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Emerging trends in sustainable design for office furniture

School of Applied Science

Master of Science

Cranfield University

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MSc Innovation and Design for Sustainability

2007/8

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Date of Presentation: September 4th 2008

This thesis is submitted as 40% of the requirements of the above MSc

Abstract

Public perception of current environmental issues has increased pressure on the producers of office furniture to decrease their environmental impact. The largest purchasers of this type of furniture have the public as their main customer; banks, schools or hospitals need to appease this sector and have been encouraged to request, from their manufacturer, a more sustainable product. The responsibility for achieving this might appear to rest largely on the shoulders of the designer. However, upon closer examination, the way in which furniture is designed for this industry, determines that choices made by the designer are within constraints incidentally imposed by a variety of factors, which significantly influences every decision. The form and structure of a product reflects a variety of elements considered by the designer. The literature review exposed no method, constructed for the purpose of differentiating these elements.

This thesis develops a method whereby a level of importance, to separate aspects which the designer will automatically consider, is determined, enabling insight into constituents of decisions which are most influential. Qualitative data was collected through semi-structured interviews with nine designers, within six large international office furniture making companies. Analysis suggests that the suppliers to this industry have considerable influence over designer's decisions. This research shows that suppliers to the industry lack incentives to develop ways to provide more sustainable products. Recommendations include the further development of 'environmental partnerships' – cooperatives with a sustainability agenda. These partnerships have potential to enhance the influence of orders positioned to increase suppliers' incentives to make available a more sustainable office furniture component.

Acknowledgements

The author would like to sincerely thank the following companies for agreeing to donate time to this study. Any success of this project belongs to the designers who assisted with its compilation. It was through their carefully considered answers to the questionnaire and discussion in the interview which made possible the data analysis and assumptions as to how the information might be useful.

Companies are listed below alphabetically; the order does not relate to the layout of the main body of text:

Companies who assisted in this study:

- Bene AG
- Broadstock Ltd
- Steelcase Werndl AG
- Svoboda GmbH
- Team 7 GmbH
- Umdasch AG

For their help and encouragement in no particular order the author would also like to thank:

Monika Huber; Barry Hewson; Patricia Murray; Alistair Lunn and Heather Simpkins

Alun Watkins of the Furniture Industry Research Association

The patient and helpful way, in which Doctor Philip Longhurst advised the author, especially during the beginning stages

The author would like to dedicate this work to Ica, Franz, Georg and Max who are always in his thoughts, and forever in his heart.

Order of Content

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List of abbreviations

BERR	Department for Business, Enterprise and Regulatory Reform
DEFRA	Department of Environment, Food and Rural Affairs
DTI	Department of Trade and Industry
EMAS	Eco-management and Audit Scheme
EMS	Environmental Management Systems
EOP	End Of Pipe
FIRA	Furniture Industry Research Association
FISP	Furniture Industry Sustainability Programme
FTSE	Financial Times Stock Exchange Index
ISIC	International Standard Industrial Classification
ISO	International Organisation for Standardisation
JIT	Just in Time
LCA	Life Cycle Analysis
MAK	The Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area
MSP	Manufacturer's Selling Price

Summary

Political parties in Europe have in recent times acquired the taste for preaching measures to save the environment; these have been coupled with regulation, which is playing a part in guarding against the destruction of the planet by ensuring complete uniformity by all member states on a wide rage of environmental issues (Brady 2008). With an enlarging Europe, regulation is having some impact on companies, but it is climate change that is now the major influencing factor that is focusing attention towards a more sustainable way of manufacturing in all industries.

Change in the office furniture industry towards a less unsustainable way of operating is moving faster than other sectors in the furniture industry. The reason for this stems from the same source driving politicians to alter in their position. It is public opinion that is providing the impetus to large global corporations and institutions to address environmental issues, which is the force behind sustainability issues becoming nearer to the forefront of companies' and national institutions' policy makers (FIRA, 2008a).

Factors which constrain decisions made regarding shape, weight, size or material finish of furniture are things of which the designer is very much aware. His or her choices of materials used in its manufacture are fashioned so as to link the supplier of the components to the market requirements. This thesis is written for companies in this industry interested in those governing aspects which influence design outcomes in the present day.

Discovering why designers make the decisions they do is a complex subject and must use their opinions to provide qualitative data. This research aims to further refine this subject by providing information which can directly link their choices and decisions to other departments of the company and to the aspects of outside influences. Its main objective is to create deeper understanding into how designers' decisions fit within a larger picture of an organisation in order to demonstrate that all aspects of company communication, internal departments, suppliers and clients are linked together and play a part in the design process of office furniture. The method used to collect data relies almost entirely on personal interviews with designers employed by office furniture manufacturers with turnovers of between 16 million and 2.7 billion pounds and employee numbers ranging from 85 to 13,500.

The interviews, which usually lasted around one and half hours, commenced with questioning the designers regarding their priorities while designing a piece of furniture. The interviews continued to discover further information regarding some of the factors behind this way of thinking including influences outside of the company's direct control. Finally the designer was given the task of apportioning importance to those outside factors and was then requested to score as to the degree the departments within the company might have influence over them. Calculating final scores provides information regarding which areas have greatest influence over the designers' work.

The research will discover that the designer is governed by influencing factors both within the company and aspects which remain outside the direct control of management. Primary considerations such as costs are considerations which restrict the decision making process as well as choice of materials the designer will specify. Results from interviews will show how the industry's environmental impact is largely governed by suppliers of the components. Even with a very large turnover a single company alone in this industry does not have sufficient influence to demand change in the way the furniture components are made nor are they in a position to influence the materials from which they are made.

The data analysis will show that within internal departments, Purchasing, and particularly Marketing have the most influence on the out-of-house factors which influence the designer's decisions. The analysis will demonstrate that sustainability issues are not yet at the forefront of shaping a product identity or in the first considerations when the company direction is being constructed. It will show that the office furniture business is very much linked with its suppliers and therefore in a significant way its course is steered by their production methods. The industry's connections with their suppliers and clients viewed systemically gives foundation to the argument for joint participation towards a more sustainable way of manufacture.

The discussion will include some of the achievements which companies have had in this movement. It will show that this industry is on the cusp of change; analyse how this success may be continued including the linkage between client, designer and the marketing department; demonstrate that with the incentive to purchase a more sustainable product, companies in this industry working in cooperation can persuade suppliers of components to alter their course of operation; and show that the suppliers of these components will only steer towards more sustainable design when clients present a unified front.

The conclusion will outline how this research has increased understanding into the functioning process which influences and constrains the designers' choices when they are working on a brief. With the information gleaned from designers it will paint a picture of the overall current attitude towards sustainability in the office furniture industry. It will examine potential benefits from further research in the area of this study.

Chapter 1
Introduction

1.1 Background to this research

The designers within most of the companies involved with this study suggested that in a few years' time there will be no option but to give the issue of sustainability equal importance with other elements such as economics and product identity. Sustainable design considerations in the office furniture industry, though in its infancy, are promising to grow to become part of all designers' remit (FIRA 2008a). Contract office furniture is leading the furniture industry towards a more sustainable use of materials and systems of production. The largest proportion of orders for this type of furniture are from banks, hospitals and schools, it is these organisations that are requesting a more sustainable product to appease their customers, the majority being the general public (FIRA 2008a). Using the direct influencing factors of the designer's decisions as a platform, this study will explore the extent to which companies in production are currently contributing to a more sustainable design in office furniture design and production, and how this trend might be furthered.

Business practice and methods of production are in this industry becoming a measure of public opinion which is becoming more sympathetic than ever before to sustainable methods of operation (FIRA 2008a). Sustainable reports are now more commonplace amongst larger companies who proudly present their innovative environmental strategy together with their financial report. Another incentive for change is cost. To quote just one example; landfill rates are currently running at £104 per tonne and this is shortly expected to increase (FIRA, 2008b).

In 2006 the furniture industry in the UK had a manufacturer's selling price [MSP] of over £6 billion, providing turnover for over 7,000 businesses and employing nearly 130,000 people, (FIRA, 2008b); it therefore has a significant environmental impact. The UK office furniture industry had, in 2007, a 14.3% share of this, i.e. £860 million which was a 0.3% increase over 2006 (Key Note, 2008). Tables 1.1 and 1.2 give a breakdown of the product sales areas in the sector in the UK, providing an overview of the office furniture industry (Key Note, 2008: in sections 2 and 3 under 'Office Furniture July 2008').

Table 1.1: Breakdown of areas of office furniture sold in the UK

UK office furniture market by sector by percentage					
	2003	2004	2005	2006	2007
Wooden furniture	51	47	44	44	44
Metal furniture	30	32	34	34	33
Upholstered swivel seating	19	21	22	22	23
Total	100	100	100	100	100

Table 1.2 demonstrates the ratio of exports to imports (Key Note, 2008).

Table 1.2: Sales [MSP], Imports, exports and net imports of office furniture to the UK

Net imports of office furniture to the UK £million MSP. 2001 – 2005					
	2003	2004	2005	2006	2007
UK Manufacturers' sales	808	770	740	716	717
Imports	203	218	246	274	278
Exports	99	111	126	134	136
Net imports	104	107	120	140	142
UK market	912	877	860	856	859

1.2 Problem statement and aims of this study

Much study has been made of the thought processes of designers. Cross (1999) for example found that designers can perceive a complete picture of a situation within which a product must become part. In this way he found designers are unlike computers. Person et al. (2007) confirmed this by highlighting the complicated patterns of influence which a designer must appreciate concurrently during the development process. Howard et al. (2008) makes a distinction between creativity and the design process, they shows how the design process is mechanical, but partners in harmony with the creative process. The designer works much like the conductor of an orchestra implementing necessary skills at the appropriate moment. It is clear the reasons behind a designer's decisions pose a complex conundrum. Howard et al. (2008) suggest additional research is conducted about the effect that different types information have on the designer and the design process.

Behind the designers' decisions is a myriad of pockets of information creating influencing factors, completing a larger picture which, when seen in its entirety, is coupled with trade-offs inherent in the prioritising process. Pinpointing areas of design influence is part of understanding this process. The office furniture industry has until now received little attention with regard to how its designers are influenced to make decisions. In this thesis the author enters a sphere of investigation within the office furniture industry, which leaves the *design process* and examines how understanding the governing reasons behind behaviour patterns of the designer may expose the reasons behind the current attitude towards sustainability.

1.2.1 Structure of argument

Much office furniture's considerable environmental impact is owed to the choice of materials and decisions made by the designer. The office furniture industry is at the forefront of a new way of working and to a large extent relies on its designers to steer towards a more sustainable product. It is not, however, correct to postulate that designers are responsible for the product's environmental impact. A holistic view of this situation demonstrates that the designer is very much part of a system and is intrinsically linked to various aspects of a product's production. Viewing designers as part of a complex systemic flow of influence is the basis for this study. The designer's decisions could be described as the 'litmus paper' telling of a causal path which leads to a product's identity and the environmental impact attached.

The literature review will show that little research has been conducted into where the influences lay behind designers' decisions. Searching for ways to improve environmental impact requires knowledge of the history attached to the decisions. The author's opinion is that when the roots of activities are exposed, defining areas in need of alteration is also possible. This study will investigate how this knowledge may be helpful when constructing a new model of operation.

Should this thesis achieve its objectives, an increased knowledge of the chain reactions linking both outside and internal department influences will be attained. An increased understanding of *how* this information might be used during the planning stages of an environmental strategy will only be known however, when a further study is made into the consequences of decisions made from each department of a company, and their effects within the chain. If this further study is undertaken, the results of this research will be even more meaningful.

1.3 Author's note

The author is English, born in Guildford and has lived in Vienna for the past six years. A graduate of furniture and product design, he has a designer / maker background producing commissioned furniture within his own business for 18 years. By attending the "Innovation and Design for Sustainability" MSc course, he made the fascinating discovery of in-depth complex influences which affect designers' decisions and choices within the office furniture industry. The author holds the opinion that humans will always prioritise manufacture with survival as their first consideration and not until there is sufficient strength of argument suggesting that sustainability issues are an integral part of this survival will they, through the technology they develop and discard, reduce their environmental impact. The research is conducted with the hope that it may contribute to the sustainability line of reasoning.

1.4 Thesis structure

Chapter	Content
Introduction:	The research problem leading to this study and the objective therein. It will also provide financial meaning of the office furniture industry in terms of sales figures in comparison to the furniture industry as a whole.
Literature review:	An in-depth review of research, which has previously been carried out in the area of this thesis. An overview of methods used to successfully collect data will provide information from which the method of research will be built.
Method:	Constructing a method to be used for this research including an explanatory note to justify the method.
Results:	Insight into the varying strengths of influence the designer encounters, providing an overview of the situation in the office furniture industry today about its attitude towards sustainability.
Discussion:	Deeper analysis of the meaning of the research, exploring how the industry could benefit from change which leads to an improved environmental impact in production.
Conclusion:	Review of objectives achieved, it will examine the limitations of the research and outline suggestions to further this study.

Chapter 2
Literature Review

2.1 Background to this chapter

The influences behind furniture design and the trade-offs therein has had little written about it according to an Environmental Consultant at the Furniture Industry Research Association [FIRA] (2008a). The author also found this to be the case; the areas of investigation included search hubs for relevant and related papers such as: Google scholar; Science Direct [Design Studies by Elsevier], Scopus and ProQuest. The author also contacted a number of universities in the UK and Austria for advice; they confirmed that this is a new area of study.

The author through the designers interviewed has discovered that there is no worldwide standard for the toxicity of these materials. Few studies have been commissioned regarding the nature of incentives towards producing office furniture with a more sustainable approach.

However, this review shows that the movement of sustainability is progressing in a positive direction. In their annual report FIRA state that members of their organisation now make up 15% of UK furniture sales, which is interesting because this shows an increase of 4% over the previous 12 months (ibid).

Methods of managing an organisation's environmental impact include ISO and EMAS, [the take-up of these has been analysed by Brady (2008) as used by all sectors of manufacturing], but do not have a specific insight into the trends of the office furniture industry.

Some papers specific to influences in design have been reviewed but because the author found difficulty in finding previous research in this area of study papers in this review include research found under the key word topic of "Green Manufacturing". Papers in this area of research which are near to the subject of this thesis have also been included in this review.

Environmental Management System [EMS] is a method of managing an organisation's environmental impact and ISO 14001 is used as a guide and to specify the requirements of an EMS. ISO 14001 and the similar but more robust and stringent Eco-management and Audit Scheme [EMAS] have in recent years become widely accepted as a measure of credible standards which provide tools to manage and improve environmental performance (Brady, 2008). Large manufacturers are increasingly aware of these standards and most have an EMS in place, they found advantages such as: demonstrating and reporting an environmentally friendly policy; and being in an improved position to understand wasteful systems of production, and methods for their reduction (Brady, 2008). Turning toward a more sustainable way of working requires the implementation of new systems which reflect these new demands. Taking a systemic approach towards constructing a system necessitates taking all factors into account; this thesis is a study of one of these factors, i.e. the influences behind designers' decisions and understanding the trade-offs involved.

ISO 14001 accreditation gives the main contractor an indication of a company's intentions and policy regarding production standards, a point argued by Sarkis (2001). In his project *'Manufacturing's role in corporate environmental sustainability'*, he discusses ways in which methods can become pivotal in producing a more sustainable product. He refers to "win/win" situations whereby employing these tools can lead to a leaner and cleaner production involving contractor/supplier cooperation resulting in a more environmentally friendly product. Regulation will have, and is increasingly having, an important part to play in giving incentives to manufacturers to implement a good EMS into their strategy by creating a situation whereby other firms, less conscientious regarding ecological matters, do not take advantage of the investment trade-offs encountered by this implementation (Sarkis, 2001).

Sarkis (2001) adds:

> *"Integrating environmental factors and the necessary organisational infrastructure to acquire this information is also in its infancy, especially in the design process"* (p.680/1).

Furniture manufacturing has recently witnessed an initiative to assist and advise companies about the implementation of environmental systems: FIRA in February 2006 was a key member in founding the 'Sector Sustainability Challenge' resulting in FISP. Launched in 2006 it has been well received by the Department of Trade and Industry [DTI][1] and the Department of Environment, Food and Rural Affairs [DEFRA]. The objectives of the programme are to provide practical advice to furniture manufacturers wishing to set up sustainable development strategies leading to FISP membership (FIRA 2008a). However FIRA (ibid) stated that with only 42 full members, FISP is in its infancy, which suggests that sustainability in the furniture industry in the UK as a whole has had a slow start.

The office sector is where the majority of engagement and acceptance of sustainability issues is currently taking place. Pressure in this sector is being applied by large purchasers such as banks, universities, and hospitals, who are asking questions about the materials source and control certification, obnoxious chemicals contained within materials, life cycle etc. Government sustainable procurement policies insist companies have an EMS in place before they are entered on their tender lists (ibid). There are also changing expectations of companies, frequently awarding contracts with the condition that old office furniture is collected by the supplier and dealt with in a responsible manner (ibid).

FIRA (2008a) has created the following slogan for promoting the development of an EMS:

> *"…don't be a victim of analysis paralysis – worrying about what to do and where to start, then doing nothing – just make change happen!"* (FIRA, 2008).

Another reason for this slow start is described by Simon et al., (1998) who argue that there is not yet enough incentive for companies to pay attention to environmental concerns. Good marketing is needed to show companies the benefits of reducing their environmental impact and thus potentially lowering production costs (ibid).

However, Sarkis (2001) argues that sustainable management tools provide direction for measures of change, which can benefit a company's efficiency in the form of increased productivity and/or improved working conditions. Both company and supplier potentially gain many advantages by using this philosophy, which provides a level playing field whereby all are working with similar constraints and incentives.

[1] Since 2007 known as: Department for Business, Enterprise and Regulatory Reform, [BERR]

2.1.1 Life cycle analysis (LCA)

Sarkis (2001) takes this into the area of product LCA, LCA is a process of evaluating the environmental impact of products. He implies good relations and communication with suppliers are made possible when there is also internal cooperation:

> *"Product stewardship will also take significant internal cooperation as it covers a tremendous range of functions across a company"* (p.673/4).

Sarkis (2001) postulates that designers and experts involved with the development of products must be aware of their responsibility concerning the materials used and the life cycle of the product.

However, Simon et al. (1998) argue that it is not reasonable to expect designers to have a life cycle philosophy without first being given information on the LCA of the supplied components. Lack of incentive is a large barrier in this industry; it appears that Government support in providing companies with incentives, is not yet available (Simon et al., 1998)

McDonough and Braungart (2002) also argue that designers are not fully informed as to the hazardous chemical issues connected to, and the LCA of, the product they are designing. They suggest the education of designers should include the materials used in their designs, and that once informed they would be in a better position to consider whether the chemicals are necessary and to make informed decisions with regard to specifying available alternatives (ibid).

FIRA, (2008a) stated that they are unaware of any LCA for materials used in office furniture manufacture. Nevertheless FIRA (ibid) state that large companies are very interested in potential cost savings induced by reuse and remanufacture, recycling leading to waste reduction, and dematerialisation reducing transport costs and lowering energy bills. Trade associations, environmental forums, and their steering group for FISP show a promising beginning in informing their members of these benefits.

Westkämper et al. (2001) in a report on LCA suggest that companies will change direction, if not to reap benefits then to avoid fines for disobeying environmental regulations. They explain these measures will force a change in the way industry operates.

> *"In Europe and Asia, regulations are becoming legally effective, burdening the manufacturer with the responsibility for the complete life cycle of a product, including the taking back and recycling of products"* (p.602).

They further observe that in Europe and Asia legislative controls are becoming more relevant; manufacturers now have responsibilities not only during production, but often for the 'taking back' and the recycling of their products (ibid). The knowledge required for the recycling or reuse of products is not currently in abundance for designers, but is becoming more essential; it also has an increasing value as more companies become involved with LCA and schemes such as ISO 14001 or EMAS.

Westkämper et al. writes on the subject (2001):

> *"Life cycle management offers the advantage of reduced expenses through the avoidance of unnecessary processes. At the same time, the processes are more life cycle oriented and more flexible and the performance of the product increases. The development of LCM will focus on reduction in the time needed and in the cost of tools"* (p.608).

An alteration in strategy attaches trade-offs and the implementation of environmental management tools is no exception. Sarkis (2001) remarks on the paradoxical nature sometimes experienced when implementing EMS and uses the 'Just in Time' [JIT] policy as an example, which he suggests that though it minimises potential material waste, has other costs attached such as more deliveries as one consequence of a reduction of stock. Perceived and actual costs attached to reducing a product's environmental impacts are discussed in Chapter 5.

2.2 Partnerships in manufacturing

Many companies have obviously overcome obstacles and have considered potential advantages of implementing environmental programmes of partnership. Carefully structured they can be beneficial to both or all members and are a way of insuring that awareness is rewarded at the forefront of environmental issues. Two examples of how this practice can produce a win win situation for the participants and the environment follow. Sarkis (2001) writes on the subject:

> *"Numerous examples appear in which multiple multi-organisational relationships benefit from environmentally conscious partnerships. For example DuPont has developed a partnership with Ford Motor in which DuPont's payments are based on the number of cars that are painted. This creates an incentive for the two companies to use paint as efficiently as possible"* (p.678).

Brookfield et al. (2008) during a 5-year research programme unearthed a successful and innovative partnership in the bicycle industry in Taiwan. Though it was not solely initiated for environmental reasons, the case nonetheless demonstrates how competitors can bring positive results by working together. Through the necessity to survive, two rival companies 'Giant' and 'Merida' developed trust between them and developed a new range of products. Traditionally the Taiwan way of business fiercely protects intellectual property. However, in 2004 these companies pooled necessary resources, and by sharing research and development costs constructed systems which led to a leaner way of production. One of their main successes was an electric bicycle, the results of which showed a handsome profit for both companies.

More than 50% of companies from the 250 FTSE index are now producing a 'Sustainable Report' accompanying their financial reports, which it is argued creates brand loyalty [stated in presentation slides accompanying a lecture on 'Communicating Sustainability' by Lynne Elvins, January 2008, Cranfield University]. Brady (2008) on the subject of EMS states the importance of including as many stakeholders as possible such as customers and environmental regulators.

However, problems with partnerships are easy to find; many problems were expressed during telephone conversations by those in the industry the author spoke with. One such problem is that a major improvement to the environmental impact in the furniture industry would involve a reduction of waste during manufacture. Much wasted material is due to a lack of communication. Many companies in the office furniture industry stated to the author that the time has arrived for challenging the norms of accepted office furniture design especially regarding waste.

The author found those interviewed concurred and expanded upon the need for change. Office furniture, for example, is based on standard modular systems which have been in place for years and have not yet caught up with the reduced space requirements of flat screen monitors. Tackling these norms and proposing new innovative environmentally sympathetic designs should be the remit of all modern furniture designers. The author found through telephone conversations that a typical example of waste is caused by lack of knowledge of the systems used by mainland European manufacturers; the result is that virgin materials are thrown away due to inefficient planning. Current office furniture design is often based around the British standard 8' x 4' {2440mm x 1220mm} board, but this size is not standard in Europe where much office furniture is made. This fact has not yet filtered to the way designers in the UK operate. This lack of communication also causes unnecessary resources required to dispose of the wasted material.

Mika (2008) of 'Steelcase', a large multinational office furniture manufacturer owned in the US, has created what she is calling 'green suppliers program'. She suggests savings will be gained by the programme, but to be fully effective it must take the form of a partnership involving talking to suppliers and sharing information with competitors; this has the potential to create a level playing field. She writes of the need to include sub-suppliers into a 'whole system' in tune with one objective for a more sustainable manufactured end result (Mika, 2008).

> *"Many of our suppliers are so enthusiastic about the 'green suppliers' program that they've encouraged other suppliers (sometimes their competitors) to consider participating"* (Mika, 2008, p.13).

Chain implications of this have much potential. On this point she adds that the increased interest will affect the manufacturers through new markets created as a consequence of this attention.

This concept, however, is not new. People concerned with issues of sustainability have been advocating collaboration as the best environmental policy for decades. Schumacher (1974) wrote:

> *"In industry, again – and, surely, industry is the pace-setter of modern life – we can interest ourselves in new forms of partnership between management and men, even forms of common ownership"* (p.18).

Senge (1999) argues that an isolated way of operating has a price, and to understand our interconnectedness can bring insight into the consequences of our actions which might have otherwise have been possible to ignore.

> *"We are educated to fragment problems into manageable, understandable parts. This apparently makes complex tasks and subjects more manageable, but we pay a hidden, enormous price. We can no longer see the consequences of our actions; we lose our intrinsic sense of connection to a larger whole" (Senge 1999, p.3).*

The general opinion held suggests that partnerships in industry can lead to an improved environmental impact of their product.

2.3 Constraints

FIRA (2008a) observes that the reasons for sustainable practice are many but as yet mostly unknown. Getting people round the table to discuss potential advantages is not easy. Regulation caused by recent changes to the natural environment has not led to a rush of companies eager to learn how to mitigate or reduce imminent costs associated with this movement (ibid).

2.4 Regulation

Regulation is the most powerful catalyst for environmentally conscious change. However this regulation has not been well coordinated in the UK with different laws for England, Scotland and Wales. On this subject Brady (2008) writes that there is no particular international system of environmental laws, each country uses different laws, some are overlapping and are uncoordinated.

Considerable improvements in the way companies operate their environmental strategy are nonetheless being achieved, and many argue that regulation is the most powerful incentive for change. Westkämper et al. (2001) remark that some governments of industrialised countries together with the European Union, are now constructing policies which govern some of the environmental impact of products such as take-back legislation for manufacturers e.g. for cars and electronic products, thus forcing designers to consider sustainable aspects during the planning stage.

International regulation is also a victim of a lack of coordination, which can make the reliability of material's toxicity and certification unreliable. FIRA (2008a) reports that chemicals detrimental to health in particle boards made in Europe now present little health hazard. However, boards in Asia are often made under different regulatory laws and may still contain levels of formaldehyde considered harmful by regulators in Europe and there is no way of differentiation yet (ibid).

Designers of office furniture are now able to choose from an increasing variety of new materials from all over the world as this industry expands. The importance of international regulation, coordination and collaboration increases, but not all countries have yet found sufficient incentives to justify the trade-offs necessary to comply.

2.5 Requirement for a new approach

Those within the industry the author has spoken with have the view that sustainability is an important issue and the future structuring of their business should take this issue into account. It was expressed to the author that designers today have a moral obligation to consider the complete process of manufacture and understand the life cycle of their product, and it is their duty to educate clients of the potential benefits of less unsustainable office furniture. Comments to the author have included that furniture should be designed with consideration for its ultimate return to the Earth's crust.

This philosophy would have many advantages as a disposal costs reduction, reduction in materials used and a potentially less expensive product or less energy used during production. Nonetheless, it is neither the full story nor will it solve all current issues. On this point some office furniture manufacturers while speaking with the author made a positive observation. The consensus suggested that the sustainability movement has started, and clients are beginning to request information about the environmental impact of office furniture. They are now more prepared to challenge 'safe' standards of current normality and listen to arguments demonstrating financial savings connected with more sustainable products. Reasoning a new approach is easier said than agreed upon, and addressing the need for an international environmental policy agreement is a large subject and beyond the scope of this thesis.

2.6 Research method case study review

The following two case studies have been chosen for their suitability for collection and interpretation of data for the purposes of this thesis.

2.6.1 Case study 1

Handfield et al. (1997), designed interviews for a comparative study with five environmental managers in the furniture industry. Their objectives were to create tools by which companies could increase understanding of organisational strategy implementation necessary within the 'value chain' to achieve more sustainable practice.

They used comparison to determine how companies were reacting to changing environmental concerns relative to others within the furniture manufacture industry. Comparison was achieved by sampling companies which were at different levels of sustainable awareness and stages of implementation of environmentally influenced practices. They chose the furniture industry not least because it most represented manufacturing practices generally, and the processes therein were used in many different sectors of manufacturing. The companies named only as: A, B, C, D and E are implied to be of a similar size carrying similar turnover and

number of employees. The paper was written by four authors: Handfield, R.; Walton, S.; Seegers, L. and Melnyk, S. all of whom reviewed the notes and interpretations of the others; each author was considered an expert in at least one area of exploration.

Method:
Areas of activity within the company were coded according to an assigned position, the scores for environmental engagement ranged from 1 to 6:
1 = Resistant
2 = Embracing
3 = Reactive
4 = Receptive
5 = Constructive
6 = Proactive
The scores were rounded to give an overall 'environmental score' (Handfield et al. 1997).

The areas of study below were each given a score according to the environmental managers:
Functional areas:
Purchasing
Manufacturing
Packaging
Reverse logistics
Product design
Marketing
Waste Stream
Management
Total score:

The interviews were carried out on site at the respondent's facility. Questions directed at the environmental managers had the objectives of dividing the activities of the company into areas of environmental impact:

- To understand their environmental strategy and how important it was to the company
- To determine which areas of environmental impact were their main concern
- To ascertain how their concern for environmental impacts translated into action and company strategy alteration

Questions asked included [quoted]:

- Do you have an EMS?
- If so, how successful has this program been and how did you measure its success?
- What are the primary components for your program?
- Is this a top management priority?

Before attempting to utilise sections of this method, it is important to understand that their method of data collection follows a qualitative and subjective path, the method of which is continually adjusted and modified according to and as results are analysed. In no way should they be interpreted as quantitative.

> *"Unlike large sample size statistical analysis, qualitative data analysis is iterative, refining, reconstructing and refocusing successive displays drawn from the meta-matrix at each iteration until the final display incorporates as much of the qualitative data as is possible"* (Handfield et al., 1997).

Comparative studies are essential when constructing a tool by which standards could be created in the 'doing', so those areas in most need of attention are exposed. Handfield et al. made this study on five different companies. The matrices of the assigned positions for the areas of activities within those companies were defined as the scores which related to the other areas of activity regarding their influence.

The approach used by Handfield et al. is defining areas of environmental concern to give an order of importance in comparison to clearly defined weighting according to the influence of an area of activity, compared with other areas of activity as perceived by all departments of a company.

Defining areas of focus in conjunction with a method of comparison is something that Ghazinoory (2005) took a step further with a technique of cross-referencing which provides increased relevance to the data collected which is thereby more effectively converted into useful information.

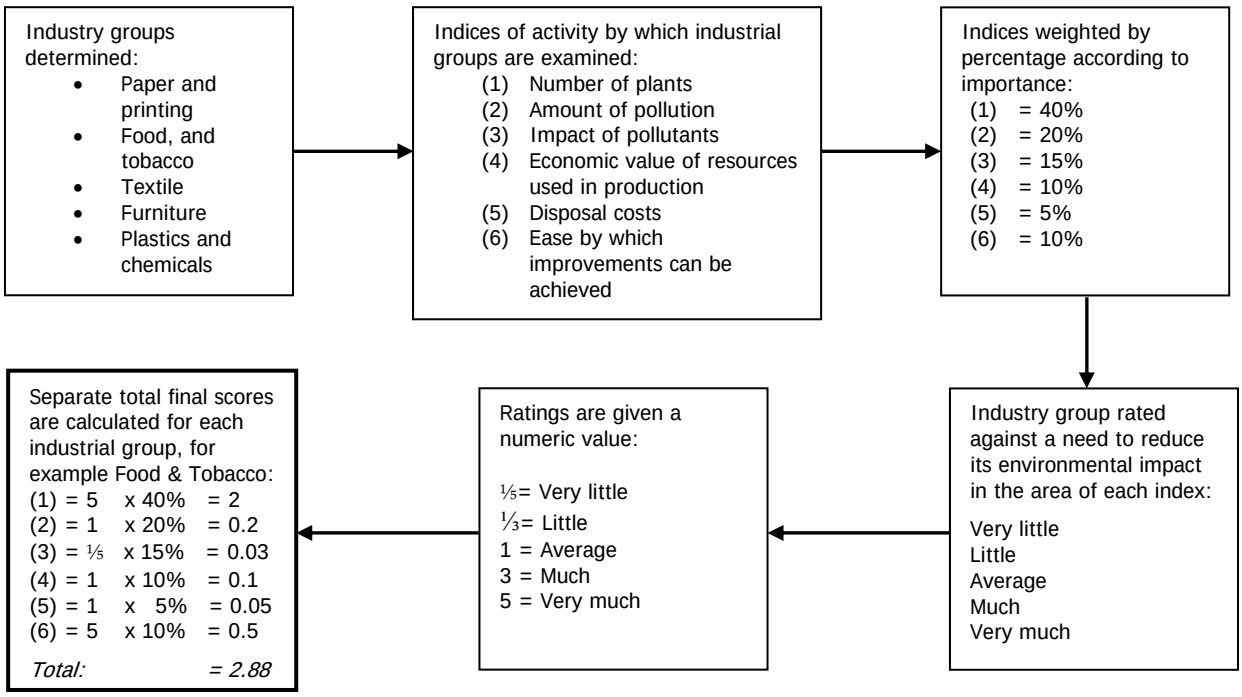
2.6.2 Case study 2

Ghazinoory, (2004) had an objective to highlight a need for change in methods of production used by a number of industries in Iran. Because industrialists of Iran would not accept practising cleaner production in all areas of industry at the same time his method behind data collection was aimed at determining an order of importance for correction and change (Ghazinoory, 2005).

With the help of relevant experts, government departments (including the department of the environment) and directors for each industrial group, a matrix was produced which demonstrated areas of industry that had the greatest environmental impact. From this it was possible to prioritise which areas of industry should first face scrutiny (Ghazinoory, 2005).

A synopsis of his method is shown in Diagram 2.1: [some of the lists have been summarised, others directly quoted]

Diagram 2.1: Summary of the method of data collection and analysis used by Ghazinoory (2005)



The significance of this method was the way areas of industry were differentiated and a tool applied with which to cross-reference the data. Ghazinoory (2005) demonstrated a method with which influencing areas of activity can be exposed. [Appendix 6 shows a more detailed version].

2.7 Chapter summary highlighting the novelty of this research

In this chapter the need for a new approach was highlighted, the benefits of environmental business partnerships were stressed and it was observed that the industry currently lacks knowledge regarding life cycle analysis. Furthermore, the role of regulation has been considered and it was noted to have positives and negatives and is therefore ambiguous. Finally, case studies were presented where previous research has been conducted into methods of data collection with the potential of suitability for adaptation and use in this research.

To summarise, it is clearly apparent that environmental considerations of sustainability issues are important, valued and can be potentially advantageous as shown by the environmental partnerships. However, equally, there are current issues in the form of limited industry knowledge and inefficient European policy. It is therefore questionable whether the regulation currently in place is conducive to the process of decreasing the environmental impact of this industry.

Having viewed an outline of the drivers for the sustainability movement, a more detailed analysis in the following chapters will look at the factors that influence the individual designer's thought processes and the causal path of their decisions therein. How this ultimately affects a company's strategy will be discussed in Chapter 5.

Chapter 3
Method

A total of thirty three companies were contacted requesting assistance with this research, six companies were willing to participate resulting in nine designers interviewed; with the exception of one all were conducted on company premises. The companies involved are mentioned by name in the acknowledgements but will be referred to in the main text as A, B, C, D, E and F in order to protect the designer's position within the respective company, this complies with ethics of data collection. Statements from the interviewees will remain anonymous both by name and to which company they are attached. Six interviews were on a one-to-one basis lasting between one and two hours and one group discussion lasting approximately one and a half hours. The group discussion was a lunch meeting with the author and three designers each employed by the same company. Those interviewed worked as employees of the partaking company; the reason this is desirable is that the designer would be entrenched in the company's philosophy and therefore would not be changing his design style often, thus his answers would be more likely to represent the company taking part.

3.1 Objectives of this research

Change is always a challenge as any alteration in course must be accompanied with some insight of which areas of the current ways of operating would most benefit from modification. Without this knowledge any new strategy has a reduced chance of success. Collecting and analysing data leading to meaningful knowledge will assist companies that are exploring ways to produce office furniture using a more sustainable method. Using information to understand areas connected with the decision path of their designer employees which has potential for improvement will equip them to make modifications leading to a more environmentally friendly way of production. Brady (2008) argues that knowledge is the prerequisite to environmental protection without which it is not possible to appreciate the environmental impacts of human activity.

This method of data collection has been constructed with reference to the environmental impact of office furniture manufacture. It will consider influencing factors both within a company and from outside [i.e.: clients and suppliers]. The results will provide information with which it will be possible to create a decision matrix to be used in respect of a future course alteration which determines elements of production that have an impact on design, and the trade-offs necessary to achieve a satisfactory response to environmental issues.

The method used for this research has been developed for the purpose of analysing data leading to information, which focuses on two areas:

1. How designers influence and are influenced by sustainability concerns with regard to specification of materials and production methods
2. To evaluate data and identify reasons behind the causes of influence

The results of the research will provide information whereby further recognition of the influence of other company departments in a product's final makeup will be possible, thus enabling understanding of the way in which their actions contribute to a designer's decisions. It is the objective of this research to provide information to the office furniture industry that is necessary when planning to alter strategy according to new awareness of environmental requirements.

3.2 Suitability of this method

This structured method of data collection offers a framework for a study, which is easy to be completed by the participant, but can provoke deeper discussion during an interview exposing judgments not previously consciously considered, giving further meaning to the study. The method adapted from a method developed by Ghazinoory (2005) looks at two distinct areas relevant to the designer's work; cross-referencing of these effectively achieves a data analysis within the process of final calculation. Scores are comparatively evaluated both from within each department of the company to which the results belong and in contrast to all the other participants of the study. Quality assurance is achieved through the aspects it evaluates: the importance the designer designates to areas of his or her designing process, the origin of influence, together with its weight of influence, leaving a total score to each in-house department. Thus without requiring further data analysis it clearly exposes areas of a company's operation most influencing the product's end design.

3.3 Area of research

Large companies designing and primarily producing office furniture have been the target of this research. The companies interviewed had the following common properties:

- Turnover ranging from £16 million to £2.7 billion.
- Employees ranging from 85 to 13,500.
- From the components purchased, all companies interviewed produce more than 50% of the furniture they sell.
- 65% or more of the furniture designs are carried out by designers employed by the companies, out-of-house design consultants are used where a new range is launched with the intention of steering global trends to the company's advantage.

Although most of the companies interviewed have their head office in Austria, the companies with the exception of one, are international with subsidiaries in the UK. The designers interviewed mostly work internationally for their companies and therefore the comments and opinions they offer can be considered to equally represent a UK company with an international operation. Designers employed by each company were requested to answer questions which represented the company within which the interview was taking place and not give their own personal thoughts or offer the philosophy of companies for which they had previously worked.

3.3.1 Locating companies willing to take part

Companies were found using lists from FIRA (2008b) which had registered with the FISP programme and from the research agency Key Note (2008), where they were listed according to their area of activity, location and turnover. Because the author, for most of this research, was based in Austria he mostly contacted companies with their head office there, but also with an operation in the UK. They were initially contacted by telephone which was followed by a personally addressed e-mail [see appendix 2 and 3] including the questionnaire as an attachment [appendix 4].

3.4 Meaning of data collected

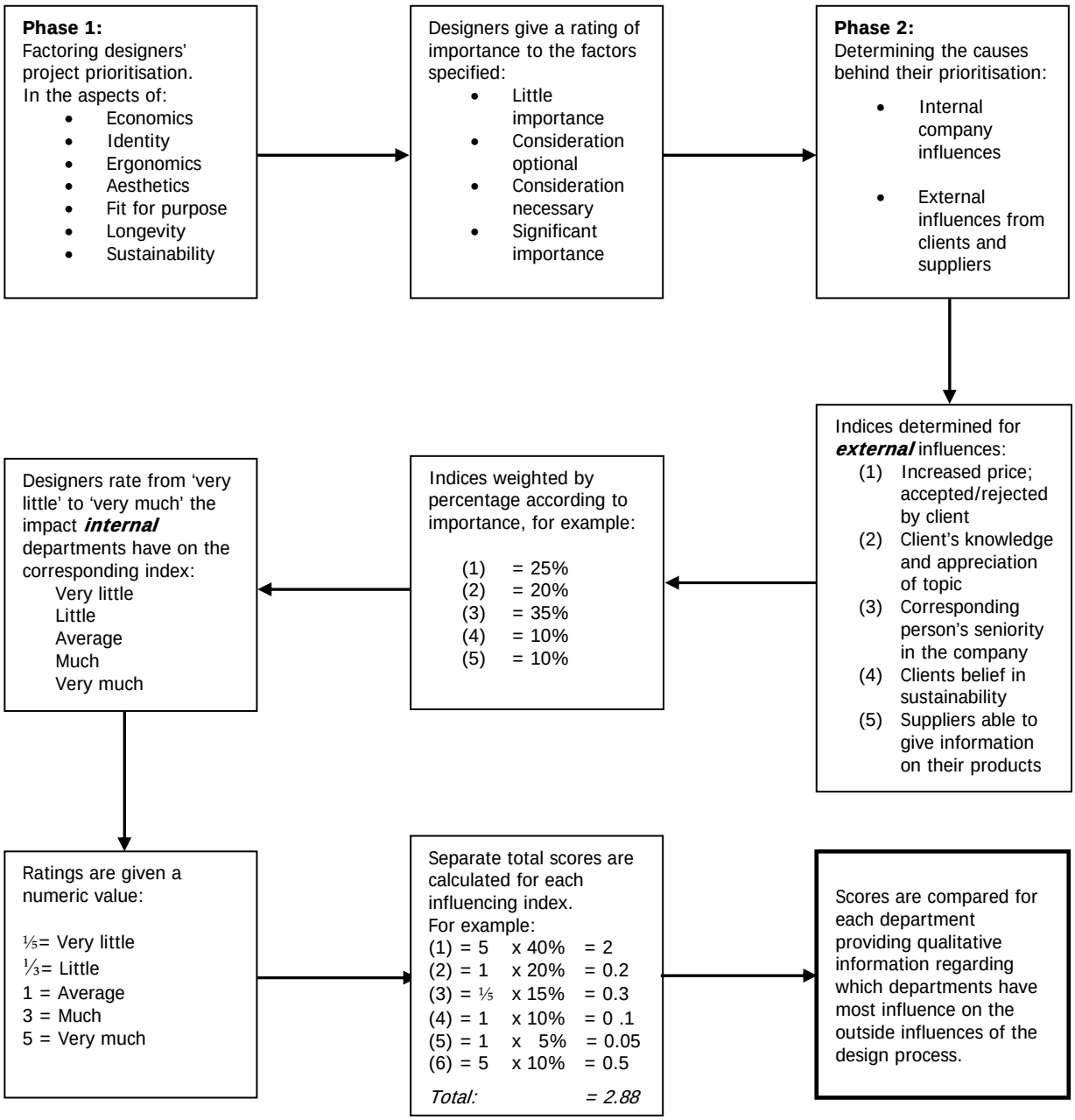
The method of data collection for this thesis will focus on the processes attached to technology and the organisation driving and creating the systems therein. The enquiry is aimed at designers. Data will demonstrate influences both inside and outside a company. Collecting this data from several companies in the industry facilitates a meaningful comparison.

3.5 Method used to collect data

Two phases of the interview were used to distinguish between how the designer prioritises his or her work and the causes behind their thinking.

The first phase was to collect information from designers which concerned their opinion regarding how they would apportion priority to the various aspects of their design, one aspect being sustainability issues. The second and most important phase will breakdown the prioritisation in the first phase; this will expose causes behind these opinions in a hierarchy of importance, separated into in-house and out-of-house influencing factors. Diagram 3.1 illustrates a concise version of this process, which is explained further on the following pages.

Diagram 3.1: Method of data collection and analysis applied; adapted from Ghazinoory (2005)



3.5.1 Phase 1: Prioritising

Using Figure 3.1 designers were asked to prioritise aspects of the design process in order to determine which areas of a designer's work normally receives priority.

Figure 3.1: Areas of priority

Please complete the following questionnaire with regard to how you prioritise your office furniture designs.				
	Little importance	Consideration optional	Consideration necessary	Significant importance
Economics				
Product identity				
Ergonomics				
Aesthetics/semantics				
Fit for purpose				
Longevity				
Sustainability issues such as: toxicity of materials used: end of life; reduced waste and disposal and so forth.				

3.5.2 Phase 2: Behind the motivation

Phase 2 aims to discover the causes behind the designer's ratings in phase 1. This will be achieved by obtaining their opinion on in-house and out-of-house influences. It will demonstrate paths of influence from which it will be possible to make assumptions concerning *the critical path of influence* leading to conclusions for a constructive way forward for a company to make improvements on their environmental impact.

This phase has four distinct steps of construction:

Step 1 – In consultation with the first two designers interviewed the indices for this study are iteratively defined

Step 2 – Designers weight indices apportioning importance of environmental impact

Step 3 – With regard to environmental impact designers are asked to reflect which departments/activities in the company have most influence on the indices set

Step 4 – Scores calculated using simple mathematics

Step 1:

The indices below represent out-of-house influencing factors to which the designer apportions importance.

In the context of sustainability for office furniture:

(1) Client's reticence/willingness to incur an increased price and/or a longer lead time
(2) Client's knowledge and appreciation of the topic
(3) With reference to attitude; the seniority within the company of the person with whom you are discussing the topic, leading to a more positive or negative outcome
(4) Client's willingness to experiment with style
(5) Willingness of suppliers to respond to requests and information such as: 'Health Hazards of Chemical Compounds in the Work Area' [MAK Commission] and LCAs of materials and components

Step 2:

Designers apportion the indices with a percentage indicator representing importance from 5% to 40% (Ghazinoory, 2005). This exercise highlights which aspects the designer considers most important and in so doing gives a hierarchy to the out-of-house influences.

Figure 3.2: Rating the importance of agreed indices

Please give a % score of importance to each index in step 1, totalling 100%								
Index	5%	10%	15%	20%	25%	30%	35%	40%
(1)								
(2)								
(3)								
(4)								
(5)								

Step 3:

Using a system which Hwang defined in 1981 (in Ghazinoory 2005) designers are asked to rate from 'very little' to 'very much' the impact that company departments have on a corresponding index, by so doing a cross reference of how in-house and out-of-house environmental influences on the designer's decisions is formed.

The ratings equate to the following values:

⅕ = Very little
⅓ = Little
1 = Average
3 = Much
5 = Very much

Figure 3.3: Outside influences related to the indices rated by the interviewee

Using the following ratings indicate the amount of influence a department might have on each index Very little [⅕] Little [⅓] Average [1] Much [3] Very much [5]					
Activities and departments by which they are driven	Number of indices				
	(1)	(2)	(3)	(4)	(5)
On-site production [Production Management]					
Technical support [Design and Technical]					
Target marketing [Marketing and Sales]					
Financial strategy [Purchasing]					

The reason for using this particular scale of rating is explained by the varying values given to the comments. 'Very little' has a 4% meaning of 'Very much'; this vast differential is likely to give an increased accuracy in analysis. For example: 'Very little' rated on a high scoring index of 40%, would still give the unambiguous and insignificant score of 0.08, the negligible influence is thus reflected. On the other hand for a 'Very Much' influence rating on a low importance index such as 5% the score would be much higher 0.25 thus the importance of the index cross-reference with the influence of the department is meaningfully reflected.

Step 4:

The department's influence within the designer's decision matrix sets a value for each index; the results are then multiplied by the weights of the indices, giving a score to each department (Ghazinoory, 2005). Scores and ratings will be calculated for each department, signifying their influence with the corresponding index. For example:

Table 3.1: An example of a calculated score

5*40% + 1*20% + ⅕*15% + 1*10% + 1*5% + 5*10% = 2.88

The score of '2.88' indicates the collaboration of the internal and external factors of influence.

3.5.3 Further information

In order for the data collected to attach meaning, it was necessary to provide a general portrayal of the company being interviewed. Once the designers had completed steps 1 to 4 the following information on the employing company was requested.

Figure 3.4: information pertaining to the general picture and type of company

Number of employees	
Turnover in previous financial year	
Proportion of your turnover derived from office furniture production	
Proportion of office furniture designed by company employees	
Proportion of sales manufactured by subcontractors	

3.6 Purpose of calculating data into a score matrix

The priorities of designers working in this industry, coupled with influencing factors of specific areas which affect the make up of a product, is the objective of this calculation. It provides information about how departments within the company relate to outside factors thereby creating a matrix, which systemically looks at some of the causes behind designers' decisions.

3.7 Difficulties encountered

The author during this research has encountered some very helpful people. An incentive given to the companies contacted, was a copy of the report [thesis] when complete, which the author stated: "will give an overview of the situation in the office furniture industry as to the current attitude toward sustainability". But nonetheless the author also experienced some negative responses in varying degrees from apathy to hostility.

Primarily information was collected by personal interviews. Companies were not easily persuaded however; a ratio of contacted companies to successful participants stands at 6:33; the majority refused to participate. An example of the reticent attitude encountered is herewith anonymously quoted: *"After your call today I looked at the document you sent and I discussed it with the Managing Director; he has instructed me not to take part in your study, therefore I regretfully inform you […]"*. The communications manager of another large company in London informed me that my request for information would be passed to their sustainability department, as they were unable to deal with it. Nothing further was heard from them. In a telephone conversation FIRA confirmed a similar experience; they explained that they had encountered parallel difficulties in obtaining information from companies where no payment was offered.

Chapter 4
Results

4.1 Overview of data and information collected

The information in this chapter contains the findings from mainly personal interviews, but also from telephone conversations with those in the industry. The overriding assertion of the participating designers was that the study would be more relevant in a couple of years' time. Nonetheless the designers interviewed generally held the opinion that even if the market is currently not overly anxious about environmental concerns, designers should be aware of them because they will soon need to know how to address these issues. Designers perform only according to the market, a market that presently does not yet fully recognise the necessity to alter its course in tune with sustainability issues. However, the general opinion is that designers will very soon be ideally placed to promote more sustainable designs with increased impact, further influencing a market which will be more ready to accept a new way of thinking about office furniture production. The influences attached to sustainability concerns are relevant today and, as the results indicate, the largest influencing factor inside a company is the marketing and sales department. Large institutions, which have the public as their customers, are now asking the salespeople of these manufacturing companies for information pertaining to the sustainability of office furniture; it is the consensus of the designers interviewed that this trend will expand to include all large-scale purchasers.

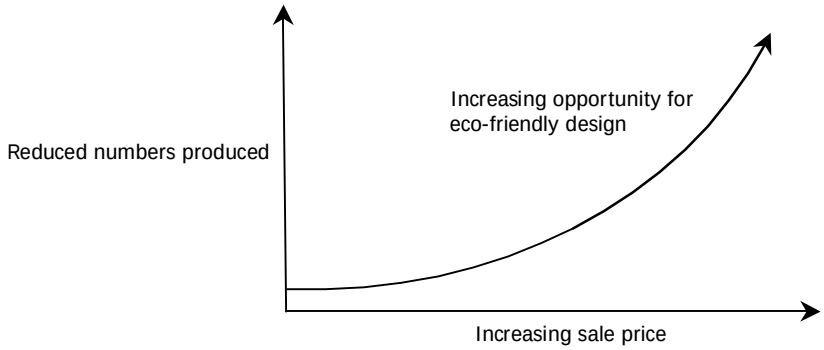
The results of the interviews will demonstrate that Sales and Marketing has the greatest amount of influence over outside factors. The consensus is that this internal department has most impact on the style identity of a company and the resulting brand legacy. Designers have asserted that their thought processes when designing are largely induced from the expectations of the client which are largely derived from this legacy. From this it is possible to deduce that Sales and Marketing has much potential to influence a change in a company's environmental impact.

Designers interviewed spoke unanimously about their companies' wish to keep costs to a minimum and consequently give the financial trade-offs, necessary to achieve a more sustainable product, careful consideration. One designer mentioned that their purchasing department bases decisions on price differential of as little as 10 pence on a unit price costing many pounds; he said that this is the main influencing factor behind choices they make concerning which materials are ordered.

Designs are largely governed by the components available which are used in the construction of office furniture: laminates, legs, glass tops, board and steel sheets for example, are being shipped to large companies in the office furniture industry by outside suppliers. Information on these components, which give descriptive qualities of the material, is not easily obtained. One designer expressed the view that sustainability can only be successful when many in the chain are involved and striving together to acquire information from suppliers, and that companies in isolation are unable to influence the environmental impact of the components they use.

Furniture components, the author discovered from the interviewees, are one outside factor which has influence over a company's strategy. For example, when considering ecological concerns, the quantity of components ordered can influence a production strategy and product standard. Mass produced items are more likely to be designed according to the cheapest available materials and components. Conversely, more expensive bespoke designs provide more opportunity to experiment. This can lead to a more ecological product as the components can be ordered from a wider range of suppliers giving more opportunity to choose the most environmentally sound. Although, turnover for bespoke items in the companies interviewed was no more than 1 percent it was important to many of the interviewees. Designers said that it was often the unusual orders which enabled the designing of items most accurately representing their desire toward a more sustainable production. Bespoke items made in few numbers result in a higher sale price which facilitates an increased sustainability opportunity, Figure 4.1 illustrates this point.

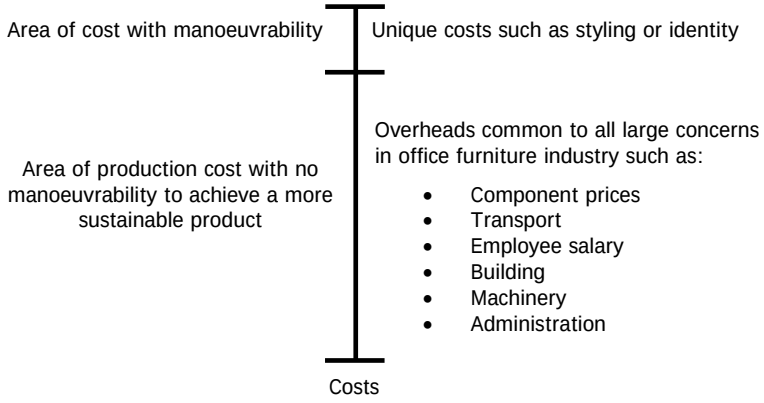
Figure 4.1: Bespoke furniture has increased opportunity for improving ecological design



Style change in this industry is slow; one advantage attached to this phenomenon, the author learned, was that the customer is more inclined to become interested in the design process and this, through his or her willingness to take part in discussions involving environmental issues, can be often reflected in a more sustainable design. Many attempts by those interviewed, have been made to extend this cooperation to include suppliers of components, on the whole, this has not yet proved possible. However, suppliers are increasingly offering information about the welfare of their foreign subcontractors, which indicates willingness to operate within the boundaries of general acceptability.

Furniture components are not the only common expenditure, which all companies in the industry have. A competitive advantage is only gained within a range of 10-15% of the total costs of a unit, by means of styling or choice of materials [see Figure 4.2]. Office furniture manufacturing is a part in a larger chain driven by the systemic interaction of suppliers of the components, transport companies and other costs.

Figure 4.2: Proportion of overheads providing manoeuvrability of design



4.2 Trade-offs

The general consensus of the designers interviewed was that although perhaps not their first consideration, the company for which they work considered overheads as the strongest controlling factor with regard to components and materials purchased. This has much impact on the way designers construct their plans. One designer said “The buyers in our company could have more power”, and went on to explain that this would only be possible when other industries such as the kitchen business have been consulted resulting in a unified front. However, any sort of amalgamation with other industries he explained would require hard decisions with regard to styling alteration of their product.

One designer for a large company informed the author that when a new shape or style is presented to 'the top floor', it would be judged relative to what had preceded it and if the styling was deemed to be too far from its predecessor, requests would be made to tone it down and to bring it back towards what was currently considered 'safe' and still in fashion. It was surmised the reason for this could be two-fold; firstly the risks of departing from tested current trends and secondly of the financial burden of developing a new line, this in the form of man hours necessary for its development and the tooling specific to its production. The company for which he worked had a very strong product identity; this point is referred to in the discussion.

The office furniture industry is supplied by many components in common with the kitchen industry, which the author was informed, is a larger business. Materials mainly used for office furniture are steel and chipboard, which make up 85% of the material costs with the chipboard being around 45%. Nonetheless no information is readily available to the designer concerning the chemicals in chipboard or how it is made.

As individuals, all designers purported to be deeply interested in ecology and consider the perceived costs of a more sustainable production as an overriding disincentive for companies to alter their course. They give this as one of the main reasons why any movement has so far been slow to implement any shifts to working practices. Another reason stated was that the complex nature of sustainability makes it almost impossible to understand. One interviewee asserted that he would like to give higher priority to environmental issues when working, but felt that this had the potential of leaving him open to criticism which he would be unable to defend. He felt controlled by a network of factors, which make up a large whole representing the business model, the overriding influence being year end profit, and management currently do not include modification towards a more sustainable way of working as a viable investment.

4.3 Data

Using the method of data collection previously outlined, the following information is a summary of information shown in Appendix 1, which illustrates the total scores of the interviewees.

[A full version of interviews can be seen in Appendix 5]

4.4 Data analysis

Tables 4.1 – 4.4 show a comparison of the 6 companies interviewed. The remarks of the designers working for these companies are shown here as a proportion of a maximum possible or, in the case of the final scores illustrated in 4.4, are shown as a percentage of the highest score. The tables form the results related to the data collection method described in Chapter 3. This data can be analysed in many ways, the author has made some analysis and comments he felt relevant to this thesis, entered in the right hand box. [The results for Company A, show a sum total of more than one interview and interviewee.]

Table 4.1 summarises how the designers of the various companies prioritise certain aspects of their work. It shows the areas which they consider during the process of design, and how much emphasis is given to each.

Table 4.1: Summary of designer's thinking process prioritisation, shown as a percentage

Company	Aspects of the design process							Analysis / Comments
	Economics	Product Identity	Ergonomics	Aesthetics/ semantics	Fit for purpose	Longevity	Sustainability issues	
A								A company with a very strong product identity, the designers would like to increase the emphasis on sustainable matters but are restricted by the management, they are steered towards a more aesthetically pleasing product which is fit for purpose.
B								A smaller company with a more localised clientele, their highest priority is economics and making sure product performs as their customers expect. Sustainability consideration is less than the average but they expect a change in this attitude shortly.
C								A growing company; the designer explained that sustainability has not been a high priority. He said that the style of their furniture does not always lend itself to a sustainable product because the components are not generally eco-friendly, but they hope to address this issue in the near future.
D								The designer interviewed gave much importance to sustainability and mentioned that the management supported his goal to design furniture with minimal environmental impact. Interestingly it has in the last three years increased its turnover by 20%.
E								A small company with ambition to reduce its environmental impact.
F								This very successful company and one of the first to remove all toxic substances from its spray booths which is just one of many measures the company has taken over the last 20 or more years to build a reputation in their way of working to be synonymous with sustainability. Note that its styling and product identity run second to that of sustainability issues, which has not prevented them from becoming one of the largest office furniture companies in the world.

Indices previously described in Chapter 3 are given importance by each interviewee, the results of which will be used in conjunction with the scores of in-house departments, the outcome of which will indicate the strength of influence each department has over the designer's work [Table 4.4]. Table 4.2 illustrates the importance given to the indices by the interviewees. It is clear from this table that index 1 [Client's reticence/willingness to incur an increased price and/or a longer lead] is generally considered of the highest importance. This table through the cross-reference calculation process explains the differential between Table 4.3 and 4.4.

Table 4.2: Summary of the importance designers gave to the indices, shown as a percentage

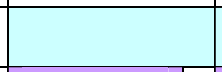
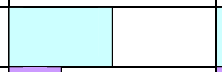
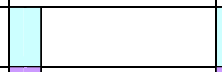
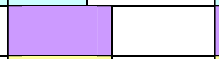
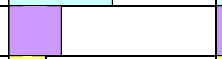
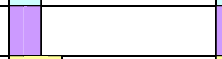
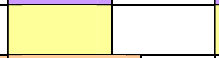
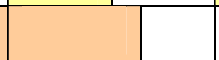
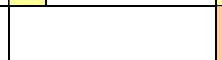
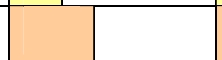
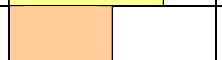
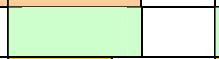
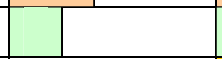
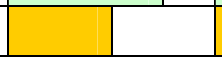
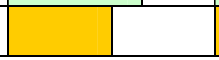
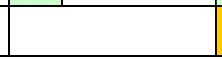
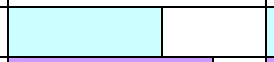
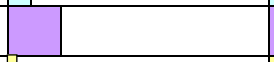
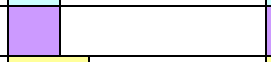
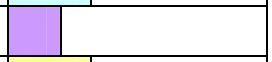
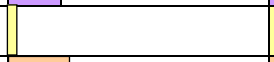
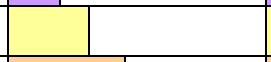
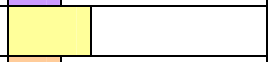
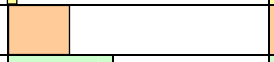
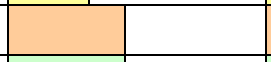
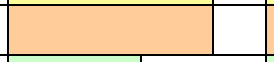
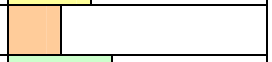
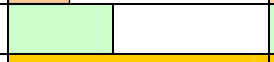
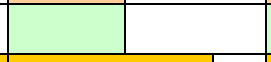
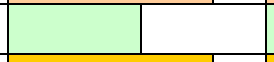
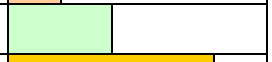
Company	Indices					Analysis / Comments
	Index 1	Index 2	Index 3	Index 4	Index 5	
A						Both company A and D gave above average importance to index 1 whether the client was willing to pay more or wait longer for a product; this compared with Table 4.1 shows a pattern, see comment in company D, box below.
B						These two companies seem to have given a fairly equal importance to all indices, this, with the exception of product identity matches Table 4.1, which is interesting when compared with the final scores where company C with a greater product identity has less influence [or perhaps interference] for the technical and production departments.
C						
D						This company and company A gave less importance than average to economics. This would appear to be paradoxical, but poses the question as to whether they associate reducing their environmental impact with extra cost.
E						In common with many indices 1 and 5 are given the highest importance
F						Their concept of the client's willingness to experiment with style [index 4] might explain their lower than average scores on aesthetics.

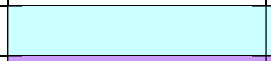
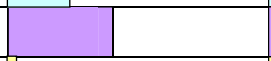
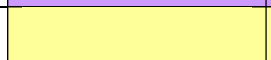
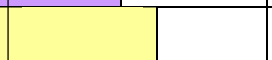
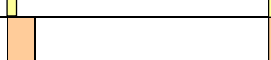
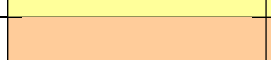
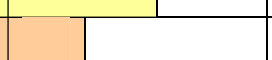
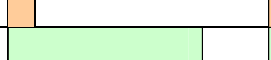
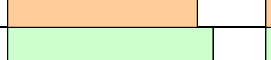
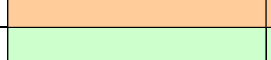
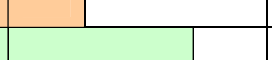
Table 4.3 indicates how the designer perceives the in-house department's influence over the out-of-house indices with which the designer will work. It is interesting how this table often conflicts with Table 4.4, which indicates strength of influence with the importance of the indices also calculated.

Table 4.3: Summary of overall in-house departmental influence over out-of-house indices, shown as a percentage

Company	Department				Analysis / Comments
	Production management	Design and Technical	Marketing and Sales	Purchasing	
A					Note how the Design and Technical department has little influence over the indices which is in contradiction to their strength of influence as a sum total when importance of the index is also taken into consideration; shown in Table 4.4 Marketing and Sales are clearly the most influential and therefore are most closely linked to how the designer considers the aspects of his work also demonstrated in the totalled scores shown in Table 4.4.
B					
C					
D					
E					
F					

The shaded areas in Table 4.4 illustrate a proportional comparison to the other departmental scores from the same company. The scores demonstrate the overall influence the various in-house departments have. Departmental influence over the indices [Table 4.3] cross-referenced by the designer giving a score of importance to each index is shown here as a total average of all indices. This table defines the collaborated results of the previous two tables; it is possible to deduce that Marketing and Sales are considered to have the most influence over the designers' decisions.

Table 4.4: Final scores indicating the total strength of each departmental influence, shown as a comparison

Company	Department				Analysis / Comments
	Production management	Design and Technical	Marketing and Sales	Purchasing	
A					The most noticeable outcome from this study was the considerable influence Marketing and Sales have over the designer.
B					Other departments have varying degrees of influence but it is Sales and Marketing with the clear lead over strength of influence of his or her work.
C					According to the designer interviewed this company does not consider ergonomics important, which may explain some of the reasons why so little influence is felt by the design and technical department.
D					Giving comparatively little influence to 'purchasing' does have a significance; this company has shares in most of the suppliers which it uses and therefore can, to an extent dictate the way furniture is produced.
E					An interesting balance which emerged through the cross-reference data analysis showing in Table 4.3 with less than average influence from marketing and sales to a final score, which meets with the average.
F					The only company with the designer apportioning more influence to purchasing over his decisions than Marketing and Sales. This fact demonstrates that once the reputation of the company is established Marketing plays a less important role.

4.4.1 Phase 1 – priorities

Generally the larger companies indicated that they gave greater importance to product identity while the smaller companies gave economics a higher priority. Those giving only a medium importance to 'product identity' perhaps unwittingly confirmed this when they also gave a low importance rating to index (4) [*Client's willingness to experiment with style*]. Others who gave *'product identity'* a higher importance, also gave a higher rating to index (4).

Longevity was not given high priority and this was across all companies; the reason given for this was that office furniture is usually replaced in less than 15 years when style changes coax clients into a refit.

Surprisingly interviewees did not always give sustainability issues high priority. After reassurance of anonymity one designer admitted that he felt so restricted that he rarely considered sustainability while designing. One pattern, which came to light regarding sustainability, was that generally those who gave it high priority also gave a high rating of importance to index (1) [*Client's reticence/willingness to incur an increased price and / or a longer lead time*].

4.4.2 Phase 2 – final scores

The highest rating of influence for any one index was *'Willingness of suppliers to respond to requests and information such as: 'Health Hazards of Chemical Compounds in the Work Area' [MAK Commission] and LCAs of materials and office furniture components'.* This in connection with 'Purchasing' was clearly in front of all other ratings. However, this department was not the overall greatest influence over the designer's decisions – 'Sales and Marketing' was by 5 of the 6 companies interviewed rated the department with the most influence. Interestingly the one whose scores offered 'Purchasing' as having the greatest influence was the largest company. The reason for this could be that their reputation has overtaken the impact of marketing.

Taken as a mean average, *'Client's willingness to experiment with style'* was apportioned the lowest percentage of importance. This, compared with *'Client's reticence/willingness to incur an increased price and / or a longer lead time'*, was an obvious winner in the ratings of importance, which begs the question of whether style is mentioned to the client with reference to sustainability.

4.5 Decision path

The path linking designers' decisions, with the in-house and out-of-house influences is revealed when examining the data above. The designers interviewed are all agreed that their decisions are influenced by their client's perception of the product as well as their requirements. Suppliers of components also have considerable influence providing some of the framework onto which the product's style is built. The majority indicated that 'Marketing' has the greatest influence over the client's demands and these, translated into a specification, in turn influence the marketing department's message. This loop, is probably one of the many loops, all of which are all in play to form the character of a company's within which the way of working, philosophy and future strategy is formed.

4.6 Limitations of data

Designers illustrated their opinion as to the various influences in play during the process of their decision-making; the research does not, however, cross-reference this perspective with that of people in the departments of the companies interviewed. A study of this nature would widen the picture of influencing factors involved at the designer's desk.

Factors which influence the designer could be described as *a first step,* in a journey towards the further understanding of the innovation attached to all products. Further research mentioned in Chapter 6 will explore ways of furthering this study.

Chapter 5
Discussion

Following from the previous chapter, the discussion will examine, with reference to sustainability, the relationship between the designer, the marketing department and the client. It will postulate the concept of a systemic process involving internal departments, the client and the suppliers of the components used for office furniture production. It will propose that these aspects of production are interlinked and part of a process, which the product identity and company philosophy ultimately represent. It will make reference to the problems being experienced by designers who are attempting to alter design towards a more environmentally friendly product by exacting pressure on suppliers to pay more attention to the environmental impact of their products. It will propose that company management, determined to reduce their environmental impact, has the potential to influence the method of production employed by suppliers and discuss ways this might be achieved.

The author has learnt through this study that designing office furniture sustainably is constrained by many factors, a view expressed unanimously by the interviewees. During a group discussion one of the designers said that 'the designer' is no more than a cog in a complicated wheel, turning with the operation of many industries. Although the office furniture industry is at the forefront of improving its environmental impact, it has only a 14.3% share of the total furniture industry's MSP turnover (Key Note 2008). With so many being involved, the designer's incentive to stand for a more sustainable product is diminished by the relatively low influence they and the employing company can have over the components also supplied to other sectors of the furniture industry.

This chapter will explore methods by which companies can achieve a goal of continually improving sustainable design by presenting a unified front when demanding information on the sustainability issues attached to the components with which they are supplied.

The components supplied to the office furniture industry are the framework of the end product and with which the designer must work. This furniture is kept on average for only 15 years, which is short in comparison with household furniture. A short turnover of this kind necessitates fast manufacture of components and low cost production, such as chipboard, melamine and pressed metal fittings (Joyce 2001). Designers stated with regard to the question of environmental impact, to a degree, they are forced to leave this issue to the industry's suppliers. One designer interviewed, whose company gave much importance to issues of sustainability, admitted that the fittings used by the company are purchased without any knowledge of which methods and materials are used in their production.

The linkage between the supplier and the manufacturer, of which the designer is a part, provides the ingredients by which a design is constructed. The resulting product identiy is the foundation with which the marketing department must work. Through the marketed message, the client becomes part of this systemic relationship; the client's requirements will complete the loop thus influencing the designer. These relationships will be further discussed in the following section of this chapter.

The larger companies of those interviewed have a stronger product identity and therefore are more conditioned to a certain method of construction; this causes increased reliance on particular components and on specific suppliers. The largest company interviewed, with a turnover of around £2.7 billion informed the author that their influence over suppliers with regard to the manufacture of the office furniture components is very little. The designer explained that their turnover paled into insignificance when compared to the quantities supplied as a whole. He said that nonetheless they are continually in conference with their suppliers arguing for a more sustainable product. He concurred that answers from suppliers argued that they receive no complaints from the other industries that use their product; they gave the kitchen business as an example, which orders in larger quantities. They gave this as a reason for not altering their way of production. During the interview the designer concluded that their suppliers have little incentive to innovate new and more sustainable methods of production including offering more information on the environmental impact of their product because only a very small part of the furniture industry as a whole is requesting such information.

This poses the question of whether small companies, less constrained by a particular product identity and therefore specific supplier, have an advantage when changing towards a more sustainable product. However, it is not possible to surmise which companies are better positioned to lessen the environmental impact of their furniture as larger companies are working with clients, the customers of which are often the public, and as current trends indicate are increasingly interested in matters of ecology. This has led to large organisations, including banks, schools and hospitals, to have incentive to purchase their office furniture with a more sustainable profile (FIRA 2008a). Companies producing furniture for these large organisations have found necessity, and some advantage, in marketing their goods as a sustainable product. However, the author has discovered no governmental support for using environmentally safer materials in this industry; inducement seems to be mainly through regulation, which Brady (2008) argues is often perceived as a burden.

Nonetheless, success has been achieved in areas in which the industry is self governing, for example: the replacement of cellulose-based paints with a water base is now commonplace as is the reduction in toxicity of glues, and composite materials. Another positive sign observed from the interviews is that companies which are attempting to steer the way components are manufactured have initiated regular discussions with suppliers in which they continually request a less environmentally damaging product. The nine designers interviewed almost unanimously stated that in a very few years' time manufacturers of these components will be expected to operate with increasing regard to the environment. Continued pressure will force suppliers to take more serious note of requests for information on the sustainability issues attached to their products.

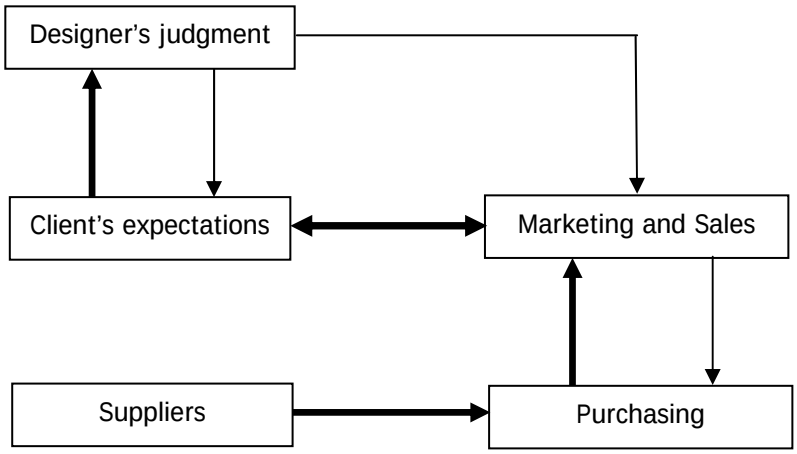
Interestingly, the author learned from the interviewees that of the companies interviewed those which demonstrated greater care for the environment for the longest now boast the largest turnover and furthermore, are showing signs of increasing their turnover. This exposes the perception, that moving towards a more sustainable profile is inconvenient and has little or no benefits, as unfounded. This concurs with Sarkis who suggests that the implementation of a good EMS brings advantages. Sarkis argues that an organisation's infrastructure needs to integrate environmental issues; this, he states, should be implemented especially in the design process (Sarkis, 2001). However, despite the idealism, and the positive changes achieved, there is still some distance to travel before office furniture is fully designed with the environment in mind.

5.1 Relationships of influence with the designer

'Sales and marketing' has been shown to have the greatest influence over the out-of-house aspects of the designer's work. Designers generally expressed that the sales and marketing department's message lead to expectations of the client, which through the designer's interpretation of these expectations directly influence the product's semantics and the message marketed. The author learned that this has particular reference to the first index in the questionnaire; *'a client's willingness to wait longer and pay more'* and is relevant here. Marketing of a product and service serves to contribute to the company's identity; from this client's aspirations, the designer be required by the employing company to follow this message through. One designer within a company producing a fairly expensive product stated that this fact often attaches a positive effect. He explained that some clients *expect* to wait longer and incur extra cost for a product which they believe has an improved quality with a reduced or even a positive environmental impact. This has the effect of widening the parameters of the designer's scope and leaves them more able to make decisions towards producing a more sustainable product.

The main influence the designer has over the marketing department can be surmised as being indirect; the path of this influence passes through the client from the marketing department and back to the designer in the form of expectation. However, it is also the designer's interpretation of the client's expectations which the marketing department will take note, both directly from the designer and through the evolving alteration of the client's requirements mainly induced by the practice of marketing. Figure 5.1 demonstrates the complex nature of influencing factors. The thicker arrows signify a greater degree of influence.

Figure 5.1: Constructing systemic causes behind the designer's thought process



5.2 The way forward

This thesis discusses is the complex nature of influence and how it is not possible to isolate one particular area of influence which affects the product's path. It has been shown that designers' decisions are also influenced by companies not connected with office furniture. The reasons behind why it is not possible for companies to insist on a more unsustainable component have been discussed. However, innovating a method whereby companies can influence how these components are produced will be discussed in this section.

Partnerships between otherwise disinterested companies and even competing companies could offer a key. Previous research holds true the argument that change is needed, authors reviewed articulate that the more people work together the easier the transformation. Examples of partnerships working on an agenda outside the company's normal remit highlight potential advantages of mutual cooperation. A view also held by Mika (2008); who suggests for a cooperation to be fully effective it must take the form of a partnership involving talking to suppliers and sharing information with competitors. Senge (1999) also argue the benefits of avoiding isolationism. Others state that environmental regulation is a necessary medicine, being the most effective method to persuade businesses to take heed of these issues and innovate ways to improve their impact on the environment, which could encourage the formation of environmental partnerships.

One of the obstacles to the formulation of partnerships is the unwanted exposure of a company's secret material, the lifeblood of successful operation. Ways to construct gates for information protection should be devised to safely enclose forums of negotiation, used to jointly influence the environmental issues common to participating companies. The incentive for forming such partnerships is in the improved environmental message given by the company concerning their product and financial savings. Preventing the escape of sensitive information and having an open and honest cooperation must, to a degree, rely on trust but need not stand between a new method of ordering components which is beneficial to the environment and all companies participating. Brookfield et al. (2008) concurred by arguing that long term partnerships, even between competing companies, can be successful provided that the trust between them in nurtured and protected.

Legal and financial frameworks, which will need to be employed to achieve such partnerships, will need to be orchestrated by a third party. This research has revealed, through the designers interviewed, that there is not one single body which furniture manufacturers can approach for information regarding the environmental impact of their materials, for example; which woods are more sustainable than others, ways to reduce or harmonise waste disposal with other companies etc. Manufacturers must apply to various organisations for help with the different aspects of their operation. A single body, which could advise on these matters and, where appropriate, recommend, and oversee partnerships could reduce an environmental impact.

The method used here to expose areas of the designer's influence will accentuate those parts of an operation, which could benefit from finding reasons for, and aspects of a company that would benefit from cooperation. This thesis has looked at the designer as the focal point of furniture production and included in-house departments' relationship with the designer. By shifting the centre of attention to include each department of a company, a larger picture would emerge which would highlight relationships between one company and another and in so doing highlight areas which potentially could benefit from a partnership.

Partnerships to improve a company's profile with regard to sustainability are still very much in their infancy, but have seen some success. With governmental support, partnership development could accelerate. This could be achieved in many ways, such as:

- Seminars for universities in which this concept could be formulated into a study programme, enabling future managers to become tuned in to this idea.
- Trade organisations could offer the services of a trained consultant in this area whose remit would include finding areas of a company's operation that have potential benefits from forming a partnership.
- A national survey would provide data for not only the viability of such a concept but also bring awareness of its future possible existence.
- An established government website whereby companies can register an interest, which invites comments from other respondents.
- Successful international environmental organisations such as the International Organisation for Standardisation [ISO] could negotiate contracts and adjudicate disputes between the environmental partners.
- Chambers of Commerce could add to their services that of an environmental partnership consultancy.

The perceived costs and inconvenience of reducing an environmental impact means that preaching is unlikely to succeed without the help of research – both qualitative and quantitative. When accompanied by facts, backed by governmental endorsement and support, the environmental message will have a far greater chance of falling on fertile ground, being appreciated by the business community and public, thus growing into an accepted way forward.

Chapter 6
Conclusion

This study has defined a method of research providing information about the direct influences of the designers' decisions, and has demonstrated the complex nature of relationships in and around the designer of office furniture. The interconnectedness of this industry's product is, as shown in the discussion, one of the main barriers preventing an accelerated improvement in its environmental impact.

Using the designer as a voice for their industry, the emerging trends on the whole are moving towards an increased belief in the benefits of a more environmentally friendly approach. Unfortunately companies who are trying to move forward in this way do not receive benefits in the short term; this fact for some means an indefinite delay in acting.

The interviews exposed that designers feel restricted and that their ingenuity is constrained by many factors which surround their work. One designer described how his influence over the design of his products appears large but in reality is very small and involves many others. It becomes clear that many, including the internal departments of a company, are involved in the design process, but not all are aware of this and consequently do not always feel the need to communicate ways to make environmental improvements.

6.1 Salient points learned from this research

- This industry has witnessed some success in reducing environmental impact, but the fear of a reduction in short term profit, and the complex and interconnected nature of operation within this industry, act as powerful constraints in achieving the improvements most companies desire.

- Through organisations with the public as their main customer designers' interest in sustainability issues is forging a more environmentally positive approach in the way office furniture is currently produced.

- There is not a single body to which companies can go for advice with regard to the sustainability issues of their materials in use; companies have to approach various bodies for advice on the many materials used.

- Exposed as a myth is the notion that environmental change leading to improvements in production has only cost attached with little long-term benefit.

- Designers' desire for a more sustainable product runs ahead of the system within which they operate and are constrained.

6.2 Unexpected discoveries

Designers are passionate beings particularly when discussing environmental issues and for this reason, the author believes, interviews lasted far longer than anticipated – one extended to over three hours.

Attitude dissimilarity towards requests for information was clearly apparent between Austrian and English people. Upon hearing the nature of the request English people receiving the call would often present a defensive stance, offering sustainability measures they already have in place, they were polite and took time to consider whether to participate. Austrians on the other hand would listen quietly to the request for information and either refuse flatly or agree without hesitation to participate.

6.3 Future research

Further research into the influencing factors of furniture design produced on a large scale has the potential to improve environmental consequences of an operation, and in the long term reduce business overheads.

The research for this thesis is concerned with the opinion of designers; research which encompasses a wider spectrum would include a study of sustainable supply chain management. Exposing these relationships would plot further into the causal path of the influences discovered in this thesis.

Continuing research in this direction would provide an improved vantage point from which the interconnectedness of the supply chain would be less opaque. Obtaining data in order to clearly define how this industry, its clients and the public influence each other should be the objective of a continued research. The author believes this would provide information with which improvements to a company's operation could be innovated.

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Appendices

Appendix 1

Calculated total scores of interviews

A.1.1 Company A

Table A.1.1: Data and calculated results for interview 1

Company department	Calculation and final overall score	
Production Management	1*(35) + ⅕*(20) + ⅕*(15) + ⅕*(5) + 2*(25)	0.93
Design and Technical	3*(35) + ⅓*(20) + 3*(15) + 3*(5) + ⅓*(25)	1.8
Marketing and Sales	4*(35) + 5*(20) + 3*(15) + 3*(5) + ⅕*(25)	3.05
Purchasing	⅕*(35) + ⅕*(20) + ⅕*(15) + ⅕*(5) + 3*(25)	0.9

Table A.1.2: Data and calculated results for group discussion [interview 2]

Company department	Calculation and final overall score	
Production Management	⅕*(35) + ⅕*(15) + ⅕*(10) + ⅕*(5) + 1*(35)	0.48
Design and Technical	1*(35) + ⅕*(15) + 1*(10) + 1*(5) + 3*(35)	1.58
Marketing and Sales	5*(35) + 5*(15) +⅓*(10) + 3*(5) + ⅕*(35)	2.75
Purchasing	3*(35) + ⅕*(15) + ⅕*(10) + ⅕*(5) + 5*(35)	2.86

A.1.2 Company B

Table A.1.3: Data and calculated results for interview 3

Company department	Calculation and final overall score	
Production Management	⅕*(35) + 1*(20) + 1*(10) + 1*(5) + 3*(30)	1.32
Design and Technical	⅓*(35) + 1*(20) + 1*(10) + 1*(5) + 3*(30)	1.37
Marketing and Sales	5*(35) + 3*(20) + 5*(10) + 3*(5) + 1*(30)	3.3
Purchasing	⅓*(35) + 1*(20) + 1*(10) + 1*(5) + ⅓*(30)	1.37

A.1.3 Company C

Table A.1.4: Data and calculated results for interview 4

Company department	Calculation and final overall score	
Production Management	⅕*(35) + ⅓*(20) + ⅕*(5) + ⅕*(10) + ⅕*(30)	0.23
Design and Technical	⅕*(35) + 3*(20) + ⅓*(5) + 5*(10) + ⅕*(30)	1.24
Marketing and Sales	5*(35) + 5*(20) + 5*(5) + 3*(10) + 3*(30)	4.2
Purchasing	3*(35) + ⅓*(20) + ⅓*(5) + ⅕*(10) + 5*(30)	2.66

A.1.4 Company D

Table A.1.5: Data and calculated results for interview 5

Company department	Calculation and final overall score	
Production Management	⅕*(40) + ⅓*(25) + 1*(15) + 1*(20)	0.51
Design and Technical	5*(40) + 3*(25) + 1*(15) + 1*(20)	3.1
Marketing and Sales	5*(40) + 5*(25) + 3*(15) + 3*(20)	4.3
Purchasing	1*(40) + 1*(25) + ⅓*(15) + 3*(20)	1.3

A.1.5 Company E

Table A.1.6: Data and calculated results for interview 6

Company department	Calculation and final overall score	
Production Management	⅓*(30) + ⅓*(25) + 3*(5) + 3*(10) + 3*(30)	1.53
Design and Technical	1*(30) + 1*(25) + 3*(5) + 3*(10) + 3*(30)	1.9
Marketing and Sales	3*(30) + 3*(25) + 1*(5) + 3*(10) + ⅓*(30)	2.1
Purchasing	⅓*(30) + ⅓*(25) + 3*(5) + 3*(10) + 3*(30)	1.53

A.1.6 Company F

Table A.1.7: Data and calculated results for interview 7

Company department	Calculation and final overall score	
Production Management	5*(20) + ⅕*(20) + 5*(35) + 5*(25)	4.04
Design and Technical	5*(20) + 1*(20) + 5*(35) + 5*(25)	4.2
Marketing and Sales	5*(20) + ⅕*(20) + 5*(35) + 1*(25)	3.04
Purchasing	5*(20) + 3*(20) + 5*(35) + 5*(25)	4.6

Appendix 2

E-mail sent as first introduction to project

Box A.2.1: e-mail sent to companies whom supplied information

Cranfield, a leading UK research University, with reference to sustainability, is undertaking research into the influences leading to how designers of office furniture make decisions and choose materials. I would kindly ask for just a very few minutes of your time to complete the attached questionnaire. The information you provide will be treated in strictest confidence, your answers to remain anonymous.

The survey
For the purposes of an MSc thesis, the information you submit will form part of a framework around which analysis will, within the theme of the paper and according to the findings, deduce current attitude toward sustainability within the furniture manufacturing business. Companies partaking in this survey will be sent a copy of this report.

About this research:
Cranfield University, UK is running an MSc course [2007/8] entitled 'Innovation and Design for Sustainability' the remit includes:

- Designing for Sustainability – which explains the principles of life cycle analysis, closing the loop
- Innovation – looking at the process of innovation
- Whole System Design – thinking systemically and the questioning of assumptions in design

The purpose of the information you submit:
The data provided will be analysed according to the theme of the thesis and discussed within the paper. The thesis when complete will be held in Cranfield University and will be publicly available, it may be published in a suitable academic journal. Companies who assist will be acknowledged for doing so, however persons partaking in this study will remain anonymous for the whole of their input with their name treated with strictest confidence. Information given will not be directly related to the companies acknowledged.

I would be very grateful to hear from you, please also call me if you wish: 0043 664 52 60 777

Survey form herewith attached.

Appendix 3

Follow up e-mail

Box A.3.1: e-mail sent to companies that did not complete questionnaire

Dear ...

I understand you may have taken the decision not to complete our survey questionnaire we sent you last month. We respect your position and appreciate the number of requests for information one can receive.

However to learn the reasons behind your decision Cranfield University would find very valuable, this would help us in constructing future requests for information. All answers will be anonymous and treated in confidence.

Appendix 4

Interview questionnaire

Name:
Position:
Company:
Place of interview:
Date of interview:

The following data represent the opinion of the above interviewee

Phase 1
Constructive thought process

Please complete the following questionnaire with regard to how you prioritise your office furniture designs.				
	Little importance	Consideration optional	Consideration necessary	Significant importance
Economics				
Product identity				
Ergonomics				
Aesthetics/semantics				
Fit for purpose				
Longevity				
Sustainability issues such as: toxicity of materials used: end of life; reduced waste and disposal and so forth.				

Phase 2
Behind the motivation both from outside the company [step 1] and inside [step 3]

Step 1:
Please read and adjust to or add to any of the below indices:
In the context of sustainability for office furniture:

(1) Client's reticence/willingness to incur an increased price and / or a longer lead time
(2) Client's knowledge and appreciation of the topic
(3) With reference to attitude; the person's seniority within the company, with whom you are discussing the topic, leading to a more positive or negative outcome
(4) Client's willingness to experiment with style
(5) Willingness of suppliers to respond to requests and information such as: 'Health Hazards of Chemical Compounds in the Work Area' [MAK Commission] and LCAs of materials and office furniture components

Step 2:
The importance of the above indices:

Please give a % score of importance to each index in step 1, totalling 100%								
Index	5%	10%	15%	20%	25%	30%	35%	40%
(1)								
(2)								
(3)								
(4)								
(5)								

Step 3:
Influence departments within the company have over each corresponding index

Using the following ratings indicate the amount of influence a department might have on each index Very little [⅕] Little [⅓] Average [1] Much [3] Very much [5]					
Activities and departments by which they are driven	Number of indices				
	(1)	(2)	(3)	(4)	(5)
On-site production [Production Management]					
Technical support [Design and Technical]					
Target marketing [Marketing and Sales]					
Financial strategy [Purchasing]					

Further information

Number of employees	
Turnover in previous financial year	
Proportion of your turnover derived from office furniture production	
Proportion of office furniture designed by company employees	
Proportion of sales manufactured by subcontractors	

Use of information gained
Companies interviewed will be referred to as A B C and names of designers will be kept anonymous, this is to protect their position in the company and according to ethical practices of data collection.

Appendix 5

Interviews

A.5.1 Interview 1

Name: Kept anonymous
Position: Senior Designer
Company: A
Place of interview: Austria
Date of interview: 6th June 2008

The following data represent the opinion of the above interviewee

Phase 1
Constructive thought process

Please complete the following questionnaire with regard to how you prioritise your office furniture designs.				
	Little importance	Consideration optional	Consideration necessary	Significant importance
Economics		x		
Product identity				x
Ergonomics				x
Aesthetics/semantics				x
Fit for purpose				x
Longevity		x		
Sustainability issues such as: toxicity of materials used: end of life; reduced waste and disposal and so forth.				x

Phase 2
Behind the motivation both from outside the company [step 1] and inside [step 3]

Step 1:
Out of house influencing factors discussed and agreed / finalized:
In the context of sustainability for office furniture:

(1) Client's reticence/willingness to incur an increased price and / or a longer lead time
(2) Client's knowledge and appreciation of the topic
(3) With reference to attitude; the person's seniority within the company, with whom you are discussing the topic, leading to a more positive or negative outcome
(4) Client's willingness to experiment with style
(5) Willingness of suppliers to respond to requests and information such as: 'Health Hazards of Chemical Compounds in the Work Area' [MAK Commission] and LCAs of materials and office furniture components

Step 2:
The importance of the above indices:

Please give a score of importance to each index in step 1								
Index	5%	10%	15%	20%	25%	30%	35%	40%
(1)								x
(2)				x				
(3)				x				
(4)	x							
(5)					x			

Step 3:
Influence the departments within the company have over each corresponding index

Using the following ratings indicate the amount of influence a department might have on each index Very little [⅕] Little [⅓] Average [1] Much [3] Very much [5]					
Activities and departments by which they are driven	Number of indices				
	(1)	(2)	(3)	(4)	(5)
On-site production [Production Management]	Average	Very little	Very little	Very little	Average/ Much
Technical support [Design and Technical]	Much	Little	Much	Much	Little
Target marketing [Marketing and Sales]	Much/ Very much	Very much	Much	Much	Very little
Financial strategy [Purchasing]	Very little	Very little	Very little	Very little	Much

Step 4:
Scores and ratings calculated for each department – signifying their influence with the corresponding index:

Company department	Calculation and final overall score	
Production Management	1*(35) + ⅕*(20) + ⅕*(15) + ⅕*(5) + 2*(25)	0.93
Design and Technical	3*(35) + ⅓*(20) + 3*(15) + 3*(5) + ⅓*(25)	1.8
Marketing and Sales	4*(35) + 5*(20) + 3*(15) + 3*(5) + ⅕*(25)	3.05
Purchasing	⅕*(35) + ⅕*(20) + ⅕*(15) + ⅕*(5) + 3*(25)	0.9

Further information:

Number of employees	1500
Turnover in previous financial year	More than £100m
Proportion of your turnover derived from office furniture production	100%
Proportion of office furniture designed by company employees	95%
Proportion of sales manufactured by subcontractors	None

A.5.2 Interview 2

Name: Kept anonymous
Position: Senior and junior designers
Company: A
Place of meeting: Austria
Date of meeting: 18th June 2008

The following data represent the opinion of the above interviewees noted in a group discussion

Phase 1
Constructive thought process

Please complete the following questionnaire with regard to how you prioritise your office furniture designs.				
	Little importance	Consideration optional	Consideration necessary	Significant importance
Economics			x	
Product identity				x
Ergonomics				x
Aesthetics/semantics				x
Fit for purpose				x
Longevity		x		
Sustainability issues such as: toxicity of materials used: end of life; reduced waste and disposal and so forth.		x		

Phase 2
Behind the motivation both from outside the company [step 1] and inside [step 3]

Step 1:
Out of house influencing factors discussed and agreed / finalized:
In the context of sustainability for office furniture:

(1) Client's reticence/willingness to incur an increased price and / or a longer lead time
(2) Client's knowledge and appreciation of the topic
(3) With reference to attitude; the person's seniority within the company, with whom you are discussing the topic, leading to a more positive or negative outcome
(4) Client's willingness to experiment with style

(5) Willingness of suppliers to respond to requests and information such as: 'Health Hazards of Chemical Compounds in the Work Area' [MAK Commission] and LCAs of materials and office furniture components

Step 2:
The importance of the above indices:

Please give a % score of importance to each index in step 1, totalling 100%								
Index	5%	10%	15%	20%	25%	30%	35%	40%
(1)							x	
(2)			x					
(3)		x						
(4)	x							
(5)							x	

Step 3:
Influence the departments within the company have over each corresponding index

Using the following ratings indicate the amount of influence a department might have on each index Very little [⅕] Little [⅓] Average [1] Much [3] Very much [5]					
Activities and departments by which they are driven	Number of indices				
	(1)	(2)	(3)	(4)	(5)
On-site production [Production Management]	Very little	Very little	Very little	Very little	Average
Technical support [Design and Technical]	Average	Very Little	Average	Average	Much
Target marketing [Marketing and Sales]	Very much	Very much	Little	Much	Very little
Financial strategy [Purchasing]	Much	Very little	Very little	Very little	Very much

Step 4:
Scores and ratings calculated for each department – signifying their influence with the corresponding index:

Company department	Calculation and final overall score	
Production Management	⅕*(35) + ⅕*(15) + ⅕*(10) + ⅕*(5) + 1*(35)	0.48
Design and Technical	1*(35) + ⅕*(15) + 1*(10) + 1*(5) + 3*(35)	1.58
Marketing and Sales	5*(35) + 5*(15) +⅓*(10) + 3*(5) + ⅕*(35)	2.75
Purchasing	3*(35) + ⅕*(15) + ⅕*(10) + ⅕*(5) + 5*(35)	2.86

Further information:

Number of employees	1500
Turnover in previous financial year	More than £100m
Proportion of your turnover derived from office furniture production	100%
Proportion of office furniture designed by company employees	95%
Proportion of sales manufactured by subcontractors	None

A.5.3 Interview 3

Name: Kept anonymous
Position: Head of design
Company: B
Place of interview: Austria
Date of interview: 20th June 2008

The following data represent the opinion of the above interviewee

Phase 1
Constructive thought process

Please complete the following questionnaire with regard to how you prioritise your office furniture designs.				
	Little importance	Consideration optional	Consideration necessary	Significant importance
Economics				x
Product identity		x		
Ergonomics			x	
Aesthetics/semantics			x	
Fit for purpose				x
Longevity			x	
Sustainability issues such as: toxicity of materials used: end of life; reduced waste and disposal and so forth.		x		

Phase 2
Behind the motivation both from outside the company [step 1] and inside [step 3]

Step 1:
Please read and adjust to or add to any of the below indices:
In the context of sustainability for office furniture:

(1) Client's reticence/willingness to incur an increased price and / or a longer lead time
(2) Client's knowledge and appreciation of the topic
(3) With reference to attitude; the person's seniority within the company, with whom you are discussing the topic, leading to a more positive or negative outcome
(4) Client's willingness to experiment with style
(5) Willingness of suppliers to respond to requests and information such as: 'Health Hazards of Chemical Compounds in the Work Area' [MAK Commission] and LCAs of materials and office furniture components

Step 2:
The importance of the above indices:

Please give a % score of importance to each index in step 1, totalling 100%								
Index	5%	10%	15%	20%	25%	30%	35%	40%
(1)							x	
(2)				x				
(3)		x						
(4)	x							
(5)						x		

Step 3:
Influence departments within the company have over each corresponding index

Using the following ratings indicate the amount of influence a department might have on each index Very little [⅕] Little [⅓] Average [1] Much [3] Very much [5]					
Activities and departments by which they are driven	Number of indices				
	(1)	(2)	(3)	(4)	(5)
On-site production [Production Management]	Very little	Average	Average	Average	Much
Technical support [Design and Technical]	Little	Average	Average	Average	Much
Target marketing [Marketing and Sales]	Very much	Much	Very Much	Much	Average
Financial strategy [Purchasing]	Little	Average	Average	Average	Much

Step 4:
Scores and ratings calculated for each department – signifying their influence with the corresponding index:

Company department	Calculation and final overall score	
Production Management	⅕*(35) + 1*(20) + 1*(10) + 1*(5) + 3*(30)	1.32
Design and Technical	⅓*(35) + 1*(20) + 1*(10) + 1*(5) + 3*(30)	1.37
Marketing and Sales	5*(35) + 3*(20) + 5*(10) + 3*(5) + 1*(30)	3.3
Purchasing	⅓*(35) + 1*(20) + 1*(10) + 1*(5) + 3*(30)	1.37

Further information:

Number of employees	285
Turnover in previous financial year	Less than £100m
Proportion of your turnover derived from office furniture production	80%
Proportion of office furniture designed by company employees	90%
Proportion of sales manufactured by subcontractors	None

A.5.4 Interview 4

Name: Kept anonymous
Position: Senior Designer
Company: C
Place of interview: Austria
Date of interview: 24th June

The following data represent the opinion of the above interviewee

Phase 1

Constructive thought process

Please complete the following questionnaire with regard to how you prioritise your office furniture designs.				
	Little importance	Consideration optional	Consideration necessary	Significant importance
Economics			x	
Product identity				x
Ergonomics		x		
Aesthetics/semantics			x	
Fit for purpose				x
Longevity			x	
Sustainability issues such as: toxicity of materials used: end of life; reduced waste and disposal and so forth.		x		

Phase 2
Behind the motivation both from outside the company [step 1] and inside [step 3]

Step 1:
Please read and adjust to or add to any of the below indices:
In the context of sustainability for office furniture:

(1) Client's reticence/willingness to incur an increased price and / or a longer lead time
(2) Client's knowledge and appreciation of the topic
(3) With reference to attitude; the person's seniority within the company, with whom you are discussing the topic, leading to a more positive or negative outcome
(4) Client's willingness to experiment with style
(5) Willingness of suppliers to respond to requests and information such as: 'Health Hazards of Chemical Compounds in the Work Area' [MAK Commission] and LCAs of materials and office furniture components

Step 2:
The importance of the above indices:

Please give a % score of importance to each index in step 1, totalling 100%								
Index	5%	10%	15%	20%	25%	30%	35%	40%
(1)							x	
(2)				x				
(3)	x							
(4)		x						
(5)						x		

Step 3:
Influence departments within the company have over each corresponding index

Using the following ratings indicate the amount of influence a department might have on each index Very little [⅕] Little [⅓] Average [1] Much [3] Very much [5]					
Activities and departments by which they are driven	Number of indices				
	(1)	(2)	(3)	(4)	(5)
On-site production [Production Management]	Very little	Little	Very little	Very little	Very little
Technical support [Design and Technical]	Very little	Much	Little	Very much	Very little
Target marketing [Marketing and Sales]	Very much	Very much	Very much	Much	Much
Financial strategy [Purchasing]	Much	Little	Little	Very little	Very much

Further information
The companies being interviewed will also be requested to answer the following questions:

Number of employees	1700
Turnover in previous financial year	More than £100m
Proportion of turnover derived from office & shop furniture production	100%
Proportion of office furniture designed by company employees	25%
Proportion of sales manufactured by subcontractors	35%

Step 4:
Scores and ratings calculated for each department – signifying their influence with the corresponding index:

Company department	Calculation and final overall score	
Production Management	⅕*(35) + ⅓*(20) + ⅕*(5) + ⅕*(10) + ⅕*(30)	0.23
Design and Technical	⅕*(35) + 3*(20) + ⅓*(5) + 5*(10) + ⅕*(30)	1.24
Marketing and Sales	5*(35) + 5*(20) + 5*(5) + 3*(10) + 3*(30)	4.2
Purchasing	3*(35) + ⅓*(20) + ⅓*(5) + ⅕*(10) + 5*(30)	2.66

A.5.5 Interview 5

Name: Kept anonymous
Position: Designer
Company: D
Place of interview: Austria
Date of interview: 27th June 2008

The following data represent the opinion of the above interviewee

Phase 1
Constructive thought process

Please complete the following questionnaire with regard to how you prioritise your office furniture designs.				
	Little importance	Consideration optional	Consideration necessary	Significant importance
Economics			x	
Product identity			x	
Ergonomics				x
Aesthetics/semantics				x
Fit for purpose				x
Longevity				x
Sustainability issues such as: toxicity of materials used: end of life; reduced waste and disposal and so forth.				x

Phase 2
Behind the motivation both from outside the company [step 1] and inside [step 3]

Step 1:
Please read and adjust to or add to any of the below indices:
In the context of sustainability for office furniture:

(1) Client's reticence/willingness to incur an increased price and / or a longer lead time
(2) Client's knowledge and appreciation of the topic
(3) With reference to attitude; the person's seniority within the company, with whom you are discussing the topic, leading to a more positive or negative outcome
(4) Client's willingness to experiment with style
(5) Willingness of suppliers to respond to requests and information such as: 'Health Hazards of Chemical Compounds in the Work Area' [MAK Commission] and LCAs of materials and office furniture components

Step 2:
The importance of the above indices:

Please give a % score of importance to each index in step 1, totalling 100%								
Index	5%	10%	15%	20%	25%	30%	35%	40%
(1)								x
(2)					x			
(3)								
(4)			x					
(5)				x				

Step 3:
Influence departments within the company have over each corresponding index

Using the following ratings indicate the amount of influence a department might have on each index Very little [⅕] Little [⅓] Average [1] Much [3] Very much [5]					
Activities and departments by which they are driven	Number of indices				
	(1)	(2)	(3)	(4)	(5)
On-site production [Production Management]	Very Little	Little		Average	Much
Technical support [Design and Technical]	Very much	Much		Average	Average
Target marketing [Marketing and Sales]	Very much	Very much		Much	Much
Financial strategy [Purchasing]	Average	Average		Little	Much

Step 4:
Scores and ratings calculated for each department – signifying their influence with the corresponding index:

Company department	Calculation and final overall score	
Production Management	⅕*(40) + ⅓*(25) + 1*(15) + 1*(20)	0.51
Design and Technical	5*(40) + 3*(25) + 1*(15) + 1*(20)	3.1
Marketing and Sales	5*(40) + 5*(25) + 3*(15) + 3*(20)	4.3
Purchasing	1*(40) + 1*(25) + ⅓*(15) + 3*(20)	1.3

Further information
The companies being interviewed will also be requested to answer the following questions:

Number of employees	500
Turnover in previous financial year	Less than £100m
Proportion of your turnover derived from office furniture production	Minority
Proportion of office furniture designed by company employees	40%
Proportion of sales manufactured by subcontractors	5%

A.5.6 Interview 6

Name: Kept anonymous
Position: Sales Director
Company: E
Place of interview: By telephone
Date of interview: 30 June 2008

The following data represent the opinion of the above interviewee

Phase 1
Constructive thought process

Please complete the following questionnaire with regard to how you prioritise your office furniture designs.				
	Little importance	Consideration optional	Consideration necessary	Significant importance
Economics				x
Product identity			x	
Ergonomics				x
Aesthetics/semantics				x
Fit for purpose				x
Longevity				x
Sustainability issues such as: toxicity of materials used: end of life; reduced waste and disposal and so forth.				x

Phase 2
Behind the motivation both from outside the company [step 1] and inside [step 3]

Step 1:
Please read and adjust to or add to any of the below indices:

(1) Client's reticence/willingness to incur an increased price and / or a longer lead time
(2) Client's knowledge and appreciation of the topic
(3) With reference to attitude; the person's seniority within the company, with whom you are discussing the topic, leading to a more positive or negative outcome
(4) Client's willingness to experiment with style
(5) Willingness of suppliers to respond to requests and information such as: 'Health Hazards of Chemical Compounds in the Work Area' [MAK Commission] and LCAs of materials and office furniture components

Step 2:
The importance of the above indices:

Please give a % score of importance to each index in step 1, totalling 100%								
Index	5%	10%	15%	20%	25%	30%	35%	40%
(1)						x		
(2)					x			
(3)	x							
(4)		x						
(5)						x		

Step 3:
Influence departments within the company have over each corresponding index

Using the following ratings indicate the amount of influence a department might have on each index Very little [⅕] Little [⅓] Average [1] Much [3] Very much [5]					
Activities and departments by which they are driven	Number of indices				
	(1)	(2)	(3)	(4)	(5)
On-site production [Production Management]	Little	Little	Much	Much	Much
Technical support [Design and Technical]	Average	Average	Much	Much	Much
Target marketing [Marketing and Sales]	Much	Much	Average	Much	Little
Financial strategy [Purchasing]	Little	Little	Much	Much	Much

Step 4:
Scores and ratings calculated for each department – signifying their influence with the corresponding index:

Company department	Calculation and final overall score	
Production Management	⅓*(30) + ⅓*(25) + 3*(5) + 3*(10) + 3*(30)	1.53
Design and Technical	1*(30) + 1*(25) + 3*(5) + 3*(10) + 3*(30)	1.9
Marketing and Sales	3*(30) + 3*(25) + 1*(5) + 3*(10) + ⅓*(30)	2.1
Purchasing	⅓*(30) + ⅓*(25) + 3*(5) + 3*(10) + 3*(30)	1.53

Further information
The companies being interviewed will also be requested to answer the following questions:

Number of employees	85
Turnover in previous financial year	Less than £100m
Proportion of your turnover derived from office furniture production	95%
Proportion of office furniture designed by company employees	40%
Proportion of sales manufactured by subcontractors	50%

A.5.7 Interview 7

Name: Kept anonymous
Position: Design Manager
Company: F
Place of interview: Germany
Date of interview: 7th July 2008

The following data represent the opinion of the above interviewee

Phase 1
Constructive thought process

Please complete the following questionnaire with regard to how you prioritise your office furniture designs.				
	Little importance	Consideration optional	Consideration necessary	Significant importance
Economics				x
Product identity			x	
Ergonomics			x	x
Aesthetics/semantics		x	x	
Fit for purpose			x	
Longevity				x
Sustainability issues such as: toxicity of materials used: end of life; reduced waste and disposal and so forth.				x

Phase 2
Behind the motivation both from outside the company [step 1] and inside [step 3]

Step 1:
Please read and adjust to or add to any of the below indices:
In the context of sustainability for office furniture:

(1) Client's reticence/willingness to incur an increased price and / or a longer lead time
(2) Client's knowledge and appreciation of the topic
(3) With reference to attitude; the person's seniority within the company, with whom you are discussing the topic, leading to a more positive or negative outcome
(4) Client's willingness to experiment with style
(5) Willingness of suppliers to respond to requests and information such as: 'Health Hazards of Chemical Compounds in the Work Area' [MAK Commission] and LCAs of materials and office furniture components

Step 2:
The importance of the above indices:

Please give a % score of importance to each index in step 1, totalling 100%								
Index	5%	10%	15%	20%	25%	30%	35%	40%
(1)				x				
(2)				x				
(3)							x	
(4)								
(5)					x			

Step 3:
Influence departments within the company have over each corresponding index

Using the following ratings indicate the amount of influence a department might have on each index Very little [⅕] Little [⅓] Average [1] Much [3] Very much [5]					
Activities and departments by which they are driven	Number of indices				
	(1)	(2)	(3)	(4)	(5)
On-site production [Production Management]	Very much	Very little	Very much		Very much
Technical support [Design and Technical]	Very much	Average	Very much		Very much
Target marketing [Marketing and Sales]	Very much	Very much	Very much		Average
Financial strategy [Purchasing]	Very much	Much	Very much		Very much

Step 4:
Scores and ratings calculated for each department – signifying their influence with the corresponding index:

Company department	Calculation and final overall score	
Production Management	5*(20) + ⅕*(20) + 5*(35) + 5*(25)	4.04
Design and Technical	5*(20) + 1*(20) + 5*(35) + 5*(25)	4.2
Marketing and Sales	5*(20) + ⅕*(20) + 5*(35) + 1*(25)	3.04
Purchasing	5*(20) + 3*(20) + 5*(35) + 5*(25)	4.6

Further information

The companies being interviewed will also be requested to answer the following questions:

Number of employees	13,500
Turnover in previous financial year	More than £100m
Proportion of your turnover derived from office furniture production	100%
Proportion of office furniture designed by company employees	50%
Proportion of sales manufactured by subcontractors	None

Appendix 6

Method of data collection used by Ghazinoory in 2005

Method summarised:
In the beginning stage of his programme groups of industry were created by the international standard industrial classification [ISIC] standards.
Areas of industry:

- Paper and printing
- Food and tobacco
- Textile
- Furniture
- Plastics and chemicals

Telephone interviews with experts of the above industries and relevant experts in the government formed the following six indices for examination. He asked the relevant experts and directors to weight the six indices according to those areas which should be prioritised for change toward cleaner production; the results were averaged and normalised [e.g.: 40%; 20%; 15%...] making a total of 100% (Ghazinoory, 2005)

Nr.	Index	Prioritised as %
1	The number of industrial units in the related industrial group	40%
2	The amount of pollution produced due to industrial activities	20%
3	The environmental longevity of the pollutants produced in that sector [length of time to decompose]	15%
4	Economic value of resources and materials of the industrial group	10%
5	Costs for waste disposal through “end-of-pipe technologies” [EOP]	5%
6	Accessibility of the needed technology for cleaner production practices	10%

The next stage was the most complicated but also perhaps most useful. Cross-referencing was achieved by asking the experts and directors to qualitatively judge the *areas of industry* as far as their situation concerning need of change when related to the indices. Respondents gave a rating to each index, a system that Hwang developed in 1981 (cited in Ghazinoory 2005). i.e.
⅕ = Very little
⅓ = Little
1 = Average
3 = Much
5 = Very much

Demonstrated here is a representation of the importance of each industry group in relation to each index (Ghazinoory, 2005, p.760). Each industrial group is given rating of importance equating to a score which when incorporated with the percentage scores of the indices an order of importance for each industrial group can be calculated. The following shows an example of this (Ghazinoory, 2005):

Industrial group	Number of indices					
	(1)	(2)	(3)	(4)	(5)	(6)
Food and Tobacco	Very much	Average	Very little	Average	Average	Very much

Calculation showing Food and Tobacco example:

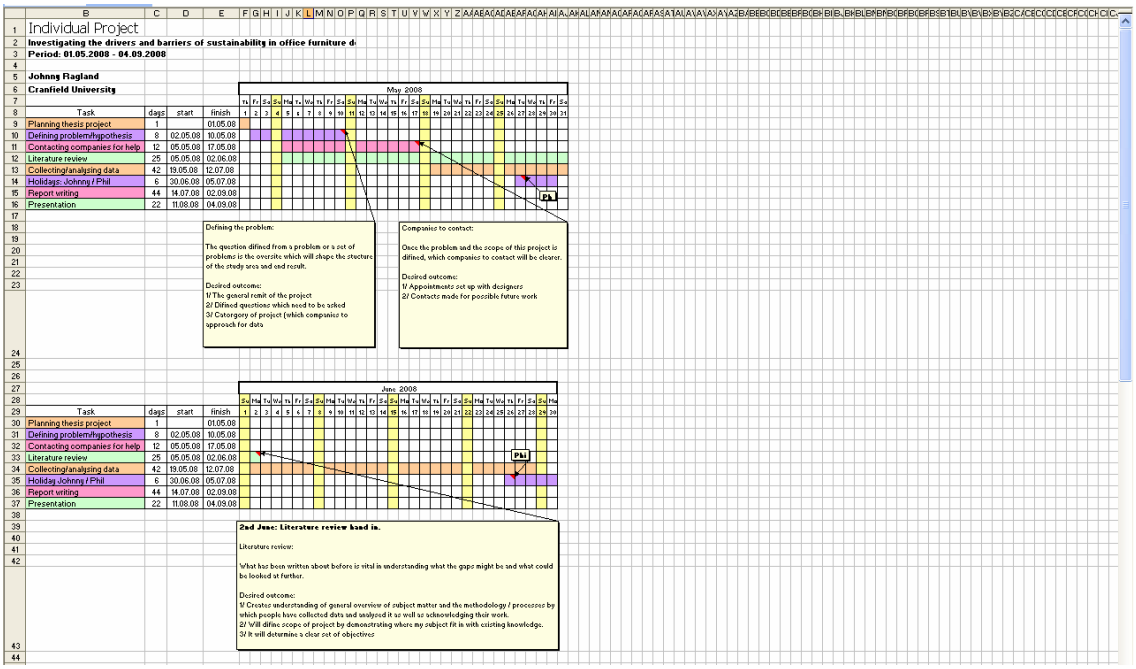
$$5(40\%) + 1(20\%) + \tfrac{1}{5}(15\%) + 1(10\%) + 1(5\%) + 5(10\%) = 2.88$$

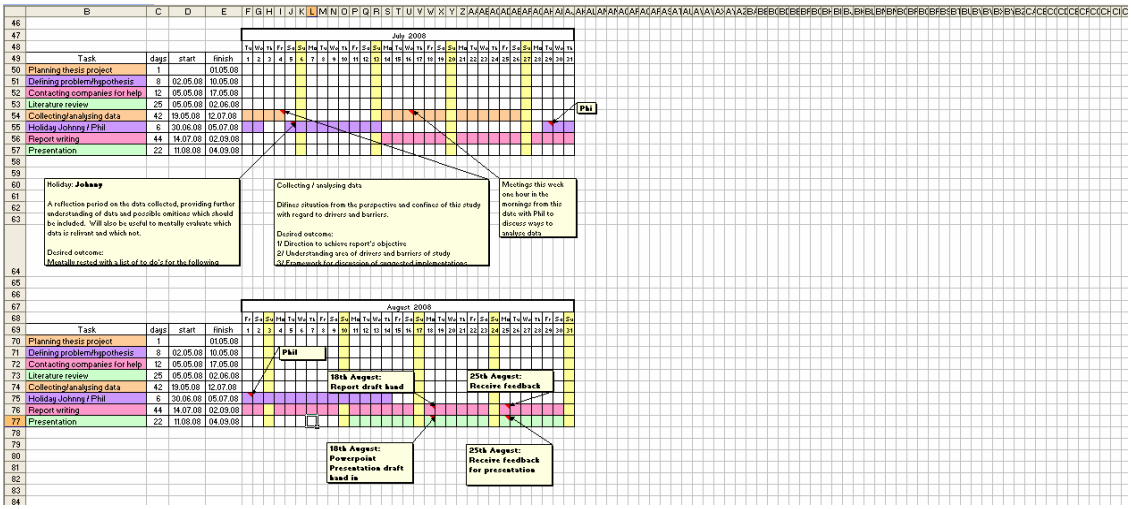
Final stage

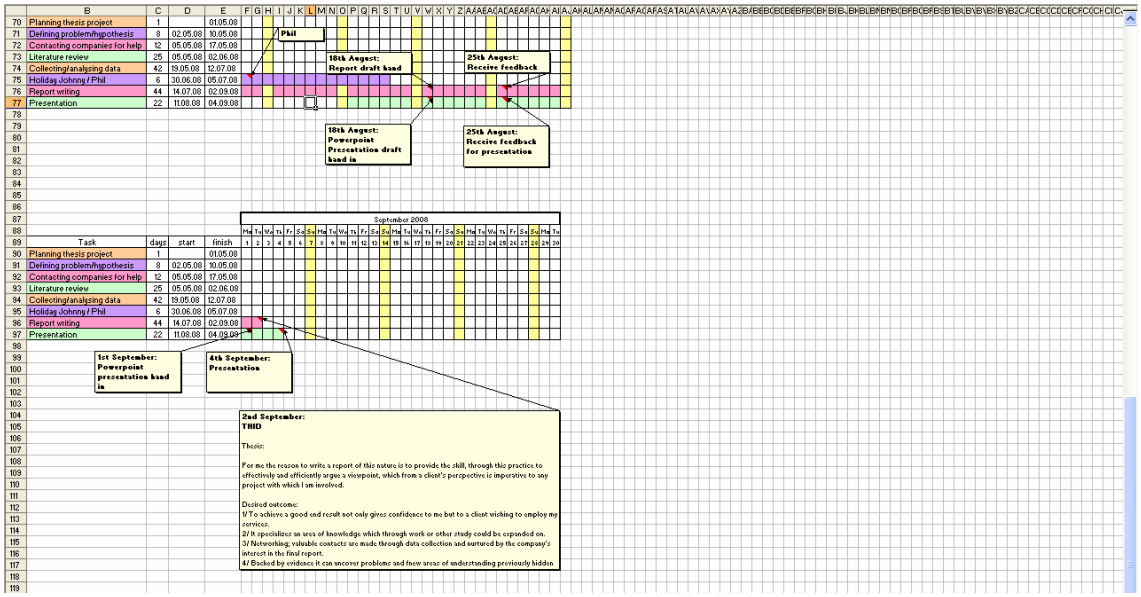
Scores were calculated for the purpose of apportioning priority to those industrial groups marked with the highest numerical score. Scores ranged from 3.27-0.36 (Ghazinoory, 2005).

Appendix 7

Gantt chart used by author for the management of this project







Task	days	start	finish
Planning thesis project	1		01.05.08
Defining problem/hypothesis	8	02.05.08	10.05.08
Contacting companies for help	12	05.05.08	17.05.08
Literature review	25	05.05.08	02.06.08
Collecting/analysing data	42	19.05.08	12.07.08
Holiday Johnny / Phil	6	30.06.08	05.07.08
Report writing	44	14.07.08	02.09.08
Presentation	22	11.08.08	04.09.08