differed from the step-wise process described by Charter. It was a fast, iterative learning process, testing client attitudes simultaneously.

CDN's process: An iterative learning process, testing client attitudes simultaneously.

5.6 Chapter conclusion

The main conclusion of these activities is that CDN's process of change through the Flores Valles project has been different to previously documented patterns. The process has been rapid and non step-wise, going from almost no understanding to presenting to the clients in a matter of weeks.

The tools for design have to be visual, quickly understandable and inspirational, and there are none that are precisely appropriate within CDN at this time.

Chapter 6. Business and context for sustainability

This chapter explores the issues and opinions about sustainability for CDN and identifies the different elements that lead to the acceptance of sustainability. It discusses patterns of change that occurred in comparison to previously documented patterns and makes some notes of caution for future changes.

6.1 A growing business emphasis

At the outset of the project in CDN, it had been recognised by the CEO that sustainability would soon become very important to the business. Figure 27 outlines the shift in emphasis that CDN used as the reasoning behind this recognition. This shows the changing emphasis of businesses over the past few years and their predictions for future years.

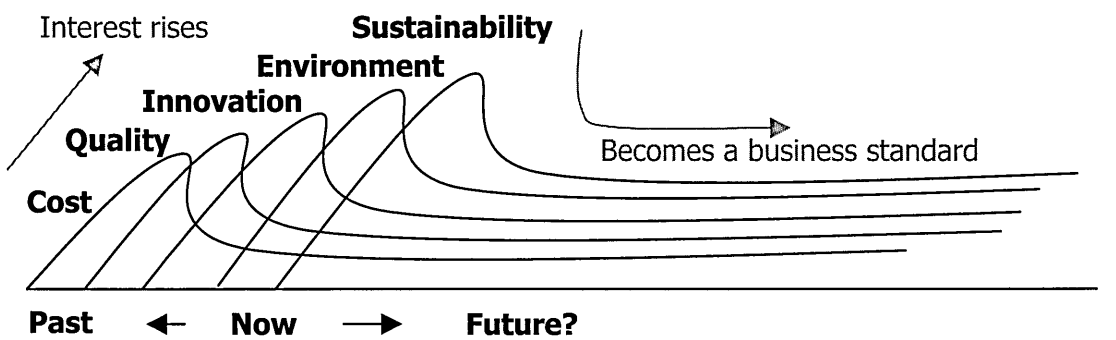


Figure 27. CDN's concept of shifting business emphasis

Each issue has had a period of introduction, which leading businesses have taken as a strong differentiator against competitors. The issue then becomes adopted to the extent that it becomes a standard part of business procedures.

In the past, cost was a differentiating factor, but then became a standard issue as many companies achieved a good level of cost reduction. Quality began to take it's place as the next emphasis, but then both cost and quality began to be taken for granted as innovation is emerging as a method for a company to differentiate. It

appears from the activities of many companies that ecology or ecological design for example is being seen as another possible phase, with sustainability thought to be the next.

During the Sustainable Vision Project for Philips it was found to be the case that companies that have taken this on board have over the past few years increased their environmental initiatives, but have also recognised that the environmental debate is now maturing into sustainability. (Blofeld et al 2002) The world leaders in sustainability see it as a big opportunity for their companies not only in differentiation, but for the long-term success of their company also.

So for CDN business the CEO and Innovation Team Leader had the insight to know that it might be an important issue in the future, although they awaited the seminars to decide whether this would genuinely be the case, and if so, what actions it might involve.

6.2 Sustainability seminars

To give a solid introduction to the subject of sustainability, the author conducted seminars. These included a 45-minute introduction to sustainability and the business case, an exercise for the participants to attempt a brainstorming style exercise to explore concepts for sustainability. A 45-minute introduction to EcoDesign tools and concepts followed this, and time was available for discussion towards the end. The audience for the seminars were the CEO, Team Leaders, the innovation department, and Managers from the France and Portugal offices.

Both parties placed great importance on the initial seminars, being for some attendees their first exposure to the subject of sustainability, particularly in reference to their own work. It was perceived by the author that there would be 'no second chances', so it was imperative that the seminars should be 'right first time'. The important aspects that were considered for 'pitching' the seminars at the right level and containing the right information for CDN were:

- **Language** - business language must be used to present a business case
- **Appropriate background to sustainability** - Enough background for grounding the subject, but not too much to overwhelm attendees with big unmanageable concepts.
- **Visual language** – important to communicate in visual language that people can relate to
- **Examples** – product and company examples strengthen the concepts presented and give memorable guides to aspire to.
- **Concise content –** the most points need to be put across concisely rather than giving too much detail.
- **Appropriateness for the audience** – a lot of consideration has to be put into WHAT information is given to WHOM. For the two seminars carried out, the content emphasis was altered considering the intended audience. For an audience composed mostly of designers and engineers, more practical tools and processes were explained. For the CEO and managers, the emphasis was on strategy issues.

6.2.1 Initial reactions in the seminars

The author's initial interpretation of the reactions of the attendees was that there was an atmosphere of negativity, which turned out actually to be thoughtfulness. When asked individually, the variety and depth of some of the comments confirmed this:

"I wanted to talk more about what other companies are doing"

" I think the exercise was the best part because it got people talking and doing something creative, that taught that the system view is important"

"I would like to know who our competition is if we went into this"

"Sustainability seems like more of a business concept than EcoDesign because it has this clear economic element, and it has a better 'conceptual image' than ecological matters."

"We consume a lot of stupid energy – like using the remote instead of switching the television off. If we want to have an energy culture, we have to be aware of how much we are wasting"

"Sustainability seems like more of a business concept than EcoDesign because it has this clear economic element, and it has a better 'conceptual image' than ecological matters, because people still think of ecology as being lower quality, associated with flowers, and bad business decisions."

"You have to relate sustainability to business to take away the more personal element...there are a lot of psychological challenges with sustainability because it forces people to question they way they go about doing things"

There was some discussion about whether sustainability would be an element that runs throughout all the methodologies, or as a separate service next to those such as Innovation. There were views from some that because of the nature of the subject, it should run throughout, and others considered that it should have more business benefit, and run as another commercial (moneymaking) service.
There was a majority agreement that any action should start now rather than wait until later, and there was a confirmation that CDN would want to go ahead, but it was still to be seen in what manner.

6.3 Acceptance of sustainability in CDN

The following outlines the factors that contributed to CDN's acceptance of sustainability as part of their future action.

6.3.1 Market differentiation for CDN

...there is a big opportunity in differentiation from other design companies

In the case of CDN, being a design company, there is a strong opportunity for being a leader. Depending on the aspirations of the company, and the type of company they would like to be in the future, there is a big opportunity in differentiation from other design companies. Other prestigious design and innovation companies currently do not appear to be overtly taking sustainability as an opportunity. Sustainability specialist design companies (such as o2France) and individuals (such as Edwin Datschefski) do

exist, but are often smaller establishments and their work emphasis is consultancy based, rather than offering much in the way of practical product design.

Moreover, in Spain, CDN does not consider itself to have much in the way of direct competitors, but as the CDN client base is increasingly international, it means that they will have to be able to cater for the demands of international clients. CDN recognises that the issues of sustainability are better versed in other European countries, therefore there is a growing chance that clients will ask for it. CDN has recognised the need to be prepared to compete with other design consultancies for international clients, and a strong knowledge base of sustainability may well give the edge over other design consultancies.

This opens the opportunity for CDN to be in this case proactive and a leader in its business area.

6.3.2 Timing within Spanish business climate

As outlined in chapter 5, some interviewees in CDN had concerns that Spain is not ready for ecological issues or further still sustainability in business. The concern was partly cultural, that Spain was considered to be behind in terms of thinking about the environment, for example: Barcelona had only recently brought in municipal bottle banks for recycling. This could be suggested to be due to economical and political reasons that have prevented its development as an issue until very recently. Compared to northern European countries the issue is not so apparent or a priority in everyday practices. However, CDN recognise that should the pace of the Spanish economy be an indication, Spain might rapidly 'catch-up' with other European countries.

An interview was carried out with the Co-ordinator of the new EcoDesign Masters programme at the Elisava Art and Design school in Barcelona. As part of the research into the timing of EcoDesign development in Spain, the co-ordinator identified that two to three years ago, when EcoDesign was beginning to be well established as a subject in other countries, it was indeed still to early a for the concept in Spain for good acceptance. However, with the rate of catch-up, two to three years into the future would be too late to begin a process of development in a business before competitors

have already taken hold. Therefore, he cited that in Spain, *"the time is now"* for EcoDesign.

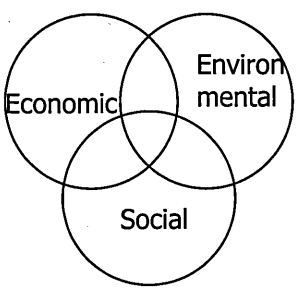
"The time is now"

CDN sees itself as leaders in the Spanish design industry rather than followers; therefore they also agreed that the time to act was now.

6.3.3 Matching company values - Sustainability over EcoDesign

During the process of discussion and particularly through the seminars, it became apparent that CDN recognise the benefits of sustainability rather than EcoDesign.

The primary reason identified by CDN here as seen in the feedback from the seminars, that the conceptual image of sustainability rather than EcoDesign is preferable.



Considering the Three Circles of Sustainability (Blofeld et al 2002) which involves economic, environmental and social elements, provides another explanation as to CDN's recognition of the business benefits of sustainability rather than EcoDesign.

Figure 28. Three Circles of Sustainability (Blofeld et al 2002)

CDN's business, particularly the Innovation department is about recognising and predicting future needs, so this is talking about people, the social area. CDN's buzzline is 'making products for people' therefore there is already recognition of some kind of social responsibility in what they are producing.

The environmental area provides more innovative possibilities in the design of systems and encouraging their customers to think in terms of business systems rather than single products e.g. systems for recycling or further closed loop systems.

The economic area is of course CDN's key concern, but the innovative, consultancy based and business-making are attractive. Therefore the economic area is the business created by thinking of sustainable strategies, which fits CDN's future aspirations of becoming '*Innovative Product Strategists*', who offer a *service* of product development.

Therefore, compared to the benefits of EcoDesign for CDN sustainability is more attuned to their future business. The benefits of EcoDesign are often recognised to be cost savings in manufacture etc, but as CDN is not a manufacturing company, it would only bring secondary benefits via their clients.

6.4 Patterns of change towards sustainability

The process of change in CDN has followed an unexpected path, and different to the process described by many authors about the environmental approaches of businesses. What is expected is a slow, step-wise process internally, before finally becoming ready to communicate about the subject externally:

"Several authors describe models of the stage wise development of the environmental approaches of enterprises. Most of these models show environmental management of enterprises build from defensive, to active, to finally pro-active and interactive approaches." *(Keijzers 2002)*

This move from defensive to proactive is the common pattern for businesses to take, considering the time element and the shift in values that is required for awareness raising, to realise benefits of such an approach, and taking action for change. Processes for growing environment awareness of enterprises tends to move from *"1. Sanitation and cleanup. 2. Pollution prevention. 3. Improvement of eco-efficiency and resource productivity, and finally to 4. Optimised integrated economic, social and ecological strategies."* (Keijzers 2002 p349-350) In design this pattern would have been echoed through design for single issues focus, to lifecycle considerations, to comprehensive sustainable design approaches. However, each step requires a change in approach, and once one method has been perfected, a paradigm shift in the organisation and management of the enterprise is required to go on to the next stage.

(Keijzers 2002). CDN's pattern may well avoid these time consuming transitions for design, although may take longer to establish initially.

6.5 CDN and sustainable services

Considering CDN's business is not manufacturing based, or material intensive, it suggests the importance of acting through the biggest area of influence, which for CDN is in the services and education it provides for it's clients. For CDN to become a sustainable company by looking only at it's own processes within the boundaries of the company, it would be limited, and have minimal impact for change. Included in this activity would of course the services it provides, but in CDN's case, this is bigger and more influential.

Similar to a teachers influence on shaping the opinions and knowledge of many, this 'acting through others' has the effect on the **quantity** of people reached and subsequent changes thereafter, which in total have a much greater influence than just exclusively internal action. The lever for change for CDN in terms of quantity and effect is in the influence on the design of products and services that are released into society.

CDN's 'acting through others' in total may have a much greater influence than exclusively internal action.

In research on progress towards sustainable business strategies, (Keijzers 2002) one of the impediments for progress is identified:

"Mostly (companies) still focus on the improvement of environmental quality of their own production process, but hardly touch upon improved environmental conditions in the supply chain. Product innovation to realise resource productivity remains another rather new issue to most enterprises." (Keijzers 2002)

If this is the case, then again CDN has an important role to play in bringing new innovative product strategies to their clients. CDN's influence on their supply chain, particularly down-stream has the potential to be incredibly influential.

6.6 A note of caution

The enthusiasm generated through this introductory project has been a positive step for CDN; however, no major change for a business is without risks. Therefore, throughout the process of change towards sustainability it is important to consider the risks for CDN in doing so. This section outlines some of the perceived risks for CDN in this process.

6.6.1 Greenwashing

One of the major risks identified in the Philips Sustainable Vision project was that of 'Greenwashing', which is a term that appeared in the late 80's after the 'fashion' for green consumerism. Many companies that had marketed their goods as 'green' were later found to have no substance to the claims, or at least did not portray the actual situation. (Blofeld, et al 2002) This has served as a lesson, but also a hindrance for companies who would now wish to communicate to customers about the environmental attributes of their products. There now remains much suspicion and mistrust within customers about the validity of corporate claims, which is difficult to rebuild. Companies such as Shell, and Nike have had their company images badly tarnished in the past through being 'caught out' or exposed about their contradictory practices. This damage to corporate image has spurred them into action for sustainability but has proven to be very difficult to reverse in the minds of the public or corporate critics.

If so, it could be problematic in the marketing of sustainability at the moment. It has to be made clear by CDN that they are not claiming that ALL their products will be sustainable at the moment, but HOPEFULLY they will be working to that being the case in the future. Marketing has to be approached with caution, and has to be clearly explained, but as a first step, articulating the intention via the website is the right beginning.

6.6.2 Internal misunderstandings of sustainability

Another note of caution to be brought to attention is the concept in the minds of the CDN employees about what sustainability means. Considering the complex nature of the subject, misunderstandings about the meaning could easily occur, which has implications for a consolidated strategy and direction for CDN. This could have impacts

on the result or quality of the designs, therefore clarity throughout their future learning process is important for collective understanding of the issues

6.6.3 Employee questioning about internal CDN sustainability

This serves more as a warning for the future rather than a risk. If employees gain a good understanding of sustainability, there is a possibility that they may begin to identify and question any contradictions between what is recommended to clients, and CDN's own practices. Employees may want to rectify the internal practices with the external claims and recommendations, so there is a feeling of confidence with the client interface and marketing.

6.6.4 Client questioning about CDN practices

A similar concern is that of client's requests. Once a client recognises what is being proposed there is a chance that they may ask for proof of CDN standards such as ISO 14001. If CDN is advocating sustainability there is a level of 'setting the example' that would firstly reinforce the message given to clients, and also reduce the risk of being recognised for not practising what you preach.

6.6.5 What is the message if there is choice for clients?

There was originally the concern that there would be an element of option for the clients for sustainability. If there is that option, it send a confused message, that would leave clients asking questions such as "Is it unsustainable design otherwise?". This problem has been encountered in CDN previously with the innovation department, which is a separate service that clients can opt for, and similar problems have occurred.

"Is it unsustainable design otherwise?"

However, CDN came to the decision that sustainability would not be an optional service, but a knowledge area which runs throughout the services, as in figure 29. This means that sustainability is then an integral part of the CDN practices, which ids working towards the aim established by Ehrenfeld:

"Sustainable practice must become an everyday new form of business-as-usual."

(Ehrenfeld 2000)

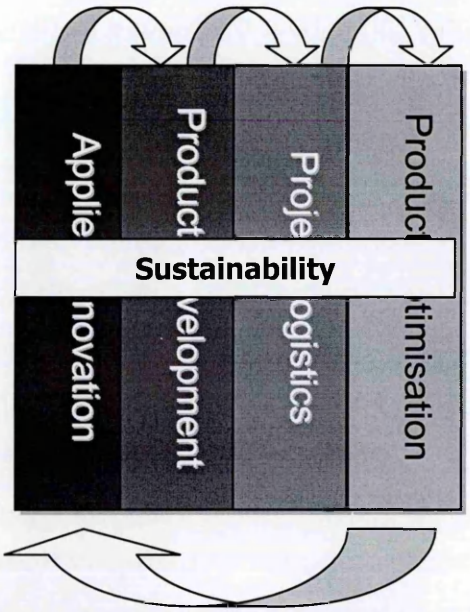


Figure 29. The positioning of sustainability in CDN

6.6.6 Mitigation

Of the risks outlined so far, many could be overcome through the process of stakeholder engagement, which means that CDN would go into active discussion with employees, clients, or any others who affect or who are affected by the business operations, and discuss this new transition. This could initiate a process of dialogue, which would reduce misunderstandings, and establish a multi directional process of improvement.

6.7 Chapter conclusion

The issues discussed in this chapter demonstrate the range of considerations that had been taken into account in CDN's acceptance of sustainability as part of their business. It began with the recognition of growing importance of sustainability, which CDN recognises as having better business benefits rather than EcoDesign. It was felt that they needed even more examples of sustainability in businesses and particularly their competition and what activities they are carrying out. There was recognition of the opportunity for market differentiation particularly in Spain, and that sustainability offered a closer look at social issues, which is akin to one of their business missions.

It was observed that CDN's process of change was unusual because it did not follow the step-wise pattern, and that their main influence for sustainability may be different to that of a manufacturing organisation. Finally cautions were identified for future consideration

Chapter 7. Design Space

This chapter discusses a key notion in design for sustainability and the limitations should the 'Design space' be reduced. Design space is considered in this study to be the breadth of design alternatives that can be suggested within the design brief. Less design space means fewer alternatives or new ideas that can be suggested. This is discussed with its relevance to sustainable design, and observations made throughout the project.

7.1 Why Design Space for sustainability?

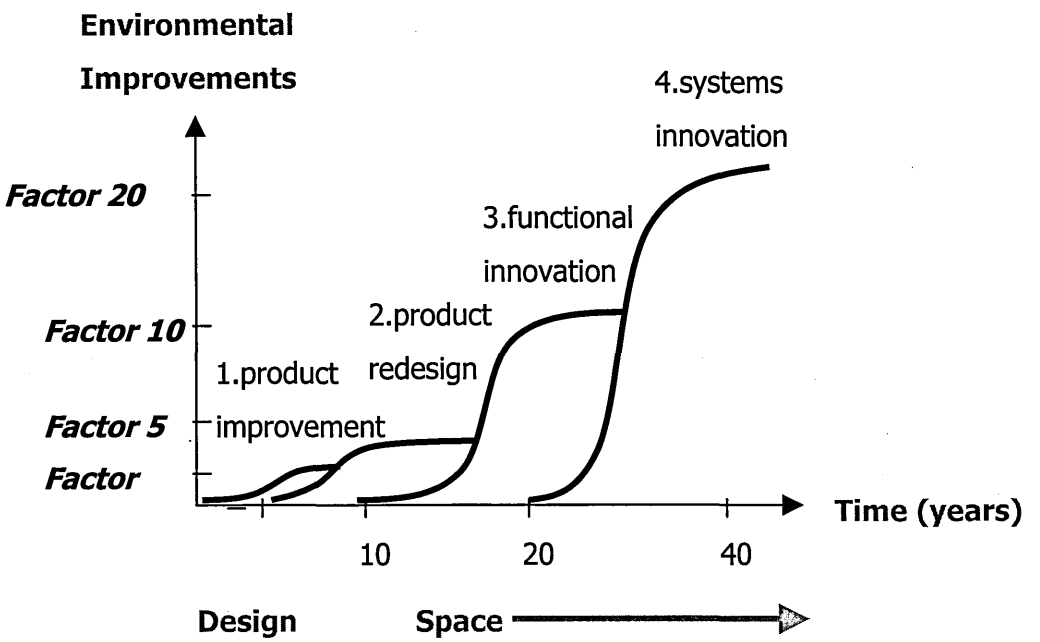


Figure 30. Four types of EcoDesign (Brezet 1998)

Figure 30 as reviewed in the literature, describes four types of EcoDesign, with associated factors of environmental improvement. If sustainable design aims to achieve the more challenging and radical targets, (level 3 and 4) then it requires a wider consideration of not just products but the systems in which they operate and the functions they fulfil. Therefore, to challenge 'business as usual'

To challenge 'business as usual' assumptions, and make more than only incremental improvements, an increasing amount of design space is required.

assumptions, and make more than only incremental improvements, an increasing amount of design space is required.

7.2 The importance of acting early

It has previously been identified that the timing for environmental decisions in design is key to developing a good environmental profile. The timing being most effective in the very early stages, particularly in the pre-specification stage. (McAloone 2000)

7.2.1 The problems of acting late

The key predicament in the approach to sustainability issues in the CDN Flores Valles Project was that many of the decisions had already been made, the product strategy decided and already presented to the client for approval. The sustainability issues were addressed once past Innovation department, which in CDN's case is where strategy is decided. The product attributes had been given to the designers to begin solid concept designs and detailed materials specifications. There was a difficulty with both time constraints and limited space for decisions that curbed the effectivity of the intentions. Previous literature has discussed that the earlier the action the more effective the changes can be in the design process:

There was a difficulty with both time constraints and limited space for decisions that curbed the effectivity of the intentions

"It is generally recognised that the conceptual stage is the most influential one with regard to the product's environmental performance"

(Baumann, Boons, Bragd 2002)

It is this conceptual stage that decisions concerning product strategy, direction, and market positioning are made. These are important for environmental performance as quoted above, but it could be suggested that they are even more so for sustainability. The reasoning is that sustainability is a big concept. It requires far more of a rethink than simply following the 'status quo', or a 'business as usual' approach to new product development. Sustainable design requires the careful consideration and balance of economic, environmental and social influences in attempt to create responsible products. These decisions are made during the initial conceptual and product strategy

stage. After this key stage, any new ideas, strategy level influences or alterations to these can be very difficult and costly. In the CDN design/engineering methodology after stage 3 most of the decision making has already been done and it becomes much more about technical details and adjustments. Demonstrated in Figure 31 are the levels of influence in the three basic stages of the design process.

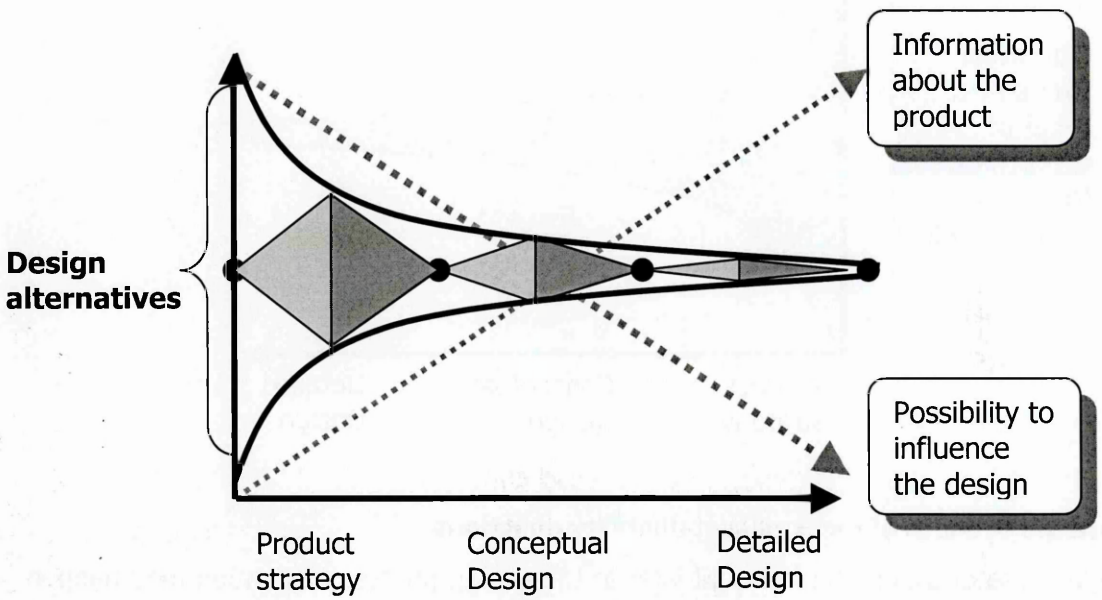


Figure 31. Early action in product development (Bhamra 2002)

Figure 31 demonstrates that the more detail and information about the product, the less the possibility to influence the design.

7.2.2 Macro questions

One of sustainable design's key attributes is that it is a guide for strategic decisions about the direction for the new product. Without this level of influence on the design process, the product will have limited attributes of a sustainable product. (e.g. The materials may well have been considered but this alone does not constitute a sustainable product). This is demonstrated through the type of questions that would be required for working towards a sustainable design:

1. What are the social behaviours we would like to encourage with this product?
2. What are the key environmental aspects we would like to tackle?
3. How does this product contribute to long term financial success?

4. What is the service or function that is needed?
5. What is the most efficient way of providing that function?
6. How can we make the product Cyclic, Solar, Safe, Efficient, Social?

The focus of these questions is broad, but essential for effectiveness for sustainable design.

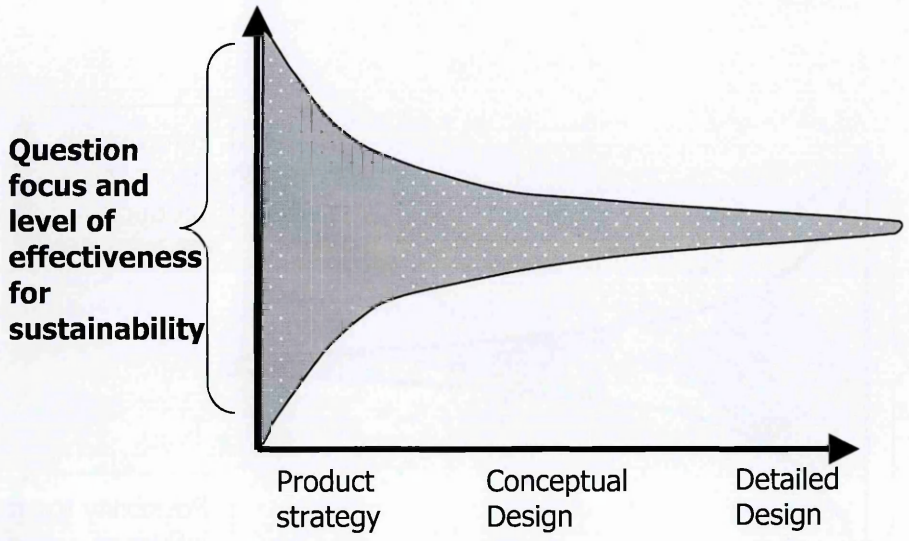


Figure 32. Breadth of focus of sustainability questions

Should these questions be left until later in the design process a situation may happen similar to what occurred in the Flores Valles project, as demonstrated in Figure 32.

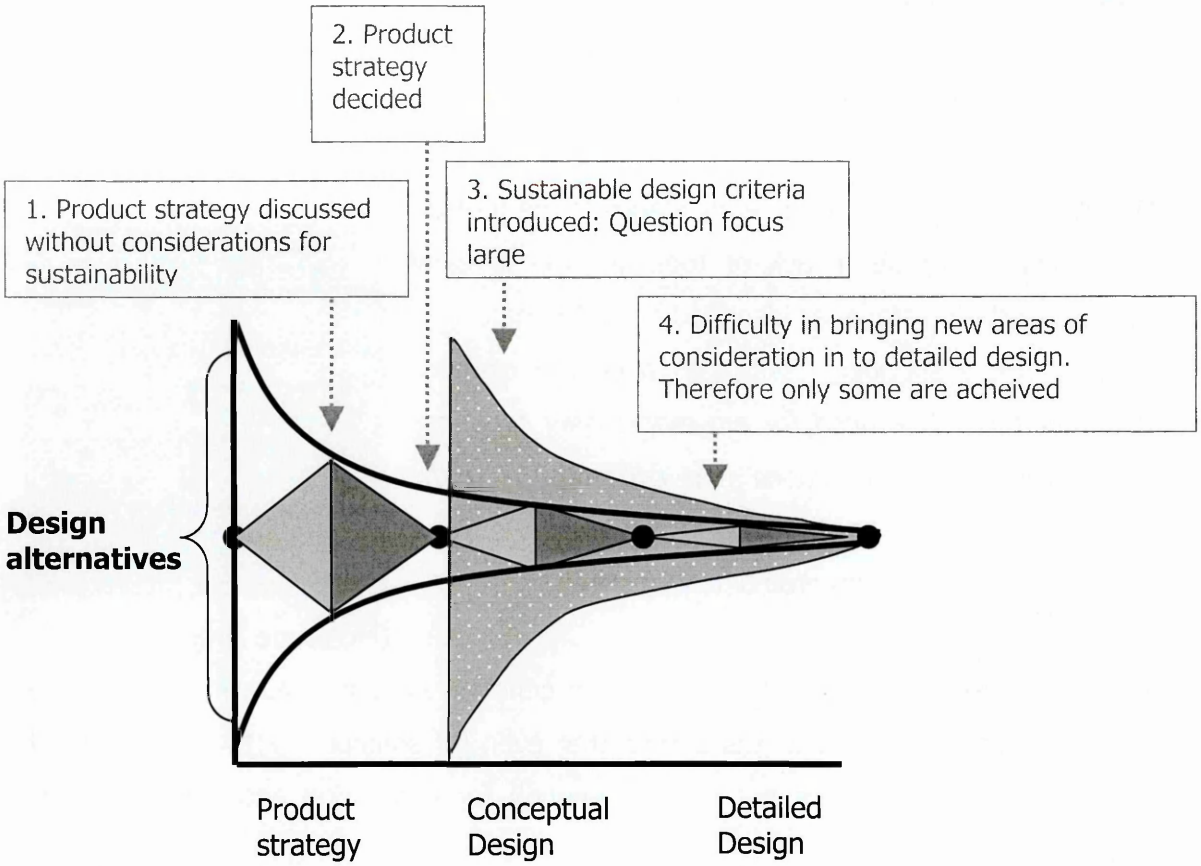


Figure 33. Too late in process

Should the sustainability questions been asked earlier in the Flores Valles project and considerations taken into account early, then it would have facilitated the process, and reduced the problems of change later on. The 'Plug and Play PLUS ECO' concept could have been presented to the clients at the outset, so that it would have been seamlessly combined with the other product strategies, which may well have even strengthened the concepts. This would have prevented many of the troubles of attempting to bring in the elements of sustainable design into the details. As was the case, only the minimum could be recommended as focus for the design work, and hence the minimum within the limitations could be achieved.

To avoid this retrofitting approach, the design /innovation team needed to be aware of the considerations and have a process for including sustainability at the outset, as in identified with EcoDesign:

"The important stage of EcoDesign is before detail design begins. You may not need to change the way you design, as long as the team are aware of the issues and specification reflects environmental priorities."

(Bhamra et al 1998)

Despite the importance of the early stages of the project, there appears to be a lack of tools for the is early conceptual design stage, as identified by McAloone:

"Finally, one resounding conclusion from the research was that there is a need for environmentally conscious design tools to be developed that concentrate on the pre-specification stage of design....However, no tools presently exist to aid this area of decision-making."

...there is a need for environmentally conscious design tools to be developed that concentrate on the pre-specification stage of design

(McAloone 2000)

The author carried out a brief experiment to generate system ideas with some of the existing design tools, and it was agreed that even for someone with a good subject knowledge, the tools were not suitable enough for generating and aiding decision making.

7.2.3 Recognition from the Design Team Leader

In the early stages of joining the Flores Valles project, the 'ecological element' was considered by both the innovation and design department to be a 'bolt-on' to the design process. The reasons for this are simply lack of understanding, which was soon rectified even after the initial information given to the designers. It was at this stage that the design Team leader suggested to present the new information to the clients, "*as something should have been presented earlier*". This was a key realisation because it indicated that action should have come earlier in the process, firstly for ease of implementation within the design process, but secondly for the greater effect for sustainability.

7.3 CDN and design space

Since CDN established the innovation department, the search for more 'innovative customers' has become a continuous question. The 'static' and older clients tend to go back to CDN for more of the same services, which is often only the design engineering.

These clients are very difficult to educate about the new CDN services, or furthermore to sell the benefits of using them. Hence the design space for these clients is very limited. However, increasingly over recent years, and CDN hopes more so in the future, they will be able to attract more innovative clients, who are more predisposed to exploring new market possibilities and product systems.

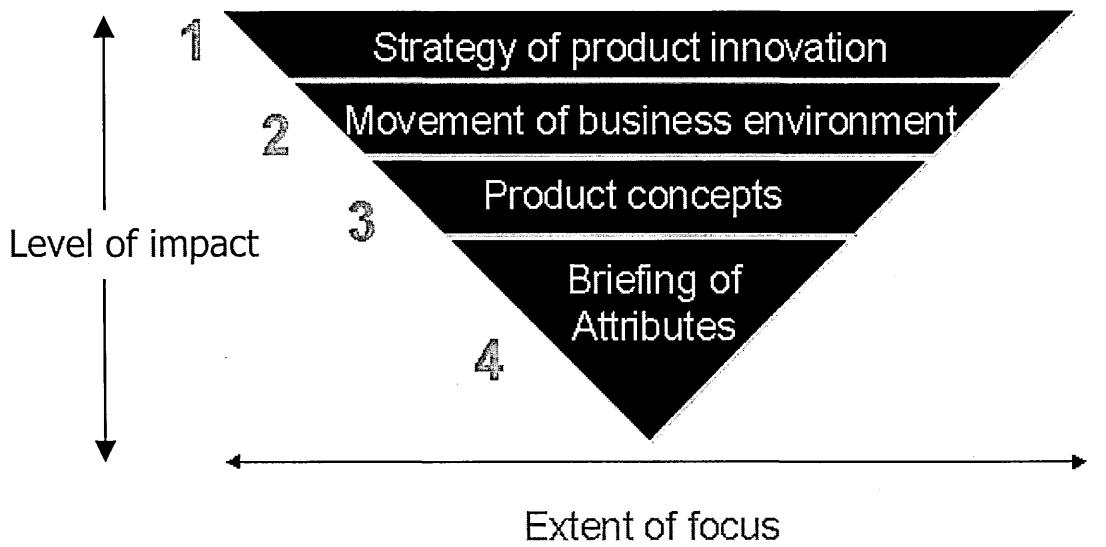


Figure 34. Innovation levels (CDN 2000)

With this in mind, the role then of CDN is increasingly about bringing clients to the earlier strategy stages of the product development process, where there is more design space. Furthermore, within the innovation service there are the four levels of the type of project brief or starting point (Figure 34), with the extending of the focus of the project brief, it opens the design space and increases the impacts of change. This indicates CDN's recognition of the design space issue, and provides clients with a visual representation of the type of services that can be offered with this increased design space.

With more frequent projects of this kind, the more the trust with clients will be built, which may result in CDN being able to further suggest more design space by opening out debates within this stage. Both innovation and sustainability would benefit from

this approach, as more possibilities can be explored and more macro questions asked, and the common aspect of both these is the future thinking needed.

7.4 Chapter conclusion

This chapter has briefly explored the importance of design space for sustainable design, and highlighted the problems with the Flores Vales project case accordingly.
The reasons for attempting to increase design space have been identified as important for future direction.

Chapter 8. Discussion

The literature review in chapter 4 it was identified that there are currently no empirical case studies of sustainability and EcoDesign implementation in design consultancies. This revealed a gap in the research, which this project begins to fill by providing a case study of the process of introduction of sustainability into a design consultancy. This is the first reporting of a case study of this kind.

8.1 Implementation

This section identifies issues for the implementation process into a design consultancy

8.1.1 Drivers and Barriers for EcoDesign in SME's

This study agrees that internal stimuli for EcoDesign are a stronger driving force than external stimuli, (van Hemel and Cramer 2002) as the momentum has been generated with CDN without big external pressures. It may be suggested that because CDN prefer to act as 'leaders' rather than 'followers' in their field, that they inherently would not wait for external pressure to increase before beginning action. The study also agrees with the literature that *some* of the most influential internal stimuli were the opportunities for innovation, the expected increase of product quality and the potential market opportunities. (van Hemel and Cramer 2002)

The 'no-go barriers' identified by Van Hemel and Cramer (2002), which obstructs EcoDesign implementation were 'No clear environmental benefit' 'Not perceived as responsibility' 'No alternative solution is available'. These barriers particularly the 'not perceived as responsibility' were overcome through education and two-way communication.

8.1.2 Design tools

The project agrees with the literature referring to the use and implementation of tools for EcoDesign, (Sherwin 2000, Lofthouse 2001, McAloone 2000) in that it was found that many of the tools developed through research so far are inappropriate for the practical use in the everyday work of a designer.

Design tools that were found to be more effective than others were visual and simple, and furthermore suggested attributes or generated ideas for designing ('pre-ecodesign') rather than offer methods for assessment. ('post-ecodesign') (Sherwin 2000)

For CDN it appears that instead of the direct application of tools already created, there will be a period of exploration for appropriateness according to their current working methodologies. The emphasis is more likely to be in the connections to these methodologies of specific actions rather than the implementation of tools as such. It is suggested that the research focus may be shifted away from developing generic tools to understanding specific companies, and the methodologies that are used in order to have more tailored methods with smooth integration into everyday work.

8.1.3 Motivations for implementation

Generating enthusiasm was key to the momentum and eventual change within CDN. During the project it was found, contrary to expectations, that generating enthusiasm for action can occur very quickly. However, this may be due to the nature of the organisation, which is very open to new ideas. It can be suggested that other reasons for the enthusiasm were that:

- One enthusiast makes a difference, particularly if they have authority to make changes
- Sustainability can be an emotive and interesting subject to people
- It was demonstrated through examples
- Business benefits were presented and business language used for reputability

It was also important that CDN had a low-risk, low-cost way to be able to initially explore these issues before committing. This project offered that chance through being a student project with little costs, a limited timescale, therefore the option to discontinue work if necessary, and the access to the available knowledge for the subject.

Communication and language were key to conveying the right message to the right people, and furthermore visual language and examples can be more powerful

particularly when communicating with designers who predominantly work with images rather than words. The Total Beauty of Sustainable Products (Datschefski 2001) was particularly successful in conveying the information in the most appropriate way at that time.

8.1.4 Patterns of change

CDN's process of change has been unusual. Rather than following the more common step-wise processes of change that often stem from smaller incremental improvements (Design for Environment), CDN has made the leap to a more radical strategy (sustainable design). Design consultancies, as explored may well be in an easier position to do this through the fact that they have less material throughputs and they are flexible enough to change rapidly. They are independent of particular sectors or product technologies, therefore their pattern for change within design is different to those of internal design departments within manufacturing organisations.

8.2 Business and context

This section identifies the business and context issues for design consultancies

8.2.1 Areas of influence

As discussed in the literature review, examples and processes of change towards sustainability are often discussed in the context of large manufacturing organisations. It was identified that some companies have more influence for sustainability not necessarily by becoming sustainable businesses themselves, but by concentrating on the services and the main area of influence they can offer to others within their supply chain.

The following diagrams demonstrate the current literature status by depicting the perceived influences and greater effect for sustainability, which are greater toward the outermost circles.

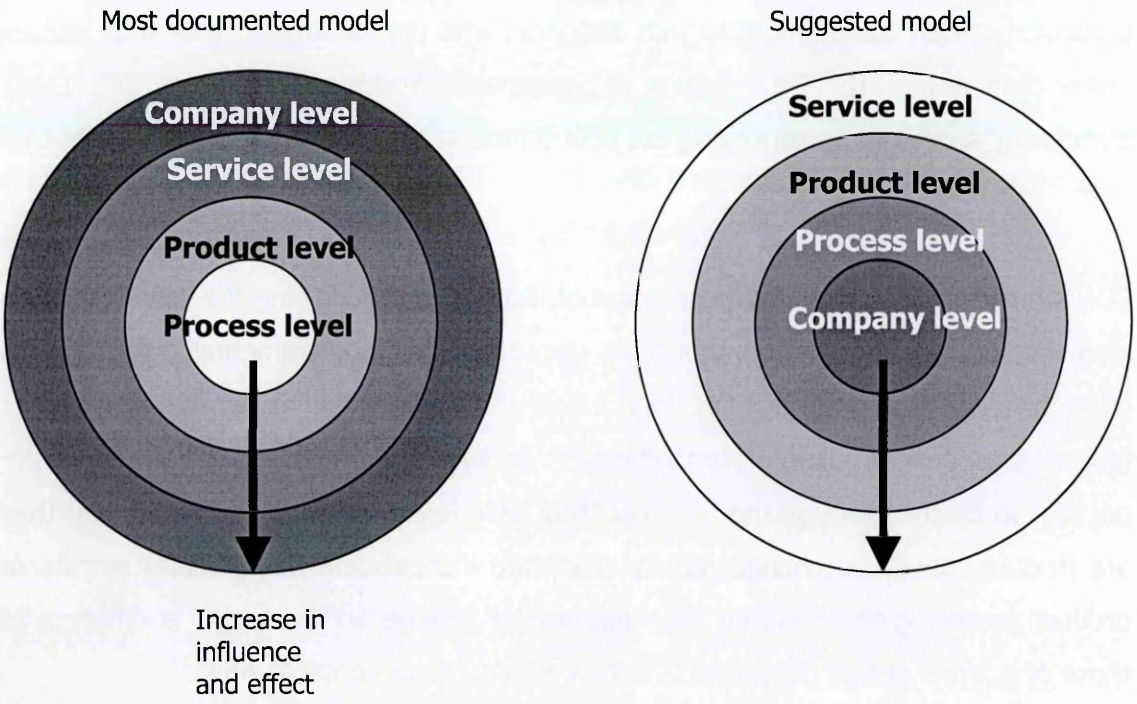


Figure 35. Levels of influence for sustainability in a company

The existing literature does not identify that some businesses may have more influences for sustainability via a different emphasis as demonstrated by the diagram on the right. Design consultancies are based on knowledge rather than on material throughputs, which means that their own operations are not defined in the same way as manufacturers. Activities such as improving environmental processes within the company are less meaningful or effective, BUT their influence on others to make improvements is significant.

8.2.2 Acceptance of sustainability

It was discovered that, concerning the image generated by the issues, the connotations of sustainability were more positive than those of ecology, EcoDesign or other environmental terminology. It was perceived that the legacy of environmental marketing and products from the 1980's and images of extremist campaigners rendered it difficult to convey as a viable business issue. Sustainability, however, was perceived by CDN as a new and interesting subject, with more in the way of business benefits through the comprehensive and interrelated nature of the issues.

It could be suggested that for future work, sustainability might be viewed in a more positive light for business than using the terms of ecological issues. This may simply be

a terminology concern, but the concept of sustainability appeared to be attractive for market differentiation due to the need for future thinking, innovation and strategy.

Design consultancies often have the autonomy and authority for change, which makes them unusual in that they can respond very quickly. It is also in their nature to respond to changing societal and business environments, as future ideas are their business currency.

A key driver for the acceptance of sustainability was the recognition of the strategy for differentiation against other design consultancies. Ad there were no clear examples of CDN's competitors really taking action for sustainability, then this was identified as a big business opportunity. For further work, the identification of this type of business issue is a key driver for acceptance and final action for the subject.

8.3 Design Space

This section identifies the learning points about design space for sustainability

8.3.1 Earliness is needed

The empirical findings of this study found, and agree with the previous literature that, indeed early action is needed for sustainable design to be successful. The Flores Valles project provided first-hand experience of the problem incurred when attempting to approach these issues to late in the process, as a 'bolt-on'. By approaching sustainability too late in the process, either it causes difficulty in the scale of the questions that need to be asked and answered, or it reduces what can actually be achieved. Therefore, further work of this kind needs to attempt to implement the changes as early as possible in the process.

8.3.2 Design space for design consultancies

It could be suggested that design consultancies have the possibility for increasing design space. Firstly the client has obviously approached them because they want something new. The design consultancy is trusted to know and understand the movements of industry, the changes in technology and future factors for consideration. Therefore there is the potential for design consultancies to challenge assumptions

within the brief. E.g. instead of asking for them to design a coffee cup, the design consultancy can ask for the brief to be widened to being a 'coffee delivery system', which gives much more possibilities for ideas and new approaches to the problem.

Design consultancies could be seen to be braver than internal design departments of companies because they have autonomy of working outside the clients industry and being able to spot, prioritise and design for new opportunities. Design consultancies are also more persuasive to innovate because it allows them to use new skills, take up new challenges as well as being able to use transferred knowledge from other sectors.

8.3.3 Design space and innovation for sustainability

It is well known that sustainability requires a rethink in strategic direction, which requires a different mode of thinking than business as usual approaches. This requires forward thinking organisations, some creativity and innovative thinking to be really successful, something that design consultancies are particularly adept at doing. This new type of challenge is particularly exciting and for some, may be a new enjoyable way of working.

8.4 Chapter conclusion

This research has successfully added to the literature by providing a case study of a design consultancy introducing sustainability to their practices, and identified the key considerations that lead to change within the case study company studied.

It was identified that design consultancies differ from manufacturing organisations because they are more flexible and open to change, are based on knowledge as their currency rather than material throughput. It was found that enthusiasm can be generated quickly and effectively, and that design consultancies may have more autonomy for change, due to their independence. They are also trusted with more design space, which would allow for better implementation of sustainable design activities, and are braver to make new suggestions, which could increase the design space of the project. Hence CDN and other design consultancies are in an advantageous position to adopt practices towards sustainability.

Chapter 9. Conclusion

This project aimed to understand the introduction process of sustainability in CDN and to draw out the lessons for other design consultancies. This aim was achieved through the case study action based research. Continuous involvement that included observation, interviews and participation resulted in an in-depth understanding and acquaintance with the company. An understanding of the introduction into CDN has now been formed, and lessons for future work with design consultancies have been identified.

Processes, tools and attributes were recommended to the designers about EcoDesign and sustainable design for Flores Valles project, and a two-way learning process was initiated. Material about sustainability issues was also developed for the clients in this project.

Seminars were successfully carried out within CDN, which provided both information and inspiration into sustainability for the attendees.

The literature survey revealed the current state of the research area, which highlighted the lack of documented case studies of design consultancies who have implemented sustainability, which this project now contributes to.

9.1 Research Limitations

As stated in the methodology chapter, it is felt that the main limitations of the research are firstly that it is a single researcher within a single company. The implications of this are that the researcher's interpretation, knowledge and opinion may have affected the results. However, this is a prerequisite for action research. That it is with one single company implies that results and conclusions are particular to the situation and may not be universally applicable. Another limitation has been the language difference between the researcher and case study company, which have prevented some situations from occurring, (e.g. interviews of some personnel) and could possibly have affected the interpretations of information by others.

Chapter 10. Future work

This future work chapter is divided into two parts, as it is evident that CDN now want to continue work in this subject. The first part explores work within CDN, and the second part identifies work areas for future research.

10.1 Future work in CDN

The aim of future work in CDN is the implementation of practices for sustainability across the company. The following are activities that will form part of the implementation:

1. Agreed definition of what sustainability means for CDN

It would be good practice to begin the process by discussing and deciding on a definition of what sustainability means for the CDN business. As is stated by Charter, this is important for the future direction of the company:

"A firm must define what sustainability means for its business - environmentally, economically, socially and ethically – as its approach to product issues will be dependent on its vision, commitment and product or service type"
(Charter 2001 p242)

Once this definition is decided, all personnel should always have the understanding to be able to take further action. This definition means the generation or appraisal of long term objectives for CDN.

2. Mapping of different types of clients and 'starting points'

To begin the process of implementation, a mapping of the client 'starting points' in the CDN product development process would be necessary. The reasoning is, for CDN, as already described with their innovation methodology; clients can opt for particular services, and opt out of others. For CDN to have ways of bringing sustainability into all projects, there must be strategies for all the services that CDN offers. The mapping of current clients, and additionally CDN's ideal future clients begins this process.

3.Training

The education process of CDN needs to continue to become more specific to the daily tasks of different personnel. Therefore a continuous process of training may be necessary.

4. Identification of influence of each department in process

The influence of each department needs to be identified. The reasoning is so that efforts can be maximised, and roles and responsibilities can be delegated in the most appropriate way. However, multi-disciplinary groups of people from each department for each project would consolidate the understanding and action in the project.

5. Placing sustainability into all CDN methodologies.

During these activities discussion is likely to take place about where sustainability fits into the existing processes and methodologies. Eventually it should seamless fit into the methodologies for effective integration into all the projects. One suggestion for identifying the attributes of sustainable products may be the development of a new Three Circles of Sustainability model in for design considerations instead of business practice.

7. Pilot project

As most like to understand a new concept through practical examples, and many learn through doing, it may be advisable to embark on the development of a pilot project or a concept project. This serves the purpose of being able to communicate the concept of sustainability to CDN's clients, demonstrated CDN's skills in this area, and facilitates the internal learning process.

8. Marketing and client interface

A strategy for the communication of sustainability externally needs to be considered to mitigate the risk identified in chapter 6 about greenwashing. It would be advisable to have an environmental or sustainability policy that clearly demonstrated commitment within the company values. Previous experience has shown that any external communication needs to be considered carefully.

10.2 Further research

It is suggested that further research might focus on the interface with designers more closely. Instead of the development of tools that are primarily developed outside of practical design situations, it is suggested that further research should concentrate on the situations that designers work within, and the methods they use. This will begin to shift the focus of research into the *practical application* of EcoDesign and sustainable design, which is a more sparsely researched area at present.

Further work with design consultancies is a clear area for research in sustainability. As this study has established that design consultancies may have a different influence for sustainability, which is through the service that they offer clients, more research will be needed about other 'knowledge based' industries to gain a full understanding of what these influences entail.

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Appendix A

Joanna Lambert: interview with Emilio Garcia

Thankyou for agreeing to be interviewed. The interview will have two parts:

- Part 1 which is general enquiry about CDN, to find out where CDN has come from, where it is now, and where it would like to be in the future.
- Part 2 is related to EcoDesign and sustainability, to discover the level of knowledge, interest and opinion in CDN.

The results of the interviews will contribute to my first task here which is "Know CDN" where I am building a map of the skills and strengths of CDN, and an understanding of how the company operates. This is essential for the other tasks I will be completing during my time here, and may be helping CDN in future work.

Part 1 – 'Know CDN'

1. How long have you been working in CDN?

   4 years

2. What is your background? Design, Engineering, Business, Other?

   Eng degree MBA 7-10pm

3. Could you briefly summarise what your position in CDN involves now?

   Since last week team leader — Prefers Team Leader
   Now eng because of MBA.
   Proj man. Client man. Inbetween. — Do only a little eng. Now practical eng.

4. a. Who do you think are CDN's main competitors?

   We think we're leaders.
   Not his job. Take product manu not design.

   b. In what aspect of the business are they competitors?

   Design sector leaders in spain.

5. To which companies does CDN aspire to being a competitor?

   Product competitive advantage development with combining departments.

6. What do you think CDN is recognised for by other businesses?

   Design but things are changing. → We now want Product strategy consultants.

7. What do you think CDN is recognised for by the public?

8. What are the most effective channels of communication between CDN and it's customers?

   Workshops or combination of mag + workshops.

Change in role → trad. workers ↓ consulting + In eng. bad not as profitable. → moving to subcontract basic engineering.

older clients

9. How well do you think the Project Magazines communicated CDN to clients?

Very well.

10. If they were to have been continued, what do you think would have been the emphasis of the latest Project Magazine?

Should be continued. Good communication. Main tool for comm with clients + changing their view

11. Why did HP choose CDN in the early 90's?

Design. HP is older client which is not easy to change. Static. If they can see the change to PD consultants.

→ Static
→ Dynamic

12. Why have newer clients chosen CDN? Design? Project Management? Cost? Quality?

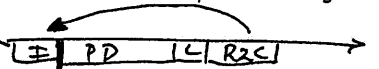
Global Prod develop.

13. How much have the new departments and additional services changed the business?

A lot, see above.

14. How has the innovation department changed CDN's initial approach to projects?

different approach
shape
product innovation
useability
aesthetics



old traditional projects.

this will happen in global projects.

15. What should CDN continue doing?

Design. practical side. Innovation. Redesign to cost

PD people see innovation as 'headaches'! Sometimes difficult to achieve.

16. What would help to improve CDN?

Bring PD + Innov. PD2C together closer.

17. CDN seems to be changing rapidly, what do you think the emphasis in the future will be?

Finish doing just consultancy. Keeping all process. Maybe split? → Consult / → Practical

Part 2 – 'EcoDesign and Sustainability'

18. How would you define EcoDesign or what does it involve?

Design taking into account ecology
Big change of mindset for clients

19. How would you define Sustainability or what does it involve?

About doing things thinking of the future.

20. a. Are there external pressures to take Ecological issues or sustainability into account in CDN's work?

Regulations - not as much as they should be.
Not a lot of clients.

b. If so who/what are they?

21. a. Are there internal pressures?

No.

c. If so who/what are they?

22. What do you think is the level of understanding of these subjects in CDN?

Medium - low.
Media.

23. Are there any recent CDN projects that you think could be referred to as Ecological?

* Rubbish basket for kitchen - requirement 2 compartments. for recycling organic inorganic.
* Plastic fence for street. Recyclable is a requirement.

24. Where do feel your influence would be in including more EcoDesign practices or processes in CDN? Materials. Not concerned about it. Chose plastic

In Project Magazine number 5, in the Ofita project is says "Ecology: the product must agree with the environmental issues: reducing, recycling, reusing etc"

25. What was taken into account in the project to fulfil this brief? Doesn't know this project.

26. What helped you to carry this out? A methodology? Information?

27. Was there any way of assessing it?

28. What information might have helped you further?

I am planning to give seminars on the subject of EcoDesign and sustainability some time over the summer.

29. What would you expect to learn from these seminars?

What should I learn in the near future to achieve my clients expectations.

30. Do you have any other suggestions for the content of these seminars?

Knowing what I should learn rather than learning things. What will climate in Spain

31. Do you think people will be willing to learn more about these subjects?

If these subjects can be applied easy + quickly to jobs.

Thank you very much for your time.

or international

Spanish clients mostly or french. 70% sp 30% int

In future more int less sp.

Seminar 1+2 Not too much time between. Need to be brief.

Need insurance of other countries business.

Appendix B

Flores Valles:

Suggested focus for

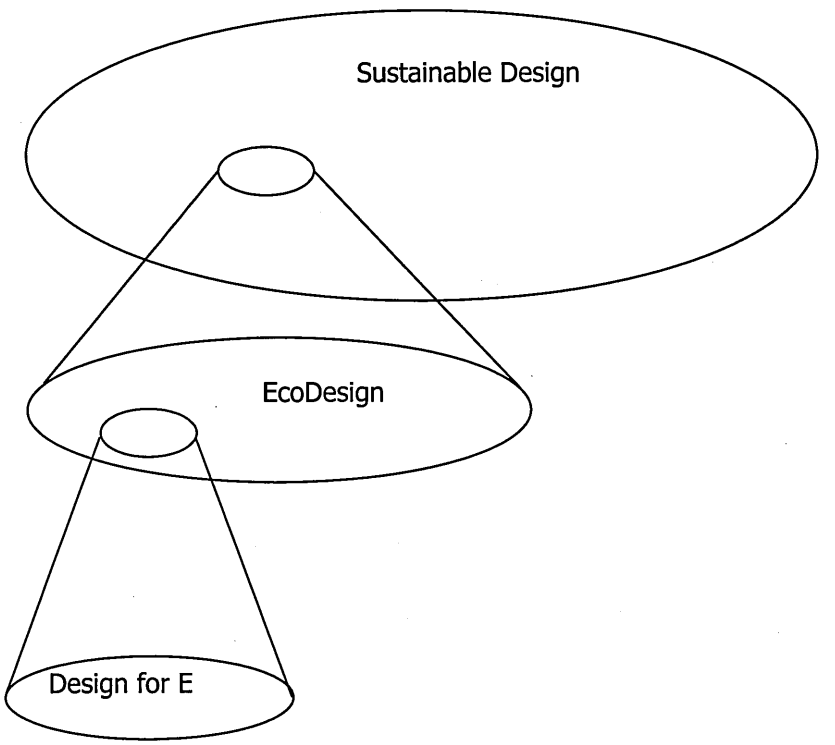
ecological attributes

1. **Making the furniture easy to disassemble and separate materials**
2. **Have a series of components that are transferable between the furniture 'team', that can be reused or rearranged in new modules. E.g interior structures**
3. **Think about the recyclability of the other parts that are not transferable.**
4. **Try to avoid toxic coatings and materials where possible**
5. **Make the materials the most appropriate for the purpose and the expected lifespan of the product**
6. **Design the products to fit together / stack or be transported efficiently in large quantities**
7. **The product should be adaptable by the user for their needs**
8. **Can you use already recycled material?**

Flores Valles - EcoDesign/Sustainable design:

attributes of products – initial thoughts.

The following diagram starts to explain the difference between Sustainable design, Ecodesign and Design for the Environment:



A product, process or system that has the potential to continue forever

...design of a product, system or service with the aim of minimising overall impact on the environment over the whole lifecycle.

...concerned with Design for disassembly and recycling at the end of the life of the product.

For Flores Valles, at this stage in the project we can hope to achieve many of some or many of the attributes for Design for Environment and Ecodesign.
The following attributes can be considered in the design process. The project may not achieve **all** of these, and we might discover that one attribute makes it difficult to achieve another, so the important thing is to **prioritise** what is most important for this project. We may also discover that some of these attributes are already being considered in the concept and design anyway, which is very positive!

Design for Environment...

Design for environment mostly focuses on the end-of-life of a product.

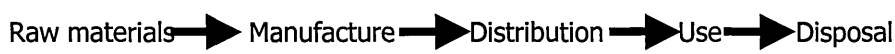
Raw materials → Manufacture → Distribution → Use → **Disposal**

...product attributes

- Easy to disassemble (e.g fixings and clips rather than glue and welding)
- Different materials can be separated as much as possible
- Some parts are easily transferred as whole pieces and reused in new models (e.g. inside structures)
- The material of some parts could be recycled and used for new parts. (This means that they might be melted down and reformed into the new shape.)

- The rest of the parts should be non-harmful if disposed of responsibly.

EcoDesign



Materials

- The materials are the most appropriate for the purpose and the expected lifespan of the product
- Reduce materials where possible.
- The materials are not unhealthy for people to manufacture, or be in contact with in use
- Can you use a recycled material?

Manufacture

- The design has simpler or fewer production processes, so that energy can be reduced in manufacture

Distribution

- The products can fit together / stack or be transported efficiently in large quantities
- The packaging is minimised or reused, or used as efficiently as possible
- Can you use a biodegradable or recyclable material for the packaging?

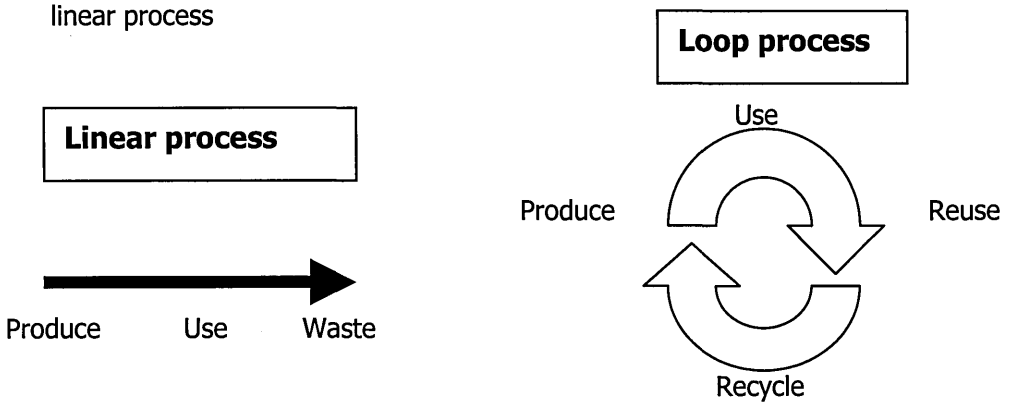
Use

- The energy and material consumption in the USE phase of the lifecycle is reduced or eliminated (a washing machine is a good example of a product where these have to be considered very carefully. This is because during it's lifecycle, more environmental impacts come the **use** phase than any other stage, because it uses so much water, energy and detergent)
- The product can be adapted by the user for their needs
- The products are perceived as having their own 'value' or 'quality' as objects (not money related value) so that they are treated with respect and care
- The products are user friendly and safe to use

Disposal – see Design for Environment

Sustainable Design – a few ideal attributes to think about for later

- Products form part of a service of delivery that creates a 'closed loop' rather than a linear process



- The materials come from a renewable resource

- Waste in minimised at all stages, or almost eliminated because all the waste is reused in other processes.

...So the products are 'CYCLIC'

- The energy used is from non-fossil fuels, preferably instead a renewable source for example solar

...So the products are 'SOLAR'

- The products use no hazardous or toxic chemicals or materials

...So the products are 'SAFE'

- All the employees that are involved in developing and manufacturing the product are treated fairly

- The product encourages good ethics

...So the products are 'SOCIAL'

- Over the whole lifecycle of the product there are improvements in efficiency

...So the products are 'EFFICIENT'

- They ensure a long-term financial benefit for the producer and consumer.....so that the service can continue

...so the products are 'PROFITABLE!'

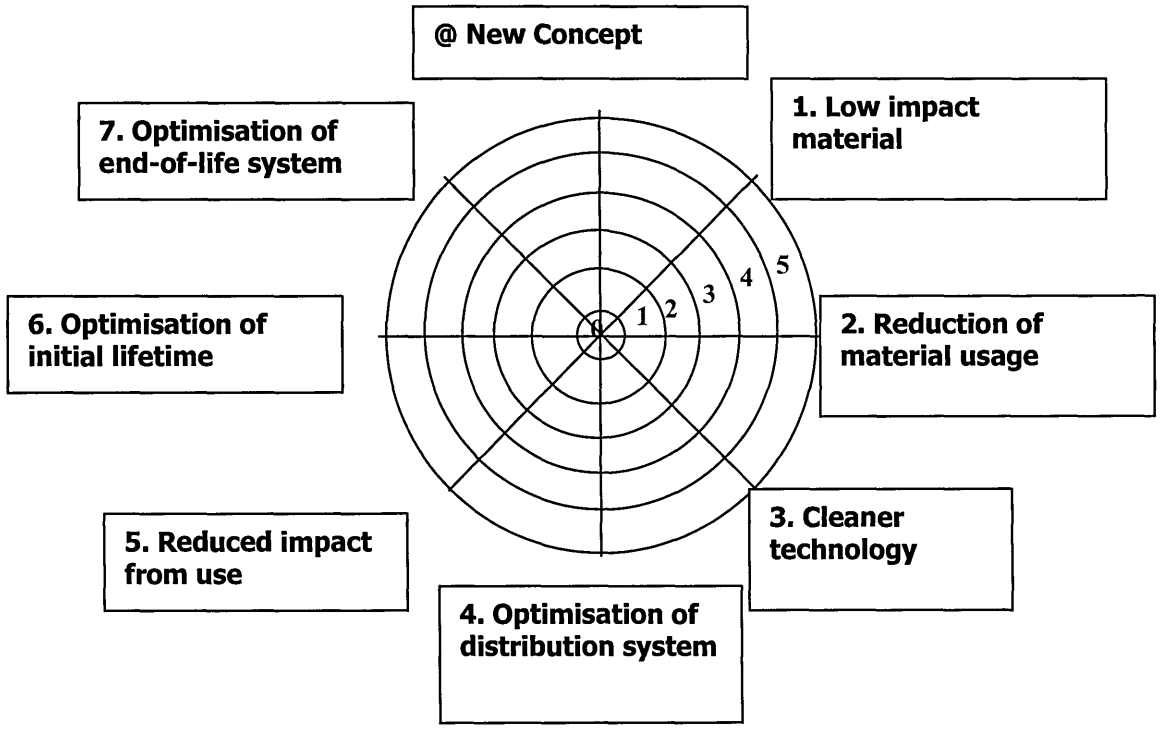
* * * * * * * * *

Sustainable design can seem a major change, and can be very daunting. My aim with showing you these examples is to show the difference between the approaches you can take. Sustainable design is often more about product strategies, and is really a continuous process of improvement towards a goal, so I suggest we bear these in mind, but look to what we can tackle in future projects.

One aspect that should be discussed is the Loop process, which might work well with the modular, 'plug and play' concept for Flores Valles. I'll explain this more later!

If you would like any more information, please contact me.

Ecodesign Strategy Wheel – Brezet and Van Hemel 1997



1. Low impact material
Cleaner, renewable, low energy, recycled, recyclable materials

2. Reduction of material usage
Weight, volume and number of materials

3. Cleaner technology
Alternative techniques, fewer steps, lower/cleaner energy consumption, less waste

4. Optimisation of distribution system
Less/ cleaner/reusable packaging, energy efficient transport and logistics

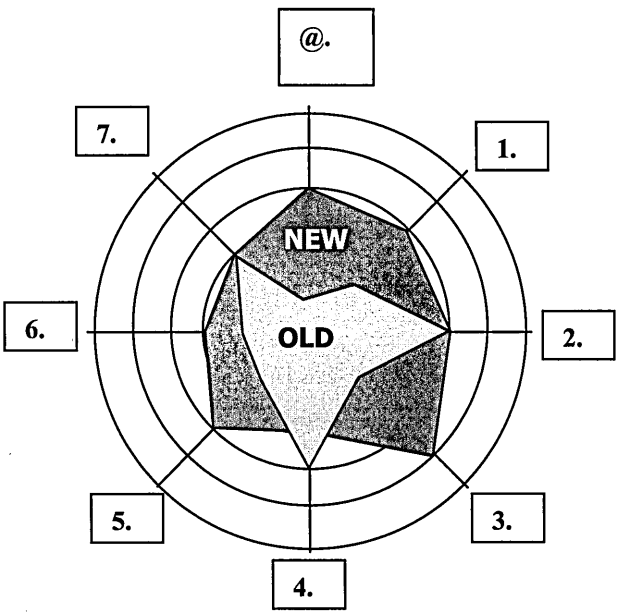
5. Reduced impact from use
Lower energy consumption, cleaner energy source, fewer/cleaner consumables, no waste of energy or materials.

6. Optimisation of initial lifetime
Reliabaility and durability, easier maintenance and repair, modular structure, classic design, stronger user relation

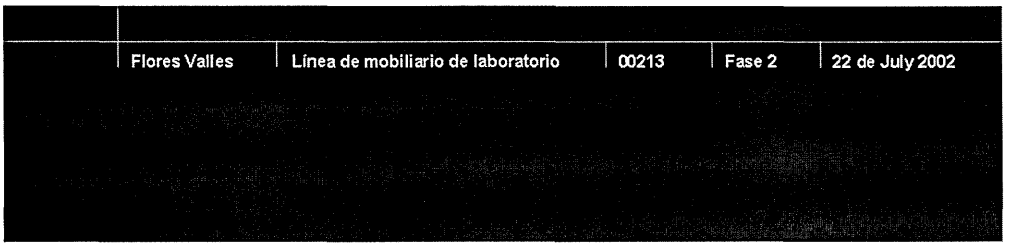
7. Optimisation of end-of-life system
Reuse of product, remanufacturing, recycling of materials, safer incineration

@ New Concept
Dematerialisation, Integration of functions, functional optimisation.

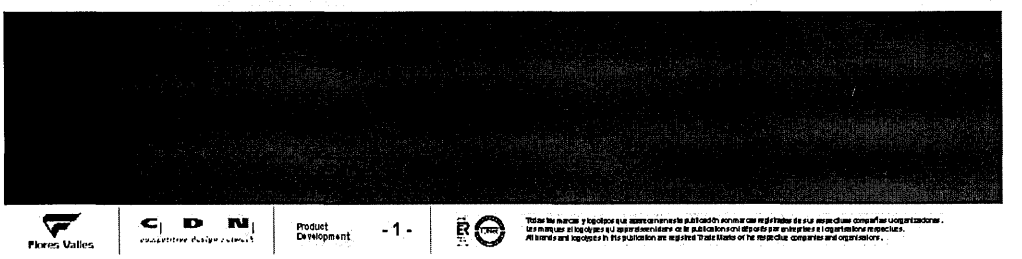
Example of mapping an old product and a new one:



Appendix C



Flores Valles



Flores Valles | Línea de mobiliario de laboratorio | 00213 | Fase 2 | 14 de junio 2002

Index

>> **Sustainable Production**

Background to EcoDesign and Sustainability

Loop processes

Opportunities for Flores Valles

Product attributes

Case Studies

➲ Background to EcoDesign and Sustainability

CDN is currently identifying the business benefits of adopting more sustainable practices, and offering their clients a service of EcoDesign throughout the projects.

The rationale behind this venture is that EcoDesign programmes bring a range of 'bottom line' benefits such as:

- Cost savings
- Added value to the client
- Legal compliance
- Increased competitiveness
- Increased innovation
- Reduced environmental impacts

We would like to begin a process of informing our clients of this move, so to introduce this subject into the Flores Valles project for further development.

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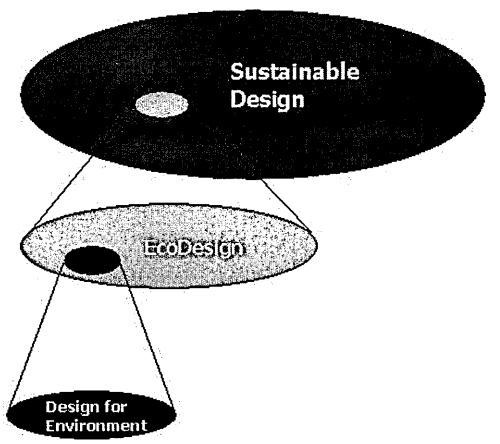
Three levels of approach to sustainability issues in design:



➢ A product, process or system that has the potential to continue forever, which considers Economic, Environmental and Social dimensions.

➢ ...design of a product, system or service with the aim of minimising overall impact on the environment over the whole lifecycle.

➢ ...concerned with Design for Disassembly and recycling at the end of the life of the product.

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Design for Environment...

***Product example:** Smart car*

- 100% powder paint coating system which emits no solvents, no lead, no cadmium, and creates no hazardous waste
- High percentage of recycled materials
- Single materials systems (see thermoplastic piece in picture)
- Standardised joining elements
- Modular construction means dismantling at low cost.
- Parts are recyclable

... focuses mostly on the end-of-life of a product.

Some examples of product attributes:

- Easy to assemble and disassemble
- Different materials can be separated as much as possible
- Use of already recycled materials
- Some material can then be recycled
- The rest of the material should be non-harmful if disposed of responsibly

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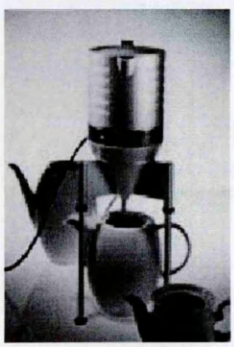
Sustainable Production

EcoDesign...



Product example:

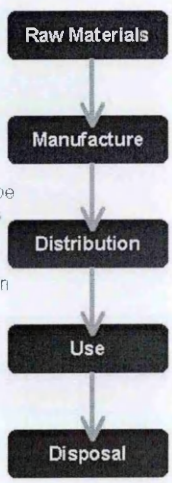
Yellow Design coffee machine

- Material saving design
- Modern technology for energy savings in manufacture and use
- Designed to be used with any coffee pot or container
- Multi-functional: can be converted into a tea maker or baby food warmer
- Modular design for disassembly, repair and maintenance

...is about the whole lifecycle of the product

Some examples of product attributes:

- The materials are the most appropriate for the purpose & expected lifespan of the product
- Reduce materials where possible
- Easy assembly
- Fewer production processes
- The products fit or stack so they can be transported efficiently in large quantities
- Using ecological packaging materials
- The energy and materials consumption in the use phase is reduced
- The product can be adapted by the user
- Can be recycled or reused



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Sustainable Design...

Product example:

Interface flooring systems

- Manufactured using only renewable energy
- ISO 14001 certified, minimum waste factory
- Uses bio-polymers, recycled or fully recyclable material
- Infinitely adaptable design
- No harmful or toxic materials used
- Interface Inc are committed to sustainable operations

...is about creating 'closed loops' instead of linear processes

Some examples of product attributes:

- Waste is minimised or eliminated because it is reused ...so the products are CYCLIC
- The energy used is from renewable not fossil fuels ...so the products are SOLAR
- No hazardous or toxic chemicals ...so the products are SAFE
- Encourages good ethics ...so the products are SOCIAL
- Improvement in efficiency over the whole lifecycle ...so the products are EFFICIENT
- They ensure long-term financial benefit for serivce to continue ...so the products are PROFITABLE

(Datschefski, E. Totla Beauty of sustainable Products)

Produce Use Waste

Linear process

Use

Produce Reuse

Recycle

Loop process

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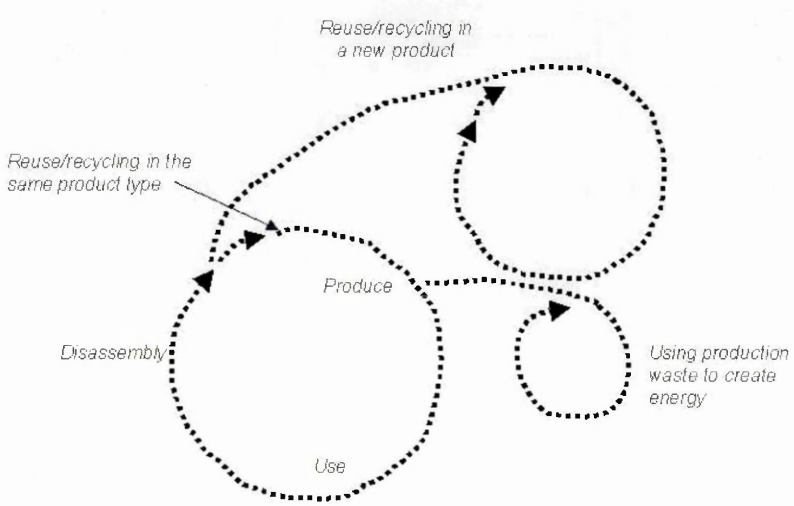
Loop processes

The aim is to close loops in the process, for example...



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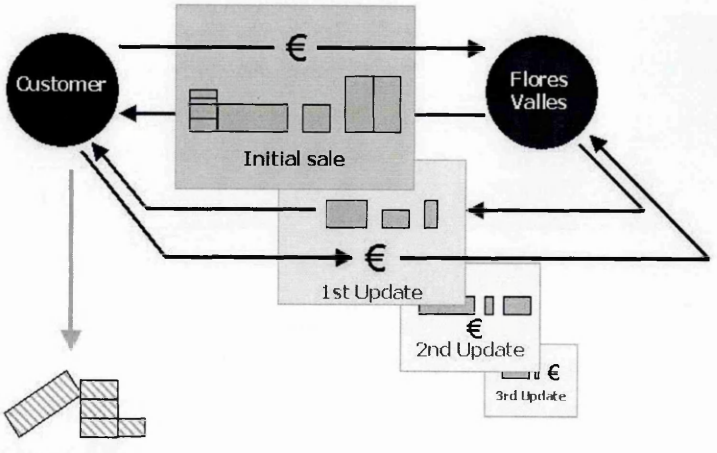
➲ Opportunities for Flores Valles:

... 'Plug and Play'



If we consider a loop system of the products in the Flores Valles range, we can start to appreciate the economic benefits of a continued service for Flores Valles's clients.

The Plug and Play system offers a big economic opportunity for Flores Valles because it means that they can offer updates of furniture for laboratories, so that they can have continued business with the laboratory after the initial sale.

Disposal of old modules = ***Lost value***

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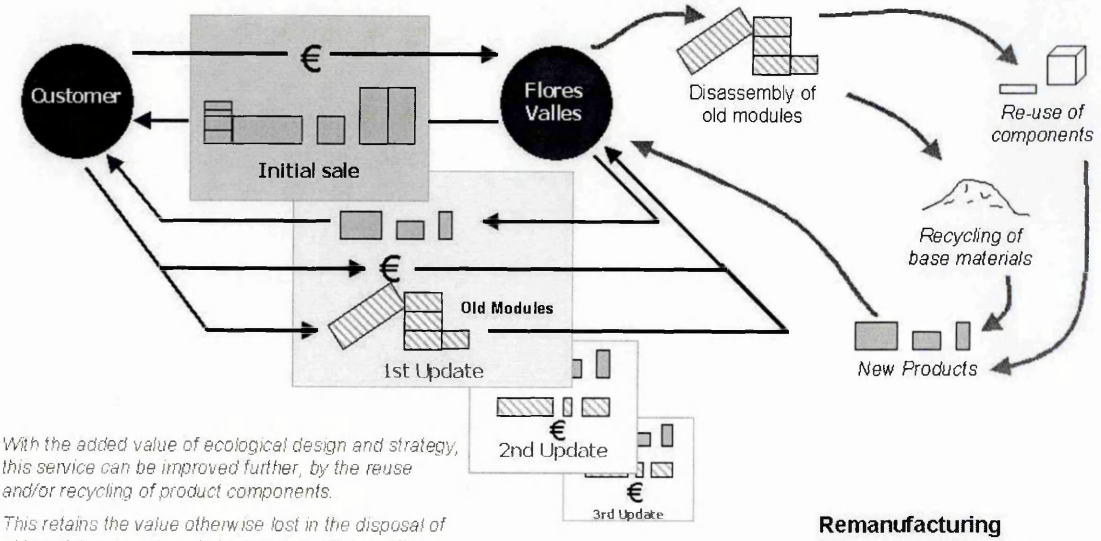
...'Plug and Play' + ECO



With the added value of ecological design and strategy, this service can be improved further, by the reuse and/or recycling of product components.

This retains the value otherwise lost in the disposal of old modules, saves costs in raw material, and offers another marketing opportunity for Flores Valles.

Remanufacturing loop = ***retained value***

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Sustainable Production

➲ Product Attributes: Suggested focal points

We have suggested some design focal points, which contribute to 'Plug and Play + Eco':

1. Making the furniture easy to disassemble and separate materials
2. Have a series of components that are transferable between the furniture 'team', that can be reused or rearranged in new modules. E.g interior structures
3. Think about the recyclability of the other parts that are not transferable.
4. Try to avoid toxic coatings and materials where possible
5. Make the materials the most appropriate for the purpose and the expected lifespan of the product
6. Design the products to fit together / stack or be transported efficiently in large quantities.
7. The product should be adaptable by the user for their needs
8. Can you use already recycled material?

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Sustainable Production

➲ Case Studies

Case Study 1:

RH furniture

RH Furniture use a system of recycling...

"you can expect at least 15 years of service before the chair reaches the end of it's practical life. At that time it can be returned to us and we will recover all materials from it, as every single part is environmentally compatible"

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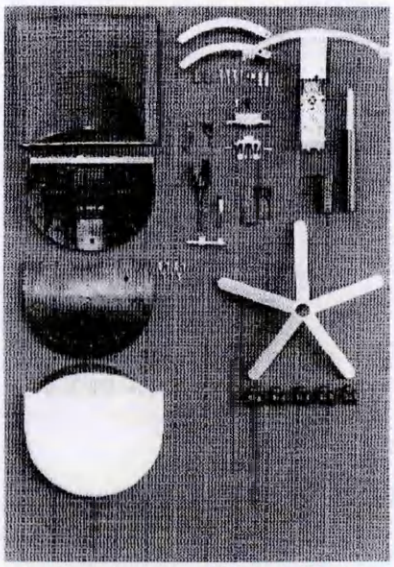
Case Study 2: Wilkhahn furniture



The Picto chair:
95% recyclable
Uses few materials
All material ecological and labelled
No Glue or welding

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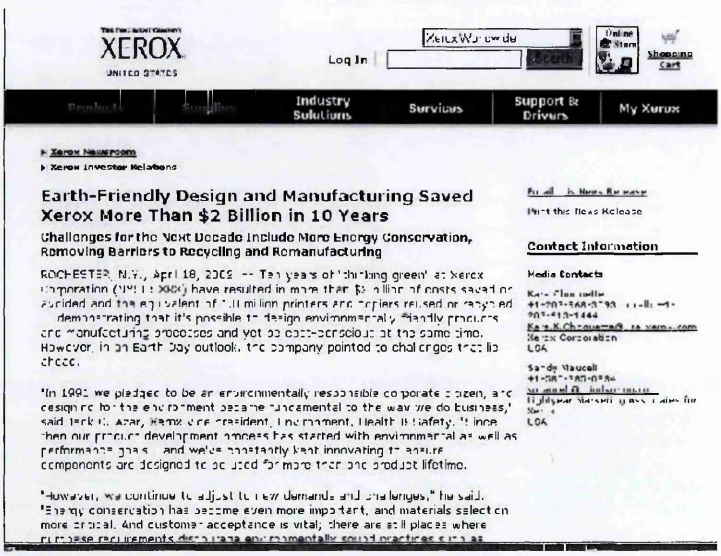
Case Study 3: Xerox photocopiers

Xerox offer a 'service of photocopying' rather than 'selling photocopiers', which means they renew, repair, and reuse many components....which has saved them $2 billion in 10 years



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Earth-Friendly Design and Manufacturing Saved Xerox More Than $2 Billion in 10 Years

Challenges for the Next Decade Include More Energy Conservation, Removing Barriers to Recycling and Remanufacturing

ROCHESTER, N.Y., April 18, 2002 -- Ten years of 'thinking green' at Xerox Corporation (NYSE:XRX) have resulted in more than $2 billion of costs saved or avoided and the equivalent of 1.0 million printers and copiers reused or recycled, demonstrating that it's possible to design environmentally friendly products and manufacturing processes and yet be cost-conscious at the same time. However, in an Earth Day outlook, the company pointed to challenges that lie ahead.

"In 1991 we pledged to be an environmentally responsible corporate citizen, and designing for the environment became fundamental to the way we do business," said Jerry K. Arar, Xerox vice president, Environment, Health & Safety. "Since then our product development process has started with environmental as well as performance goals ... and we've constantly kept innovating to ensure components are designed to be used for more than one product lifetime.

"However, we continue to adjust to new demands and challenges," he said. "Energy conservation has become even more important, and materials select on more critical. And customer acceptance is vital; there are still places where purchase requirements drive more environmentally sound practices such as

Print this News Release

Contact Information

Media Contacts

Xerox Corporation
LOA

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