When Design Matters

A Study of the Product Oriented Environmental Performance at B&O - With a Point of Departure in the EuP Directive

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Abstract:

This report addresses the problem definition: How will the EuP Directive create incentives for improving the environmental performance at B&O, and how can a proactive strategy for improving product performance be incorporated in the company? The problem definition is investigated through an interdisciplinary case study of Bang & Olufsen a/s and their product oriented environmental management.

B&O places high emphasis on the design and the quality of their products and considers compliance with environmental legislation as being a part of this.

The EuP Directive aims at integrating environmental considerations in the design of energy-using products. No final requirements exist as the Directive is not fully implemented, but possible requirements are found to concern standby and on-mode energy consumption as well as noise limits.

With a point of departure in the current practices at B&O, a strategy for complying with the EuP Directive is developed, and it is assessed that B&O is able to comply without changing significantly in the existing procedures. It is concluded that the EuP Directive does not create significant incentives for improving the product related environmental performance at B&O.

A proactive strategy is developed, consisting of three overall steps, which contain a number of concrete measures B&O can apply. Significant changes in the company attitude are however needed, before a proactive strategy can be applied.

Preface

This report has been conducted as the reification of our master thesis from the Department of Development and Planning, Aalborg University in the spring of 2007.

Through this study we have had the opportunity to investigate practices at B&O in-depth, which have allowed us to meet and get to know a range of interesting, helpful and inspiring people. We are grateful for this experience, and hope that more companies will be open for this kind of interaction with students from institutions of higher education. We have no doubt that mutual benefits have been achieved following the collaboration.

We would like to thank all who have supported the completion of this thesis. Special thanks go to Lone Nielsen, who with her kind manner has contributed with valuable information and an insight in company perceptions and performance. Additionally, Gert Yde Jacobsen deserves thanks for his frankness and enthusiasm about our project.

We would also like to thank Rune Bruhn-Jensen and Thomas Ditlev Petersen, who kindly have provided explanations, interpretations and guidance in relation to the more product technical aspects of this report. It was needed and helpful.

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The Environmental Challenges for Companies

1

The point of departure for this report is a study of Bang & Olufsen (B&O), a company known worldwide for its high quality design in audio and video products. B&O's chief executive officer, Torben Ballegaard Sørensen, describes the success of the company as follows (Hansen 2007a):

> '*The success of Bang & Olufsen rest on a concept of good design that is simple on the outside, but immensely complex on the inside*.'

It is within the nature of B&O to constantly strive for creating the best products, and seek to break the boundaries of what can be expected, a strive that has resulted in a range of audio and video products based on advanced technology and innovative design. This constant strive will inevitably also affect the environment, and the purpose of this report is to investigate how B&O integrate product oriented environmental considerations in the product development process, initially asking the question of what makes a company improve the environmental performance of its products. In the case of B&O, BeoVision 9 and the ICEpower technology are two examples of products, where the environmental outcome of the two development processes have been rather different. BeoVision 9 is a television that contains new and advanced technology, but it is also the largest television ever created by B&O, and as a result only 15 televisions can fit into a truck at a time (Nielsen 2007a). The ICEpower technology, on the other hand, is a small and high quality amplifier technology, which makes it possible to significantly reduce the size of the amplifier, leading to reduced material and energy consumption (B&O ICEpower n.d.).

The approaches being applied to improve environmental performance have changed over time, and this has influenced the environmental awareness in many companies. This change is also reflected in the trends and focuses of the public debate concerned with environmental impacts, as well as the regulation types applied to influence company performance. For this report, a point of departure is taken in *the EU Directive for setting ecodesign requirements for Energy-using Products* (the EuP Directive), which is part of a recent development towards product oriented regulation. The Directive provides coherent rules for ecodesign, and thereby seeks to improve the environmental performance of energy-using products. This study therefore also investigates how the implementation of the EuP Directive will influence the environmental performance of B&O's products.

As a start however, the different approaches for companies to address environmental impacts, the trends in the public debate as well as the different regulation types are further presented in the fol-

lowing, to give an overall understanding on the influences on companies, and thus place B&O and the EuP Directive in a larger context.

1.1 Approaches for Addressing Environmental Impacts

The different steps on the stair presented in Figure 1.1 illustrates different approaches for addressing environmental challenges, which gradually have been changing the environmental awareness in companies over time. In each of the approaches lies an implicit understanding of the cause of the problem and its potential solutions. The upper steps represent the newest approaches, but many companies are still acting on lower placed steps.

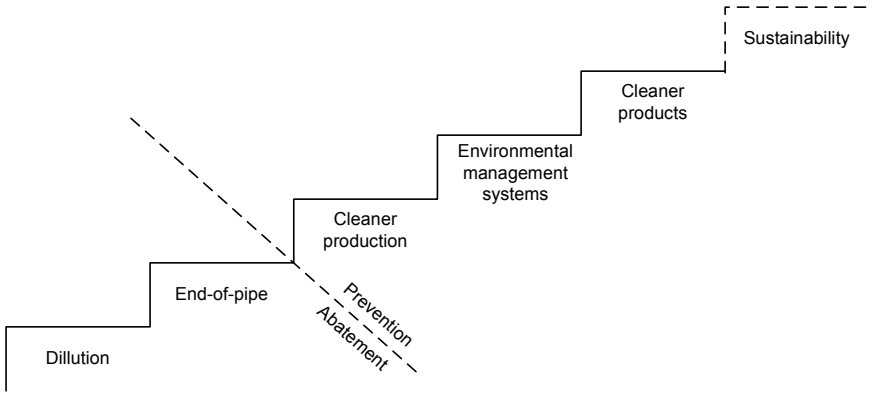


Figure 1.1 The development in approaches for addressing environmental challenges, also influencing the environmental awareness of companies. Based on Remmen (2001, 54-57) and Thrane (2005).

When environmental considerations first became an issue in western countries in the 1960's, dilution and end-of-pipe technologies were the preferred approaches (Remmen 2001, 54). As this proved insufficient, focus gradually changed to a more preventive approach, and cleaner production was introduced. Later the management approach was included with environmental management systems (EMS), and ongoing improvements became a goal. Gradually, the focus of proactive companies has changed to more product oriented approaches, where the impacts related to the life cycle of the product are considered. The product oriented approach was initiated as many significant environmental impacts were not considered when solely looking at the production site. In the electronic industry much attention is given to especially energy consumption, but also hazardous substances and electronic waste is in focus. As the figure illustrates, the top step is sustainability, which encompasses economical, social and environmental aspects. Integrating all three aspects requires the companies to have different perspective on among other things equality, market conditions, and product definitions. Sustainability is illustrated with a dotted line as it can be argued that there are several steps between cleaner products and sustainability, and it can even be discussed whether sustainability can be achieved on company level at all.

1.2 Trends and Focus in the Public Debate

The focus on products is also prevailing in the public debate, and many tendencies in the world of today influence companies. In the case of B&O this includes global challenges such as climate change and more close challenges, such as the specific environmental impacts particular related to the electronic industry. Most recently, reports from the UN Intergovernmental Panel on Climate Change (IPCC), have pointed out the connection between human activity and the increasing environmental impacts, and previously the reports have provided important input among others to the formulation of the Kyoto Protocol (IPCC 2007). A recent report published on the economic consequences of climate change is the Stern Report, which emphasises the need for action now, and argues that actions now will have much lower economic cost than if no actions are taken (Stern 2007).

A recent Danish initiative is the *1 Tonne Less* campaign launched by the Danish Ministry for the Environment and the Ministry for Transport and Energy. The campaign aims at creating awareness on minimizing CO_2 emissions, and so far more than 1800 people have made reduction commitments (Danish Ministry of the Environment 2007). Also former Vice President Al Gore and his movie *An Inconvenient Truth* have been attracting a lot of attention to this very issue. Although climate change has been dominating in the public debate, environmental issues related directly to the electronic industry have also received attention. A year ago it hit the headlines that huge amounts of electrical waste was shipped to for instance Africa and treated there, with immense environmental and physical damage as a consequence (DR 2006).

In line with the increased attention on environmental issues, companies adjust their approach as well, and today it seems important to have an ethical stance. A Danish initiative is the Danish Council for Sustainable Business Development from 2006, which aims to strengthen the competitiveness and earning capacity of Danish business through a focus on sustainable business development (Danish Council for Sustainable Business Development n.d.).

1.3 Regulation Types to Influence Products' Environmental Performance

Different types of regulation are also essential in order to further the focus on the environmental performance of products. According to Rubik (2005, 170), studies have shown that more than 70% of the costs of product development, production and use are determined when a product is designed, and he therefore argues that it can be presumed that a large share of the environmental impacts related to a product is determined as well. It is therefore important that the regulation is aimed at influencing how products are designed and thereby the environmental performance of products. The EU has taken up this approach in its Integrated Product Policy (IPP), which aims at minimizing environmental impacts from products by looking at all phases of the product's life cycle and taking actions where it is most effective (European Commission 2007a). According to Rubik (2005), IPP uses a range of different approaches to influence the environmental performance of

products, which are illustrated in Figure 1.2. Each of the four approaches seldom stands alone, as there often is interaction between more approaches.

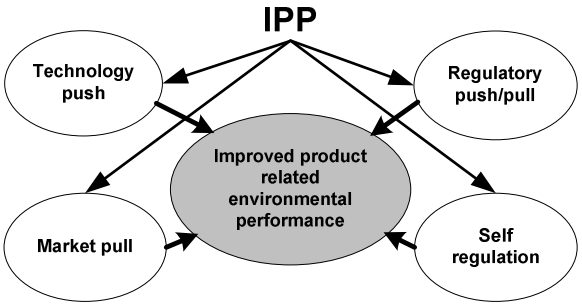


Figure 1.2 IPP focuses on different approaches to influence the improvement of the product related environmental performance. Based on Cleff and Rennings (1999), modified by Rubik (2002) and Remmen (2005).

As seen, IPP seeks to influence product performance through four different approaches; technology push, market pull, self regulation and regulatory push and pull. Each of the approaches is discussed in the following including examples from the electronics industry.

Technology Push

New eco-efficient technologies can, according to Cleff and Rennings (1999, 192), influence the improvement of the product related environmental performance. This can be defined as a technology push factor, denoted as technology regulation. When technologies are used as a push factor, the companies aim to gain competitive advantages through creating products with improved attributes compared to the products of their competitors (Høgenhaven 2005, 17). Examples of technology regulation are for instance the concept of Best Available Techniques (BAT), which among others are present in the IPPC Directive[1] and in the Danish Environmental protection law.

Market Pull

The influence from the market pull is driven by demand factors, such as customer demands and image management, and market instruments such as eco taxes or tradable permits are also categorised under market regulation (Cleff and Rennings 1999, 192). Smink (2002, 88-98) emphasises four main actors representing market pull factors; business networks, supplier/buyer relationships, green consumers and financial institutions. A fairly recent study of the Danish electronic industry has revealed that 90% of the electronics companies indicate that customer demands are the primary source for product innovation (Høgenhaven 2005, 11, 67).

[1] The IPPC Directive on integrated pollution prevention and control was adopted in 1996 (European Commission 1996).

Self Regulation

Self regulation has been defined in many ways. One definition encompassing the environmental aspect was given in 1996 by the OECD, who defined self regulation as when industry unilaterally commits itself to improve product performance in the area of environmental protection (OECD 1996). Hence, self regulation is an approach where companies themselves initiate moves to improve for instance their environmental performance. Voluntary agreements between businesses and EMS are examples of self regulation (Rubik 2002). The incentives for companies to engage in voluntary actions are, according to Carter (2001, 192), often the increased profits. Another example is companies' participation in product panels, for instance the Danish Electronics Panel from 1998, which have had a significant influence on bringing environmental issues on the agenda in the electronic industry (Electronics Panel n.d.; Knudsen, Jensen and Chabert 2003). The aim of the panel was to generate activities that influenced the behaviour and attitude of the population in order to reduce environmental impacts from electronic products, by focusing on instruments like eco-labelling and environmental declarations (Electronics Panel n.d.). These instruments can also be categorised as self regulating measures, however eco-labels are not widely used in the Danish electronics industry (Knudsen, Jensen and Chabert 2003).

Regulatory Push/Pull

The regulatory approach gives incentives or poses demands on companies to improve the environmental performance of products, also denoted as public regulation. In recent years there have been several examples of this. The WEEE Directive makes the producers responsible for the end-of-life treatment of their products, which ideally should create incentives for ecodesign. Other examples are the RoHS Directive, which set up requirements regarding banned substances, while the REACH regulation transfers the overall responsibility for obtaining knowledge on chemicals from the authorities to the producers and importers of chemicals. All of these can be regarded as a regulatory push factor, as the companies are forced to comply with the legislation. Regulatory pull factors, on the other hand, are for instance when companies are given an incentive for improving their performance and through this gain economic benefits (Smink 2002, 20-74). A new regulation that influences the electronic industry is the EuP Directive, which is in focus in this report.

1.4 Reactive and Proactive Companies

The different regulation types along with the tendencies in the public debate are factors contributing to the environmental awareness in companies and the approaches applied to deal with environmental impacts, as illustrated in the stairs in Figure 1.1. How the different types of regulation affect companies is among other things determined by their approach to environmental causes and solutions, and thereby their stance on these stairs. As an example reactive companies acting on the first steps, will typically be affected more directly by regulatory regulation than proactive companies, which are placed further up on the stairs. Their higher position will often be caused by their previous use of self regulation and their response to market regulation, as well as their reactions to public concerns.

The EuP Directive focuses on energy consumption and the related impacts, and can be seen as using a mixture of all four regulation types. B&O is currently facing challenges posed through the Directive, and has to determine a strategy for action. In this regard it would be relevant to question, whether enough incentives are created for improving the environmental performance of products through complying with the EuP Directive, or whether a more proactive strategy would give basis for more improvements and for advancing their position on the stairs.

1.5 Problem Definition

These considerations lead to the following problem formulation:

> **How will the EuP Directive create incentives for improving the product related environmental performance at B&O, and how can a proactive strategy for improving product performance be incorporated in the company?**

As part of formulating the problem definition, a number of limitations are made. First, studies of the EuP Directive are focused on the Directive in its final shape, and the studies do therefore not encompass in depth analyses of the preparatory work leading to the Directive. Secondly, the study focuses on consequences of the EuP Directive at B&O. It is therefore not analysed how the Directive could be improved, or how the EuP Directive will influence actors in the product chain to influence B&O to improve their performance. Thirdly, the study applies an organisational focus on product related environmental performance, and does therefore not specify how for instance components could be technically changed. And fourthly, the product development process at B&O is studied by focusing on the sequences of events related to two specific products, BeoVision 7 and BeoMedia 1. The study does therefore not consider the complete product portfolio of B&O. The products are further presented in Chapter 4.

1.6 Structure of the Report

The report is divided into three parts, to emphasise different focuses throughout the report. The three parts, with the exception of Chapter 2 that concern the research design and methods are illustrated in Figure 1.3 including the chapters and appendices related to each part.

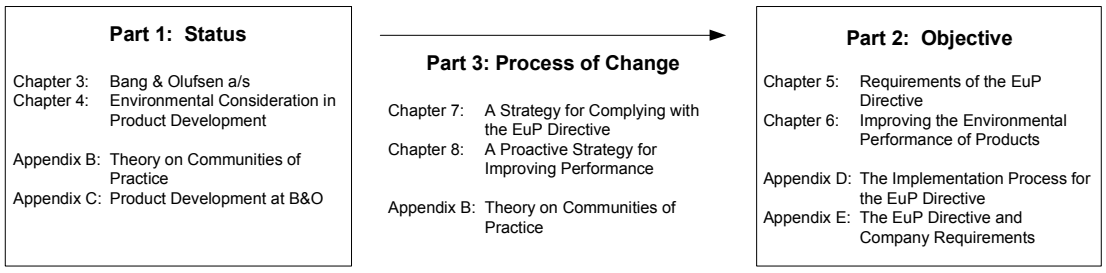


Figure 1.3 Illustration of the overall structure of the report.

The status part, constituted by Chapter 3 and 4, is an analysis of the overall environmental management at B&O and particularly the way in which environmental considerations are integrated in the product development process. The research questions related to this part are:

- What are the general characteristics of B&O as a company, and how are environmental aspects at an overall level integrated in the company?
- Which are the main elements of the product development process, and how are environmental considerations integrated in this?
- Which communities of practice can be identified in the product development process at B&O in relation to environmental improvements of products?

The objective part, constituted by Chapter 5 and 6, set up objectives which concern two main aims. The first is constituted by an analysis of the EuP Directive, leading to an identification of the potential requirements following the Directive. The second is constituted by two strategies for how the environmental management at B&O should develop in order to improve the product related environmental performance. The first strategy aims at complying with the EuP Directive, and the second is a proactive strategy for improving the product related environmental performance. The research questions related to this part are:

- Which requirements will the EuP Directive most likely pose on B&O as a company and the products produced by B&O?
- Which measures can support B&O in the process of ensuring compliance with the EuP Directive?
- Which measures can support the incorporation of a proactive strategy for improving product performance?

The process of change part, constituted by Chapter 7 and 8, is an analysis of the needed changes in order to achieve the objectives set up through the second part. As for the compliance strategy a range of actions are recommended by the project group. For initiating a more proactive strategy a range of actions are recommended, and an overview of expedient steps to take is provided. The research questions related to this part are:

- Which actions should be initiated at B&O for ensuring compliance with the EuP Directive?
- Which actions should be initiated in order for B&O to introduce and implement a proactive strategy for improving the product related environmental performance?

Each of the three parts is initiated with a dividing leaf. The purpose of this is first of all to outline the focus of the specific part by highlighting the relevant research questions. Secondly, it is explained how various theories are used. In all, the dividing leaves should therefore be seen as three analytical frameworks, which are used to guide the analyses and structure the report. The methods applied for answering the research questions and through these the problem definition are presented and discussed in the following chapter.

Research Design and Methods

2

This chapter presents the research design used in the study as well as the data collection process, the data analysis and interpretation and finally how the findings have been validated. Initially, an explanation of how the study was initiated is presented.

2.1 Initiating the Study

This report constitutes the outcome of an interdisciplinary study using B&O as a case. The use of B&O as case subject was initiated due to a desire from the project group to base the thesis on a company perspective, where relevant problem areas could be identified. An initiating expression of interest in collaboration was exchanged between the project group and Charlotte Buur Poulsen, Head of the Safety, Health and Environment Department (SHE) at B&O at the time. Subsequently, contact was made with environmental consultant Lone Nielsen, who became the primary contact person. Compliance with the EuP Directive was chosen as a starting point given that it for B&O is a pending challenge. Following, relevant problem areas were identified, and the scope of the project has gradually evolved resulting in the wording of the problem definition.

2.2 Research Design

The focus of this report is an investigation of environmental considerations in the product development process. Multiple ways to exist to analyse this; in this report focus has been on the organisation of B&O, and how environmental considerations happen within the organisation. However, a cross-organisational perspective has been applied in order to clarify the dynamics and interdependences between involved actors. It has been sought to broaden the scope by including considerations on the linkages between B&O and their suppliers, though only to a limited extent.

In the study a phenomenological hermeneutic approach has been applied, emphasising the focus on investigating the case from within the company and using empirical data, such as interviews and observations to understand the perceptions of involved actors when mapping the development process. A further use of the phenomenological approach is that experiences to a high degree have been sought described before interpreted. The concept of the circle of hermeneutics has been used for ensuring continuous interaction between the empirical data gathering process, the theories and literature used to support this, and further to analyse and interpret the findings. This is further described in Section 2.4. Qualitative methods have thus been dominant because of the problem defini-

tion, and given a desire to engage in the project as entailed through the study scope. In relation to the use of theories, these have been applied as supporting the case study engagement in contrast to an approach where theoretical propositions structure the study, the data gathering process as well as the interpretation. Additionally, considerations about the target group of readers have been influential in this regard, limiting the focus on theoretical considerations in report.

2.2.1 Case Investigation

Given that this project to a high degree is based on empirical data, visits performed at B&O have been crucial. The project group has visited B&O on three occasions, where the length of the visits respectively has been one day, two days and one week. Structuring the visit cycle is centred on feeding knowledge gained from one visit into the project and then further into the following visit. A final meeting has been held with Lone Nielsen at Aalborg University, with the primary aim of assisting in a process of validating the output of the study. Prior to visits at B&O, emphasis has been put on determining objectives for the different visits and ensuring that these were either met or revised. Table 2.1, shown on the next page, gives an overview of the objectives used for structuring the visits.

Table 2.1 constitutes a list of applied objectives, either fulfilled or partly fulfilled. The list is a result of a process where the objectives have been adapted continuously, recognising that some objectives were unachievable. This was for example the case for an objective stating that *knowledge* about all management of environmental issues should be obtained. This objective was deemed too exhaustive compared to the expected gains from such an analysis, and is therefore not represented in Table 2.1. Despite the different deviations, the objectives have been crucial in planning the visits, in the data gathering process and in evaluating the visits. This is seen through the changed character of the objectives throughout the table. Obtaining understandings in the first two visits primarily is of explorative character, and functioned as preparation for the third visit, which have been more structured and descriptive, based on objectives stating knowledge needs. As an example, the second visit should assist in obtaining an *understanding* of the product development processes, whereas an objective for the third visit was to obtain *knowledge* about environmental considerations in the product development.

Date	Objectives
5/2	Get to know each other
	Understand current challenges in the environmental management at B&O
7-8/3	Understand the product development processes
	Understand how environmental considerations are incorporated in the product development process
	Understand which communities of practise that exists at B&O, especially related to environmental management, product development and other areas relevant for the EuP Directive
	Understand how the different communities of practice collaborates, and which brokers and boundary objects that are involved
	Determine which products at B&O that will be affected by the different implementing measures
	Discuss criteria for selecting products
	Knowledge of the selected products
	Clarify the course of events expedient for the next visit
16-20/4	Knowledge of the EuP Directive's likely impacts on B&O
	Knowledge of the appropriateness of applying different tools for environmental management at B&O
	Knowledge of the product development processes for BeoVision 7 and BeoMedia 1, including key persons, environmental considerations incorporated and important decision points
	Knowledge of the experiences gained through the participation in previous environmental projects
	Knowledge of how different departments and communities of practice work with environmental issues, and how product related environmental considerations are incorporated
	Knowledge of learning cycles related to the incorporation of environmental considerations in different project sequences
19/5	Receive comments on chapters in this report describing the current status at B&O
	Receive comments on chapters in this report describing the objectives for B&O
	Receive comments on proposed processes of change

Table 2.1 Illustration of the objectives structuring the content of the meetings with B&O employees. Specific concepts are presented and explained in the following chapters.

2.3 Data Collection

The data collection is based on four collection types; interviews, observations, a course in product development and literature studies. The methods are presented in the following.

2.3.1 Interviews

Interviews are primary source of data, both in relation to the analysis of the EuP Directive and the analysis of the product development processes at B&O. Appendix A presents the interview guides used for structuring the interviews. In general the interviews are built on the knowledge gained through the use of theories, literature studies and the product development course. It has been chosen to record all interviews and subsequently transcribe all interviews. Despite a risk of limiting the interviewees in their replies, the recording has been assessed expedient due to different considerations: all interviewees should approve used statements, which is assessed to minimize their poten-

tial fears of misquotes. Taking the amount of interviewees and the limited time in which they were conducted into consideration, the risk of loosing information, if not recorded, has been assessed more significant. Finally, when recording the interviews more focus can be put into the interview process in contrast to spending time noting replies.

As the final requirements following the EuP Directive are not yet determined, it has been necessary to interview people who are assessed knowledgeable about the possible future demands. It is found expedient to gather viewpoints from a broad spectre of involved organisations, including the responsible authorities, industry and an environmental NGO. One interview has been conducted with each of the persons mentioned in Table 2.2.

Name	Affiliation	Relation to the EuP Directive
Peter Nielsen	The Danish Energy Agency	Responsible for the EuP Directive in the Danish Energy Agency
Rikke Traberg	The Danish Environmental Protection Agency	Among the responsible for the EuP Directive in the Danish Environmental Protection Agency
Tina Sternest	The Danish Industry Association	Responsible for the EuP Directive in the Danish Industry Association
Christian Poll	Danish Society for Nature Conservation	The employees in the Danish Society for Nature Conservation most involved in the implementation process of the EuP Directive

Table 2.2 Overview of the people interviewed about the potential consequences of the EuP Directive.

Given the key positions of particularly Rikke Traberg and Peter Nielsen, their viewpoints have been valuable in the process. Furthermore, Tina Sternest and Christian Poll have the advantage of not being legally responsible for the national implementation, and have thus been able to contribute with more critical viewpoints. The interview guide has been used rather stringently in all four interviews.

Table 2.3 presents the employees interviewed about routines at B&O. The interviewees have been selected due to their professional relations to either the two chosen products or due to their experiences with issues applicable in all product development processes. It is characteristic for the key persons listed in Table 2.3 that they all work on several products simultaneously, and therefore possess knowledge reaching beyond their respective field of work. Preparing the interviews for the different employees have been an extensive process with a range of different sources used to support the mantra; *environmental considerations in the product development and the EuP Directive*. In addition to theories and literature studies, also the product development course and knowledge about the two chosen products have been used. Particularly important is however, the order in which the different interviews have been conducted. Lone Nielsen has been consulted continuously which, combined with the findings from the first two visits, have functioned as preparation for the third visit. Additionally, the third visit took place over a week, which allowed for an iterative process where experiences from one interview subsequently have been used in the following. This has entailed continuous adjustments in the questions for each interviewed person and the interview guide has thus not been used stringently.

Name	Title	Time of Interview	Primarily Relevant for which B&O Product
Finn Andersen	Project manager	April 18	BeoMedia 1
Freddy Wind	Senior engineer	April 17	No specific product
Gert Yde Jacobsen	Project manager	March 8, April 20 and email contact	BeoVision 7
Hanne Holm Mathiassen	Production technician	March 7	No specific product
Jens Bendix	Departmental manager	March 7	No specific product
Jesper Juhl Jensen	Mechanics coordinator	March 8	BeoVision 7
Jesper Olesen	Manager of the Test & Approval Department	April 17	No specific product
Kristian Langergaard	Consultant in the Purchasing Department	April 17, 19 and email contact	No specific product
Lars Farving	Environmental consultant	April 16	No specific product
Lone Nielsen	Environmental consultant	February 5, March 7-8, April 16-20, May 25, phone and email contact	No specific product
Mette Juhl	Environmental consultant	March 7, April 16	No specific product
Per Bruun	Design coordinator	April 19 and email contact	No specific product
Rikke Nedermark	Project manager	April 16	No specific product
Rune Bruhn-Jensen	Technical product manager	March 7 and email contact	No specific product
Torben Kyed	Product manager	April 17 and email contact	BeoMedia 1

Table 2.3 Interviewed key persons in the product development process at B&O or with relevance for the integration of environmental considerations in the development process.

2.3.2 Observations

Interviews with different employees have been the primary approach during the visits at B&O, but observation has subsequently proved to have played a significant role. In the first two visits primarily direct observations were performed, when investigating the way in which employees interact and their general attitude towards the company. Observations of this type have been made through conversations in the canteen, rendered possible given the extent of the visits. When performing interviews with employees showing a particular interest in environmental considerations in the product development, also a more participating type of observations has been applied. This has for instance been the case in interviews and conversations with Lone Nielsen and Gert Yde Jacobsen, where the project group have commented on the environmental performance at B&O, and furthermore suggested improvement areas which subsequently were discussed.

2.3.3 A Course in Product Development

Product development and production processes are concepts not previously investigated by the project group, which has lead to the participation in a course at the Institute for Production at Aalborg University dealing with these issues. The course has provided the project group with an insight in

how different companies have chosen to structure the product development processes. Additionally, the lecturer Poul Kyvsgaard Hansen has conducted research on the development processes at B&O, and has thus contributed with new perspectives on this.

2.3.4 Studies of Literature

Different literature studies have been performed primarily centred on the following topics:

- Product development
- The EuP Directive
- Tools for product oriented environmental management

The product development processes at B&O has previously been the subject of scientific investigations, which means that literature about the processes exists. This has been used in Part 1 to outline the development process, and as a foundation for investigating how environmental considerations occur in the process. Furthermore, confidential internal documents have been studied to assist in the mapping of the product development process and the incorporation of environmental considerations.

A thorough analysis of the EuP Directive in its current form is conducted in Part 2. The final requirements of the EuP Directive will be settled through a range of implementing measures, based on preparatory studies, which as of now are being prepared. Studies of these have been found expedient in order to strengthen the evidence of the expected requirements.

Different tools, strategies and procedures possible for companies to use in their environmental management have been the objects of considerable literature studies to support Part 3. Given that numerous sources exist on the subject, it is chosen to use wide-ranging sources and through these establish a plausible image of the possibilities companies can make use of in their efforts.

2.4 Data Analysis and Interpretation

As mentioned by Møller (2002, 40), it is not possible to clearly distinguish between data collection and data interpretation. The types of interpretation used in this study resemble the explanatory building approach, which according to Yin (2003) has as a goal, '*to analyse the case study data by building an explanation about the case*'. Using this understanding, the analysis and interpretation is built on an iterative process, where empirical research from one visit feeds into empirical research in the next visit along with the incorporation of theories and other information sources. In that way, a number of research loops are created, where the data gathered from one visit is analysed and interpreted through different research methods, and the created understanding feeds into the next visit, which then again is analysed and interpreted.

There is a close relationship between the data gathering process and the ways of interpreting and analysing the findings throughout the study. Pattern matching has been applied in the analysis, to

benchmark the different statements and along with literature studies determining the actual development processes. Theory is subsequently applied in the interpretation process. Wenger (1998) has been used as a primary theory on organisational learning, supported by perspectives presented in Bakka and Fivelsdal (1999). Wenger (1998) is assessed to be an expedient primary theory given the focus of the study, identifying actions and relationships in a cross-organisational perspective. Wenger (1998) seeks to identify individuals with a shared community evolving around a certain practice of the given individuals, which is further explained in Appendix B.

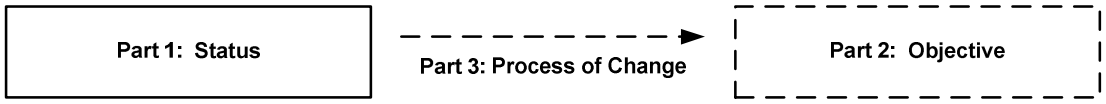
2.5 Data Validation

Though the qualitative research style applied is assessed expedient given the focus of the study, it entails a risk for sources of error. Reservations can be put forward given the uncertainties embedded in the interview method. For B&O-employees this is in particularly related to the fact that they inherently are fond of their workplace and thus tend to state matters as supporting this view. It does, however, appear to the project group that the interviewees have been honest in their replies, answering the questions to the best of their knowledge. Furthermore, the project group have signed a confidentiality agreement, which is assessed to have encouraged sincere replies from the interviewees. Finally, the interviewees have approved all statements used in this report which also is an important part of the data validation.

There is no doubt that the research style has entailed some extent of personal engagement from the project group, which only can be expected using the chosen research approach. A considerable amount of interviews have been conducted at B&O, continuously reinforcing a social and cultural understanding, increasing the risk of biased interpretations. It is however sought to target the areas of analysis from multiple sides, minimizing this risk. Regarding the product development processes, the empirical findings have been supported by articles on the subject provided by sources external to B&O as well as through interview with various employees. As for most data on environmental considerations, only validation by B&O employees has been used. This has however been thoroughly elucidated using data triangulation in the form of posing questions related to the same topic to different employees in different positions and with different responsibilities. As for the persons interviewed about the EuP Directive these have been selected due to their different positions in relation to the Directive. The validation of their statements is thus provided through the data triangulation which the selection of interviewees represents.

Validation of the suggested strategies in Part 3 have been sought through having Lone Nielsen read and comment on the two strategies, in relation to her visit at Aalborg University in the end of May. In order to further adapt the two strategies to the context at B&O, the comments from Lone Nielsen have been incorporated in the proposed strategies.

Part 1: Status



This part of the report constitutes the status part, with the purpose of analysing how B&O at present considers environmental aspects. This is done through an analysis of the environmental management, and how environmental considerations are integrated in the product development at B&O. Three research questions are related to this part:

- What are the general characteristics of B&O as a company, and how are environmental aspects at an overall level integrated in the company?
- Which are the main elements of the product development process, and how are environmental considerations integrated in this?
- Which communities of practice can be identified in the product development process at B&O in relation to environmental improvements of products?

Analytical Framework – Part 1

This dividing leaf serves the purpose of presenting the framework applied in the analysis of the environmental management at B&O, and the analysis of the integration of environmental considerations in the product development. These analyses are presented in Chapter 3 and Chapter 4, which constitute Part 1 of the report.

Chapter 3 presents B&O as an organisation, including a presentation of the current environmental management at B&O. As regards the methodological considerations, Bakka and Fivelsdal (1999), with their perspectives of organisations consisting of structures, cultures and procedures, have been used as support in the organisational analysis.

Chapter 4 focuses on the integration of environmental considerations in the product development. This is studied with a point of departure in the perspective of Etienne Wenger, who presents the theory of *Communities of Practice*. According to Wenger (1998), '*communities are formed when people engage in a process of collective learning in a shared domain of human endeavour*'. According to Wenger (1998, 8) learning is very central point, and for companies learning is an issue of sustaining the interconnected communities of practice through which an organisation knows what it knows and thus becomes effective and valuable. The theory is further presented in Appendix B, and some of the main points are:

- The understandings of communities of practice as learning
- Creation of meaning through participation and reification
- Shared practices
- The explicit and the tacit content of communities
- The domain of a community
- Boundaries between communities of practice
- The ability to link communities through brokers and boundary objects

These points and understandings are used as a guiding principle in the analysis of the product development process and environmental practices at B&O, and have been guiding when formulating interview questions for B&O-employees involved in different stages of the product development process. In this regard, the analytical framework has helped to make sure that all relevant aspects of the theory have been covered in the questions asked, and furthermore in interpreting the findings.

The analytical framework is made specific through a number of questions, presented in the following list. These questions are used to identify and describe important communities of practice as regards the integration of environmental considerations in the product development process:

- For each of the communities of practice that exists in the product development, what is the domain, who constitutes the community and what is the shared practice?
- What does the different communities of practice see as meaningful, and how does this find expression in participation and reification?
- How are links established between communities of practice – who are the brokers and which are the boundary objects?
- What is explicit and tacit in the different communities of practice?
- How does the company sustain its communities of practice, in order to become valuable and effective?
- Which historical and social context influences the communities of practice?

These questions are investigated following a description and analysis of the product developments processes for BeoVision 7 and BeoMedia 1, structured according to the phases in typical B&O product development processes. This constitutes the ground on which the communities of practice are identified.

Bang & Olufsen a/s

3

This chapter answers the research question: What are the general characteristics of B&O as a company and how are environmental aspects at an overall level integrated in the company? First, different company characteristics are presented, and secondly the environmental management at B&O is presented, including policies, actors and activities.

3.1 Formation, Crisis and Restructuring

In 1925, the two engineers Peter Bang and Svend Olufsen founded B&O. Their common interest was the radio, but their first product was an *eliminator*, which makes it possible to connect radios directly to the mains supply. The product was launched as the electricity started to become common in Danish households, and the two engineers earned enough money to move into their own factory in Struer (B&O 2006a, 6). The focus on the design and quality of the products emerged in the end of the 1960's, as many radio and TV factories in Europe had closed due to competition from Asian manufacturers (B&O 2006a, 7).

In the late 1980's and early 1990's, the company faced a serious crisis, and closure or acquisition by another company seemed unavoidable, but a new management was appointed and a restructuring of the company began (Hansen et al. 2002, 37). Part of this restructuring was to make the company more focused and customer oriented, by identifying the company's core knowledge resources and making the organisation more focused on sales (B&O 1993). The core knowledge resources relate to acoustics, picture, the operations of products and mechanical competency, such as anodisation (B&O 2006a, 33-4). Activities not related to the core knowledge resources were sold off. This meant that the actual production processes were limited, and the use of assembly and product development by partners increased. The product development process within B&O was also tightened.

3.1.1 B&O of Today

The vision of B&O is to, '*constantly question the ordinary in search of surprising, long-lasting experiences*' (B&O 2006a, 33). This is further elaborated in the core values; design, craftsmanship, performance and humanisation. This means that the products are to have a unique design, a quality beyond the expected, and be able to continuously surprise and delight the users. Furthermore, it should be possible to integrate the products in the individual setting of the customers' home (B&O

2007a). It is these characteristics B&O uses to promote their products and to achieve an understanding of these as being high-class.

Today, the key words for B&O are customer demands, execution and growth. B&O as a corporation consists of both non-brand dependent and brand dependent business, where the latter contain the more traditional B&O products, and thus is of primary concern in this report. The structure of the brand dependent business is illustrated in the following figure:

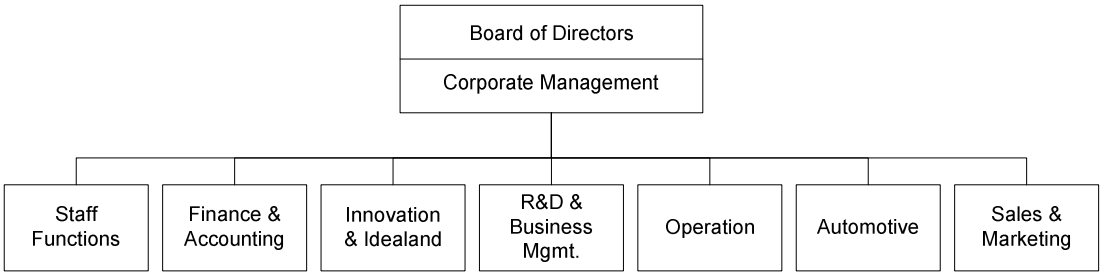


Figure 3.1 Company structure according to management level (B&O 2007a).

The production and assembly takes place within the Operation Department. B&O has two production sites; one in Struer, Denmark, where the most advanced processes takes place, and one in Kopřivnice, The Czech Republic, where the more simple and if possible more labour intense assembly processes are carried out (Bendix 2007).

3.2 Values Materialised: The Products

In the accounting year 2006/2007 six new products were launched, and it is expected that approximately 20 new products or updates will be put into production in the following year, as approximately 25% of the yearly turnover should originate from new products (Bendix 2007). This emphasises the pace in which new products are developed and launched, and how significant the product development processes are for B&O. A further sign of B&O's focus on product quality is that the Development Department is ISO 9001 certified (B&O 2006a, 34). B&O's product line-up of approximately 40 products can be divided into the following categories:

- Video products, called BeoVision
- Audio products, called BeoSound or BeoCenter
- Loudspeakers, called BeoLab
- Telephones, called BeoCom
- Integration systems, called BeoLink
- Digital media products, called BeoPort or BeoMedia

There appears to be a tendency towards broadening the product line-up. Products like video and audio products are traditional B&O product types, whereas the digital media products have been presented on the marked within the last few years.

3.3 The Employees as a Resource

The number and type of employees at B&O has developed in line with the restructuring of the company. Currently 716 hourly paid workers and 1176 salaried workers are employed at the head quarter in Struer (Nielsen 2007a).

Self-development and career change opportunities exist for employees regardless of position, and are part of a B&O company culture (Bendix 2007; Bruun 2007). If you as an employee show interest in and capabilities for a different area, prospects for a career change are good.

According to Kirkegård, Olsson and Nielsen (1996) the focus on design and development has not resulted in a working environment based on fancy designer furniture. As an illustration of the large involvement and pride many employees puts into their work, Kirkegård, Olsson and Nielsen (1996, 127) mention that, '*in the Product Development Department you do more than you are obliged to and demand less than you are entitled to*.'

A culture among the employees becomes evident through the way every-day activities are carried out. In general, employees try to minimize the amount of needed procedures, they favour solutions adopted along the way and random meetings in the hallway can be the way in which changes occur (Nielsen 2007a). Furthermore, Bendix (2007) states that employees in between, regardless of position, can approach one another to ask questions and propose new solutions. This stresses the need for persisting and engaged employees, and that the approach appears to function reflects positively on the employees.

Despite the, in many ways, laid back atmosphere at B&O it is evident that not all topics are up for discussion. One example relates to final decisions about the exterior design of the products, where the external chief designer David Lewis, always gets the last word. Whenever in doubt, he gets the final call (Bruun 2007; Hansen et al. 2002, 40).

3.4 External Relations: the Market

B&O managed to overcome the crisis in the 1990's and continue to ensure positive economic results as summarised in Table 3.1.

	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006
Net turnover (mill DKK)	4,212	3,974	3,613	3,742	4,225
Result before tax (mill DKK)	228	290	341	380	431

Table 3.1 Net turnover and result before tax seen in a five-year period (B&O 2006a, 13).

From Table 3.1 it appears evident that B&O is in a process where the net turnover, and thus the product sale are roughly stabile. The result before tax has however been developing steadily in a positive direction, and leaves the best result for years. To sustain the positive results, pleasing the customers are important; these are presented in the following section.

3.4.1 B&O's Customer Types

At an overall scale, B&O has two types of customers; business and consumer. The latter can be divided into three sub-types; the gift collection group, the core group and the BeoLiving group (Kyed 2007). The primary business is related to the core group, which often are consumers buying a television and a few accessories. According to Kyed (2007), money means nothing to the Beo-Living consumer, who rather frequently purchases new products.

One example of a business customer is hotel chains who arrange their rooms with B&O products. At present, B&O is represented in more than 100 five-star rated hotels world wide, and the number is increasing (B&O 2006a, 10). Another very significant business customer is Audi, to which high-end sound systems are sold. Also on this area the sale is expected to increase the following years (B&O 2006a, 28).

A central point is that B&O does not ask their customers what they want, but rather they want to create great and surprising experiences (Hansen et al. 2002, 41).

3.4.2 Suppliers and Partners

The suppliers used by B&O can be divided into four types depending on the types of interrelations between B&O and the supplier. The supplier characteristics are presented in Table 3.2.

Supplier	B&O's investment	Suppliers' investment	Suppliers on the market
Key	High	Low	Few
System	High	High	Few
Capacity	Low	High	Many
Standard	Low	Low	Many

Table 3.2 Types of suppliers characterised by the level of investment in the relations from both players, along with the amount of potential suppliers in the category (Møller 2003, 6-10).

The level of investment and the number of players on the marked are of particular importance, as it indicates how dependent B&O is on its suppliers. They can be dependent following a high level of investment in product development activities; including time and money spent (Møller 2003, 6). When suppliers' investments are high they produce B&O specified items, and their dependency of B&O increases. As seen from Table 3.2 it is evident that B&O experiences the largest dependencies related to the system suppliers and in particular the key suppliers. To increase the understanding of supplier dependency, the money flows between B&O and their suppliers are illustrated in Table 3.3.

Supplier Segment	Within the EU	Outside the EU
Key, System	Medium share	Medium share
Capacity, Standard	High share	Low share

Table 3.3 Shares of total purchase within and outside the EU (Langergaard 2007).

The primary investments are made within the EU, and more specifically the capacity and standard suppliers constitute a very significant share of the total purchase. However, it is essential to recognise that even one key or system supplier can be more critical for B&O than a large share of for instance capacity suppliers.

In 2006 B&O established a system for responsible supplier management, which helps categorise the different suppliers and identify potential risk relations with these (Langergaard 2007). The supplier management system's focus on environmental considerations and the content of the documentation involved are further explained in Section 3.5.2.

Following this broad introduction to B&O, the remaining part of the chapter concerns different characteristics of the environmental management at B&O.

3.5 B&O and the Environment

Environmental considerations are embedded at various levels and in various departments at B&O. Initially, the environmental policy is in focus, as this is essential for understanding how environmental aspects are prioritised by management and how environmental considerations are integrated within the organisation. Secondly, groups and departments concerned with specific environmental aspects are presented. Finally, the main activities and external networks related to the environmental management are presented.

3.5.1 Environmental Policy and General Attitude

The overall structure and focus of the environmental management at B&O is coined by the environmental policy which states:

> '*Bang & Olufsen works continuously on minimizing the effects on the environment. Equal weight is given to finding a balance between the needs of the environment and the consideration given to our products´ practical qualities, economic value, aesthetic value and a long life span. In this way, Bang & Olufsen endeavours to be among the best in the business [...]. We wish to be a part of sustainable global development and view our activities within a life cycle perspective. As a minimum, Bang & Olufsen will comply with national and international environmental requirements*' (B&O 2007a).

The policy statement emphasises product related environmental impacts as being a primary concern, but still stresses the need for viewing the potential impacts in relation to other engagements

important in the company. As for the desire to be among the best in electronic business, Nielsen (2007a) states that this should be understood as the best third of the business. To what extent the content of the environmental policy guides the everyday work at B&O is uncertain, but when reviewing the environmental policy from 1996, it is clear that the only alteration since then is the addition of the last sentence in the policy.

As also indicated in the policy, environmental issues are just one parameter being influential for the general profile of the products. Environment is typically seen as an aspect within quality; it is expected to be in order at all levels, but the products are not to be marketed on their environmental performance, wherefore eco-labels are not considered desirable tools (Nedermark 2007). Thus, environmental performance does not bear the same significance, as the four core product values mentioned in Section 3.1.1. However, B&O has followed the development related to the approaches for addressing environmental impacts closely, and has also been a frontrunner in some areas, which is further described in Section 3.5.3.

3.5.2 Groups and Departments Concerned with Environment

The following list gives an overview of the groups and departments identified as concerned with environmental considerations. These vary in size, and are further presented in the following:

- The supreme strategic group: M1
- The Department of Safety, Health and Environment, SHE
- The Purchasing Department
- The Product Development Department
- The Test and Approval Department, T&A
- The Production Department
- The Service Department

The Supreme Strategic Group: M1

M1 is the supreme strategic group with regards to environmental issues. It consists of the chief executive officer, the executive vice-president, the chief of Operations, the chief of Product Development and the chief of Cross-Functional Quality and Environment (Juhl 2007). The group meets once a year to discuss issues briefed by those employed within the area. Typically activities in the past year are discussed along with areas of focus for the year to come (Nielsen 2007a). Among other things M1, through the environmental policy, sets the overall guidelines for how environmental considerations are incorporated in the organisation.

The Department of Safety, Health and Environment

The SHE Department includes the environmental consultants, and constitutes in many ways the focal point of the environmental management, though having interactions with various departments and persons throughout the organisation. The SHE Department is part of the Department for Cross-functional Quality and Environment, as illustrated in Figure 3.2.

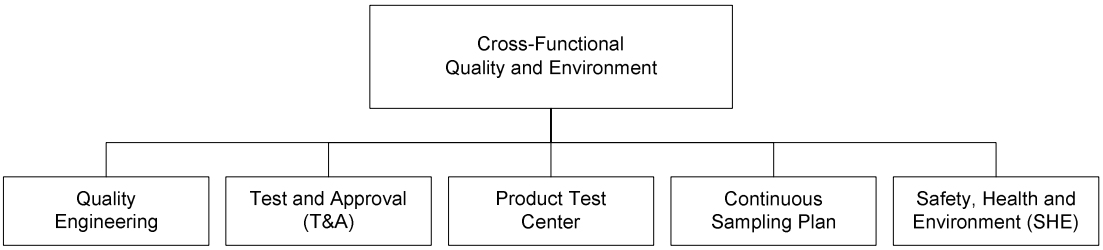


Figure 3.2 The organisational location of the SHE Department within the sub-department of Cross-functional Quality and Environment (Nielsen 2007a).

The work conducted within SHE is concerned with the working environment, external environment and product environment, which have been based on the concept of life cycle thinking for years (Nielsen 2007a). Seven full time positions are occupied within the different focus areas, as illustrated in Table 3.4.

Name	Working Areas
Rikke Højer	Head of SHE
Lone Nielsen	Product environment
Mette Juhl	Environmental legislation
Lars Farving	External environment and working environment
Helle Torsbjerg Niewald	Mental working environment
Hanne Sørensen	Physical working environment
Jens Simonsen	Safety

Table 3.4 Employees in the SHE Department and their primary focus area (Nielsen 2007a).

Due to the nature of her tasks, Lone Nielsen is located in the T&A Department, which is illustrated in Figure 3.2; whereas the remaining staff is located a ten minutes walk away. Lone Nielsen is of particular importance in relation to the EuP Directive, as she is responsible for the compliance process, though supported by environmental consultant Mette Juhl.

As seen from Table 3.4, three persons are working with environmental issues. The collaboration between these more or less takes place in two groups. The environmental consultants Mette Juhl and Lars Farving collaborate at present on the compliance with the REACH regulation, which also involves the Purchasing Department. Lone Nielsen and Mette Juhl constitute the second group, and their collaboration is often directly related to product environment. Given that Lone Nielsen's daily work takes place in the T&A Department, it influences the collaboration between her and Mette Juhl. Officially they meet four times a year and have a weekly staff meeting with all the employees in the SHE Department. Juhl (2007) adds that they are in almost daily contact by email or phone, but that, '*much is lost when we do not sit together*.' Despite the division of work into two groups, it is evident that they support each other in many activities, using their differences in expertise. As an example, Lone Nielsen occasionally invites Lars Farving to meetings in the product development

teams, for instance when questions about glue types are on the agenda (Nielsen 2007a). The specific activities taking place within the SHE Department are further presented in Section 3.5.3.

The Purchasing Department
The Purchasing Department is the link to the suppliers, if need for information or questions about supplier's environmental performance occur (Nielsen 2007a). Following the wish to avoid negative media exposure, environmental considerations are important issues in the purchase situation.

The supplier management system introduced in 2006 was initiated and completed by the Purchasing Department (Langergaard 2007). It is based on the ideas of the CSR-compass, which is an initiative developed by the Danish Ministry of Economic and Business Affairs, the Confederation of Danish Industries and the Danish Institute for Human Rights (CSR-compass n.d.). The system includes a code of conduct and a supplier self-evaluation scheme. The code of conduct informs the suppliers about B&O's expectations related to human rights, labour and the environment, with the primary focus on the first two aspects (B&O 2006b, 9). Besides signing the code of conduct the suppliers have to fill out a self-evaluation scheme. This contains a range of questions about their environmental management system, environmental policy, banned substances and willingness to provide product information (B&O 2006c, 5). An auditing company is used to verify the information provided. Langergaard (2007) mentions that no supplier collaboration has ever been cut off due to disagreements about environmental performance. He further states that if disagreements should occur, then it would not be a significant problem to end the collaboration.

The Product Development Department
The Product Development Department primarily includes environmental considerations in the shape of environmental requirements, either set up due to internal or external demands. These are obligatory to comply with and incorporated during product development. These are followed throughout the product development process, and thus affect a range of people. Compliance with the mandatory requirements has to be verified as the project is completed. Chapter 4 presents a further elaboration of the department.

The Test and Approval Department
The work of the department is focused around monitoring the different requirements, which the products are to comply with. As mentioned in Section 3.5.2 Lone Nielsen is situated in the T&A Department, and she is responsible for the environmental requirements. Requirements are also found in areas such as electromagnetic compatibility and product safety. The responsibilities of the department are further elaborated in Chapter 4.

The Production Department
The production processes at B&O are limited due to the large share of outsourcing. The two existing plants in Struer deal respectively with specialised production and specialised assembly. The remaining assembly takes place in B&O's plant in the Czech Republic. Due to the types of activities the primary environmental considerations in this regard concern the working environment.

However, since an anodic coating installation is in operation a green account has to be completed every year.

The Service Department
The Service Department is responsible for informing customers about environmental aspects, which is done in the user manual (Bruhn-Jensen 2007). One example is the sign of the obligatory crossed dustbin, as required by the WEEE Directive. In addition, no training material for dealers on environmental issues is available, and if questions occur these are forwarded to Lone Nielsen (Nielsen 2007a).

3.5.3 Activities and Networks
The following section presents the main activities and projects undertaken by SHE, also in collaboration with other departments and external networks, especially related to product environment. The most current activities are presented first.

The leaflet: *Down to the Smallest Detail*
Reporting to the public about environmental activities at B&O was previously limited to the preparing of green accounts. However, no one seemed to pay interest and in 2000 Nielsen (2007a) argued:

> '*How about we try doing something different instead, something that interests our customers and dealers, related to what we actually get questions about?*'

The result was *Down to the Smallest Detail*, which is a yearly-published environmental leaflet. Each year a new product is in focus, and environmental aspects throughout the product lifetime are presented. Many of the aspects however are in common for several products, and the leaflet therefore gives a broad introduction to the considerations related to product environment at B&O. The leaflet is yearly published in 500 Danish and 500 English copies. In 2005, the leaflet took a point of departure in the products made in Automotive, and Nielsen (2007a) mentions that they have used the leaflet actively in their marketing.

Implementing an Environmental Management System
A project recently initiated at B&O is the implementation of an EMS. The process was initiated in spring 2007, and it is to encompass all of B&O in Struer. According to Nielsen (2007a), it has been a desire within the SHE Department for years to have such a system. Additionally, the leader of the production plant in Struer has been an advocate for the implementation, and the customers of Automotive have been a driver as well. Lone Nielsen explains that the process is a bottom-up process, and that the management, besides approving the initiation, not is a part of the process. Nielsen (2007a) elaborates in this regard:

> '*Our management does not see this as something just to get done with; they do not go through with this because we [employees in the SHE Department, ed.] have been talk-*

ing about it for years […]. They want this. There are just other things prioritised equally high, which they would rather focus on, and that is why they choose to do it this way.'

Lone Nielsen and Mette Juhl are responsible for the implementation. It is the intention to let the first few years be a learning period, where they audit the system themselves and then achieve a certification hereafter (Nielsen 2007a).

Compliance with REACH Legislation

Compliance with the REACH legislation is another project currently in progress, managed by Mette Juhl and Lars Farving. Instead of filling out applications if a certain chemical is to be used in the production, it has been chosen to phase out these (Juhl 2007). There are still uncertainties about the final consequences for B&O, but it is certain that B&O will be given some responsibility when components are imported from non-EU countries. This requires information about the materials used by their suppliers, and request letters have recently been sent out (Juhl 2007).

Compliance with RoHS Legislation

The RoHS compliance process has recently been finalised, and it is said to be the single most comprehensive project ever completed at B&O, and almost all departments were involved (Nielsen 2007a). A RoHS and WEEE compliance group, called ELMG[2] was established to supervise the process (Juhl 2007). The primary challenges were related to the process of clearing all products for lead based soldering, and ensuring that all components from suppliers were in compliance. Despite that B&O started this process at an early point it was still very challenging, as it required the most comprehensive information exchange ever. It took a period of two years from the first request letter had been sent out, until all needed information was gathered (Langergaard 2007). During the process B&O experienced some benefits, as brominated flame retardants proactively had been phased out several years before the RoHS Directive (Juhl 2007) This was done, as B&O does not want any negative story to be addressed to the products (Nielsen 2007a).

External Networks and Groups

To support the activities taking place within B&O, different employees are represented in various national and international external networks where challenges and activities are discussed. These networks are part of larger industry associations such as the European Information and Communications Technology Industry Association (EICTA), the Danish trade association for it, telecommunications, electronics and communication enterprises (ITEK) and the Union of Reliability and Environmental Technology (SPM). Furthermore, B&O is also represented in the newly founded Danish Council for Sustainable Business Development, where one of the members of the M1 group is participating (Danish Conucil for Sustainable Business Development 2007).

[2] ELMG is an abbreviation for Environmental Law and Management Group. The group includes M1 members, with the exception of the chief executive director, and in addition to representatives of SHE and a representative from the Legal Department are participating (Juhl 2007).

The EDIP Project
During the 1990's, B&O participated in the EDIP[3] project. The EDIP project was limited in man-hours, and knowledge about the specific project was and is limited within the organisation, according to project manager Rikke Nedermark, who was responsible for the project (Nedermark 2007). The results of the project however, do seem to have been anchored in the organisation. This is particularly seen in the high awareness of the significance of energy consumption in the use phase (Nedermark 2007). One example is the standby energy consumption, which have been reduced from 2.5 Watt to around 1 Watt in the period from 1999 until today (B&O 2004, 11).

As a result of the EDIP Project, B&O have conducted a number of life cycle assessments, which previously were part of *Down to the Smallest Detail*. However, in recent years it has been chosen not to make life cycle assessments as the outcome of these did not match the effort (Nielsen 2007a).

The transECO$_2$ Project
The project took place from 1997-1999, and focused on environmentally friendly transportation of goods. The aim of the project was to establish activities in collaboration with purchasers and supplier of transport (IFT, ITD and ETU n.d). The project is mentioned in an environmental review from 2004, but today the knowledge about the project appears to be limited. However, transport is a focus area, and B&O demand efficiency of their carriers in their use of resources and application of technology in transport units (B&O 2007a).

3.6 Discussion of B&O's Present Environmental Management

It is evident that B&O as a company is very focussed on the development and sale of new high-class products, and design is in focus. This takes place either within the company in Struer, in the Czech Republic, or through established partnerships around the world. The processes conducted at B&O, and the culture it takes place within, is penetrated by this overall aim of producing quality luxury products. It originates in the company history, and is carried on through restructuring and through the everyday activities carried out in an open environment. It is furthermore evident that the operation is successful, new marked segments are challenged, and the financial situation is in great prosper.

It is evident that B&O focuses both on traditional environmental management related to smoke, noise and dirt as well as on product oriented environmental management. This work involves departments all over the organisation.

The strategic decision making with regards to environmental issues is placed high in the organisation, but environmental issues appear only to be discussed rather seldom. Furthermore, it is clear that the company is not interested in eco-labels or other additional labels on the products. B&O has participated in several projects on environmental issues, which caused various activities to be initi-

[3] EDIP is an abbreviation for Environmental Development of Industrial Products.

ated, for instance the making of life cycle assessments, but as the activities has ended it is questionable whether the knowledge is updated. The Purchasing Department plays a significant role in relation to suppliers' environmental performance, though there does not appear to be much collaboration with the SHE Department, which is considered to be the focal point as regards environmental considerations.

As for the environmental management at B&O, there is no doubt that compliance with legislation, especially EU legislation, has had high priority the last years, and many activities are concerned with this. Furthermore, B&O has also initiated the implementation of an environmental management system. Is it also clear that B&O has been engaged in more proactive activities, which are summarised in the following list:

- The preparation of the leaflet *Down to the Smallest Detail*, which presents environmental information in a product oriented and story-like way
- An early focus on RoHS, which turned out helpful in the compliance process
- Participation in the EDIP project, which was an eye-opener for energy use in the use phase, and the knowledge gained have been integrated in product development

Using the concepts regarding different approaches for addressing environmental challenges, as illustrated in Figure 1.1, it appears that B&O in its environmental performance acts on different levels. B&O continues to have focus on the cleaner production approach, while climbing the stairs towards both the management system approach and the product oriented approach. However, it appears that neither of the steps has been fully reached: B&O has only just initiated the process of implementing an EMS to ensure continuous improvements, and despite a product focus a holistic product oriented effort throughout the company is not initiated.

The following chapter gives a more thorough analysis of how environmental aspects are incorporated in the product development processes.

Environmental Considerations in Product Development

4

This chapter answers the research questions: which are the main elements of the product development processes, and how are environmental considerations integrated in this? And additionally: which communities of practice can be identified in the product development process at B&O in relation to environmental improvements of products? First, the product development characteristics are presented followed by an analysis of how environmental considerations are integrated in this. Following this, the process including the involved actors is interpreted using the concept of communities of practice.

The product development process at B&O is structured in accordance with the TOP-model[4], which is a model developed at B&O. The TOP-model is presented in Appendix C, which serves as the foundation for the analysis, and explains the technical terms used in the TOP-model. The two products BeoVision 7 and BeoMedia 1, are used as a point of departure in the following analysis. The products serve a structuring function, and concrete examples from the specific development processes are used throughout the chapter. The following points constitute the structure of this chapter:

- Presentation of the TOP-model
- Characteristics for BeoVision 7 and BeoMedia 1 and their development processes
- Integration of environmental considerations in the product development process
- Identification of communities of practice in the integration of environmental considerations in the product development process

4.1 Structuring the Product Development

The aim of using the TOP-model in product development is to minimize the time used in the product development by making well-considered decisions, and reducing the number of returns to previous phases (Kirkegaard, Olsson and Nielsen 1996, 216). The TOP-model is illustrated in Figure 4.1.

[4] TOP is an abbreviation for the Danish terms *Tempo Og Produktivitet* (pace and productivity).

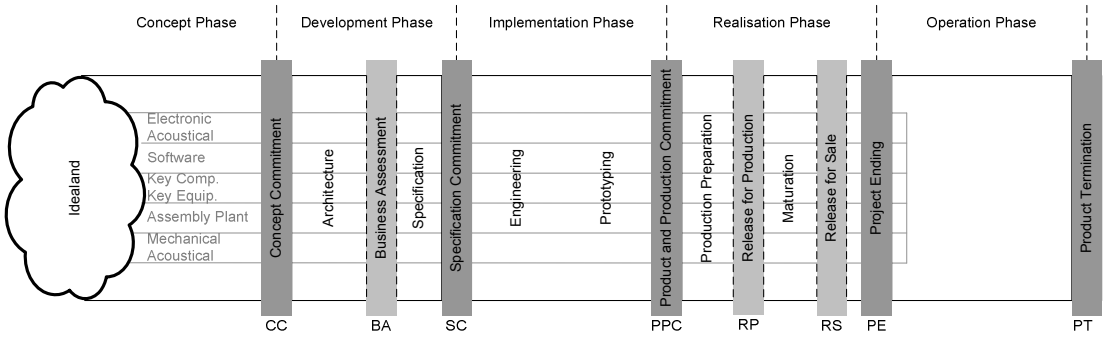


Figure 4.1 The TOP-model. The dark grey bars illustrate decision points, whereas the bright grey bars illustrate milestones. After Kirkegaard, Olsson and Nielsen (1996, 217) and B&O (2007b).

As Figure 4.1 illustrates, the TOP-model consists of five phases, each ending with a decision point. Further, each of the phases includes different milestones and is supported by tools and checklists, which are found on the Intranet of B&O (B&O 2007b). All the different product aspects, for instance software and hardware, are developed in parallel during the process. The length of the phases in the figure does not reflect the length of the actual phases. According to project manager Gert Yde Jacobsen, the implementation phase and the realisation phase until release for production is ideally the longest parts (Jacobsen 2007). The following ordered list presents the five phases:

- Concept phase: The product concept is developed
- Development phase: The product concept is transformed into product specifications
- Implementation phase: The product specifications are transformed to product and process documentation, prototyping begins and these are tested and evaluated
- Realisation phase: The necessary tools, processes and production equipment are provided, the products are released for production and in the end released for sale
- Operation phase: The products are produced and sold

4.1.1 The Project Development Group

In the concept phase the designer bears the responsibility for the product. Following the concept phase, the concept is handed over to the project management encased in the project group, as illustrated in Figure 4.2., shown on the opposite site.

As seen from the figure, the project group consist of different types of actors. Placed in the centre of the figure is the project manager, whom along with a product manager bears the overall responsibility for the final product (Kyed 2007). The three coordinators are each accountable for a specific technological element. The internal actors comprise a varying number of constructors. According to Jacobsen (2007) the constructors are the ones doing the actual work, as they are turning product specifications into physical products. The external partners can include both constructors and coordinators depending on the degree to which the product is developed by external partners.

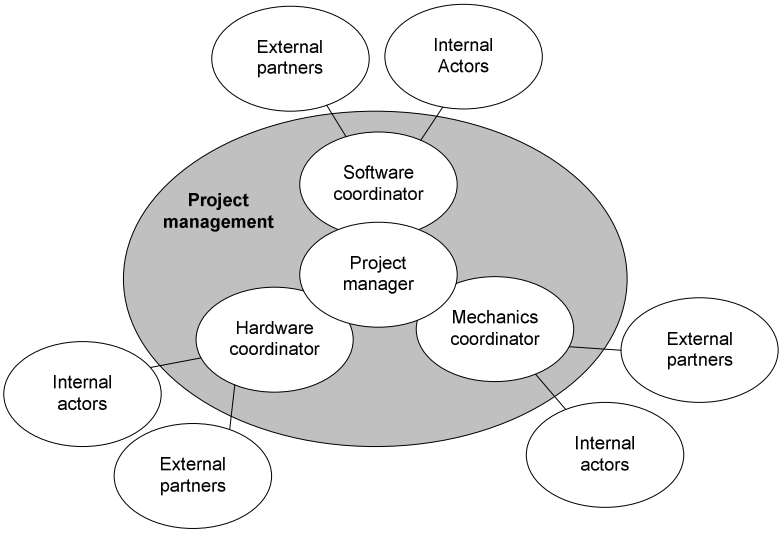


Figure 4.2 The project group, including the project management as illustrated by the grey circle and an outline of the internal actors and external partners involved.

4.2 Product Development Histories and Innovation

To support the mapping of the product development process and avoid bias, it is chosen to gather information related to the development of two different products, and use the findings as a picture of how the product development process typically takes place. Based on discussions with the employees Lone Nielsen and technical product manager Rune Bruhn-Jensen, representing both environmental and technical product knowledge, BeoVision 7 and BeoMedia 1 are chosen, as two products representing the variety of products and development processes. The discussions revealed different characteristics influential for the product selection, presented in Table 4.1.

Parameter	BeoVision 7	BeoMedia 1
Product type	Traditional B&O product	New B&O product
Developed by	B&O	B&O and partner
Produced by	Primarily B&O	Partner

Table 4.1 Illustration of the differences in development characteristics for the two products selected as guidance for the analysis.

The characteristics presented in Table 4.1 indicate that there are significant differences in the development processes for the two products. Theoretically, the development of new products begins in Idealand in the concept phase. However, this is not always so, as is the case with BeoMedia 1. At B&O it is common practice to update existing products, as the components available often are renewed; one example is that new flat screen monitors are introduced every seven months (Jacobsen 2007). Such update projects do normally not start in the concept phase, as they take a point of departure in the existing product. Theory operates with a frame for identification of different innovations types called ‘4P’, which are (Hansen and Bessant 2006, 4):

- Product innovation, concerning changes in the products
- Process innovation, concerning changes in the production processes
- Position innovation, concerning changes in the context in which the product is sold
- Paradigm innovation, concerning changes in the underlying mental structure that is the foundation of the company's actions

Different levels of innovation can occur seen on a continued line where an incremental change, meaning a smaller adjustment, is one end and a radical change, meaning totally new thinking, is the other. In the following, the characteristics of the development processes for BeoVision 7 and BeoMedia 1 are presented, focusing on the relation to the TOP-model.

4.2.1 Special Characteristics of the History of BeoVision 7

BeoVision 7, illustrated in Figure 4.3, is a traditional B&O product, which to a large extent is designed and developed at B&O (Jacobsen 2007). This implies that many internal actors have been involved, but also external partners have been significant. As an example, the project management is in continuous contact with an Italian partner, as Jacobsen (2007) states:

> '*I have a coordinator who is in daily contact [with the external partner, ed.] either by phone, mail or drawing files. It is as if two constructors were working just next door.*'

It appears that even though the product to a high degree is developed at B&O there is still massive contact to external partners.

Initially, the development process of BeoVision 7 started in the concept phase in Idealand, but since then the first version has been updated regularly through incremental changes. The process has been structured according to the TOP-model, however Jacobsen (2007), in his function as project manager, states that he often uses the TOP-model as a checklist to make sure that all necessary steps are taken, rather than he follows the model stringently.

Figure 4.3 BeoVision 7 and speakers (Expert 2004; M.A.C. 2006).

4.2.2 Special Characteristics of the History of BeoMedia 1

BeoMedia 1, illustrated in Figure 4.4, is not a traditional B&O product. First and foremost it is regarded as a black box focusing primarily on software, and according to Finn Andersen, who is the project manager for BeoMedia 1, some would claim that the design is missing (Andersen 2007). BeoMedia 1 was developed together with an external partner, which means that the majority of the involved actors were external.

According to Andersen (2007), the product was designed and developed in collaboration between different project groups and has not been through a conventional concept phase. Andersen (2007) describes the development process of BeoMedia 1 as follows:

> '*As we are taken out of the ordinary development routine, we can do things much faster and we are working with a very flexible partner who was faster than B&O [would have been, ed.] to execute the decisions.*'

This meant that compared to traditional B&O products, the time spend only made up approximately 1/3 and the cost only 1/4 of traditional development projects (Andersen 2007). It was characteristic for the process that the TOP-model and its different reports were used for communicating within the organisation, but the milestones and checklists were seldom used.

In terms of innovation, BeoMedia 1 is defined as a radical product innovation within the context of B&O, as this type of product changes the way in which B&O consider audio products. On the world market however, BeoMedia 1 would not be defined as a radical innovation as similar products have been on the market for a while. BeoMedia 1 could also be defined as a radical change in the product development paradigm, as the development process did not include Idealand where all B&O products traditionally are designed.

Figure 4.4 BeoMedia 1 and the user interface of BeoMedia 1 (Ynter n.d.).

After having presented the characteristics of the product development process, the following section contains an analysis of how environmental considerations have been integrated in the process.

4.3 Integration of Environmental Considerations

Point of departure for the analysis is the TOP-model, and the different employees interviewed in particular about BeoVision 7 and BeoMedia 1 and more in general about environmental aspects in the product development process. The non-stringent use of the TOP-model in the product development processes also influences the incorporation of environmental aspects, and it is not possible to point stringently to where and how these are considered. A division is made between the following types of environmental considerations:

- The environmental considerations obligatory to include in the different phases
- The environmental considerations non-obligatory to include

4.3.1 The Concept phase

The concept phase mainly takes place in Idealand where a concept is developed, the overall product characteristics are determined, and all surface material is selected. This phase is thus significantly influential in determining the environmental profile of the product.

Obligatory Incorporation

No obligatory requirements of any kind are to be considered by the designers in Idealand. This is stressed by design coordinator Per Bruun (2007) who states that:

> '*We do not pose any demands on our designers, we do not control them, and I personally think that it is some of this we make a living by. We as technicians, even if we are very good, then we still see it from a technical point of view […] and if you want to design the world's best audio and video equipment, then that it is just not always good enough*.'

The quote stresses that it is not just environmental limitations and considerations that are not welcome in Idealand, but all limiting factors. Furthermore, Bruun (2007) states that he does not know the concept *ecodesign* and that he is rather certain that no other employee in Idealand does. As stated in Appendix C, the phase is ended with the concept commitment report, which can include environmental issues. It is the intention that concepts with environmental aspects unfamiliar to B&O are considered, and their potential influence assessed. An example is when limitations on surface material become a mandatory requirement (Nielsen 2007a). Jacobsen (2007) states that none of the projects he has been involved in since 2000, when he was appointed as project manager, have been altered due to such considerations in the concept phase.

Non-Obligatory Incorporation

Various project members and other staff members are systematically and randomly participating in the discussions in Idealand. These include:

- Product managers, who could comment on business perspectives
- Project managers, who could comment on product development perspectives

- Constructors, who could comment on potential specific technical difficulties in the product development process
- Operation managers, who could comment on issues related to manufacturing
- External partners, who could comment on how they can contribute
- Environmental consultants, who could comment on specific environmental issues

It is often through the interactions with these people that environmental considerations, despite the 'no-restrictions policy', occasionally enters Idealand. Nielsen (2007a) mentions that she occasionally is called to Idealand to comment on different solutions from an environmental point of view. The assessments are often based on product drawings, models or notes (Nielsen 2007a). Jacobsen (2007) states that if a product in the concept phase involves features which will interfere with the mandatory requirements at a later time the designers are made aware of this. Nielsen (2007a) elaborates that this often occurs in relation to the physical stability of the product. Jacobsen (2007) explains that not many environmental considerations are necessary at this point, due to the tradition for working with the same materials, of which the impacts are known. A fictitious example of taking environmental considerations beyond the mandatory requirements is given by Jacobsen (2007), who states:

> '*If a new peculiar construction is on its way, with increased use of for example metal casting, then I believe I would think twice; how will the life cycle for the product be? Can it be discarded? Is there anything in the production process that will be in conflict with legislation or with our attitudes towards the production environment?*'

Despite the foresight expressed in this quote, such considerations appear to be seldom. According to Andersen (2007) one reason is that the employees are not measured on their incorporation of environmental considerations. He further states that such measurements would encourage a greater focus on environmental issues in the product development.

4.3.2 The Development Phase

In this phase the overall development process is determined, including considerations about what the important focus areas should be in the development process. This is thus important in relation to the emphasis put on environmental considerations throughout the process.

Obligatory Incorporation

In the architecture part of this phase product performance in a life cycle perspective is discussed. These discussions result, among other things, in an estimate of the product's expected lifetime, which also is important in an environmental perspective. A BeoVision 7 is for example designed for a minimum life time of 10 years, but based on previous experiences with televisions, it will most likely last significantly longer (Nielsen 2007a). In the specification part all project members, including external partners, are to be selected. External partners can influence the environmental

profile of a product significantly, especially in a product development processes similar to the one of BeoMedia 1.The selection of suppliers is also important due to the environmental impacts of their components. As mentioned in Section 3.4.2, a code of conduct and a supplier evaluation scheme is used in this regard.

Another crucial event in this stage is the preparation of the product requirement portfolio, in which the different types of product characteristics are set up, as presented in Appendix C. Environmental considerations are described in the mandatory requirements. Both Nielsen (2007a), Jacobsen (2007), Olesen (2007) and Nedermark (2007) state that it is unlikely that environmental consideration will become more than mandatory requirements. When asked about possible changes, Nedermark (2007) elaborates:

> '*It is possible to imagine a lot of things, but do I think that it is likely within the next 20 years? No, I do not think so. The market can change, everything can change. It will also be a question of the expectations from the customers, and if these suddenly should change and expect something else, then we will align.*'

Environmental considerations lie thus within the mandatory requirements, which can be based on either external requirements such as legislation or internal B&O norms. The mandatory requirements group approve new mandatory requirements as they become relevant. All mandatory requirements are gathered in a pool, from which Lone Nielsen chooses the environmental requirements relevant for the given product. For both BeoVision 7 and BeoMedia 1 the environmental mandatory requirements include the following topics:

- Must comply with the WEEE Directive
- Must comply with the RoHS Directive
- Required percentage of materials possible to recycle
- Forbidden substances and materials
- Before release for sale a disassembly test has to be performed
- Surface treatment requirements

The first three points are based on external requirements, the fourth contains both internal and external requirements and the last two are only based on internal requirements. It is the different mandatory requirements that form the basis for integration of product oriented environmental considerations at B&O, and also external partners are given the product requirement portfolio (Nielsen 2007a). Two things separate the requirements for BeoVision 7 with those for BeoMedia 1; For BeoVision 7 there are internal requirements on standby consumption, which does not appear to be the case for BeoMedia 1, and for BeoVision 7 a reference is made to a guideline for environmental design. When asked about the guideline, Nielsen (2007a) states that an old guide for environmental design has been hiding on the intranet for a while and that only the more experienced staff members will know how to find it. Juhl (2007) further states that she does not think anyone is using it at

the moment. A new internal mandatory environmental requirement has been applied since the specification commitment report for BeoVision 7 and BeoMedia 1. This concerns the on-mode energy consumption, where no limit value exists, but it is required that the on-mode consumption is measured and shown on a label on the back of the products (B&O 2006d).

In this phase Lone Nielsen also hands the project group a checklist of environmental information to be filled out and returned two weeks before the release for production point. The checklist contains the overall issues and their justification as presented in Table 4.2.

Topic	Information needed	Purpose
Packaging	Dimensions and weight information about the packaging used	To be used by the subsidiaries when they register the import of packaging surrounding the finished products as required by the EU Packaging Directive
WEEE	Weight of product	Requirements in accordance with the WEEE Directive
Batteries	Type of batteries used	Needed when exporting to Belgium due to customs rules

Table 4.2 Primary content of the environmental checklist (B&O 2006e).

Non-Obligatory Incorporation
As was the case in the concept phase Lone Nielsen can be asked to comment on various topics related to the product environment, where she can explain which solutions she finds expedient, and which she does not approve of.

4.3.3 The Implementation phase
In the implementation phase constructors selects all product internals, and determine thus a significant part of the environmental profile of the product.

Obligatory Incorporation
In the implementation phase the mandatory requirements become decisive, as these must be complied with through technical solutions. In cases where the requirements are not meet before the product and production commitment, the project manager can apply the mandatory requirements group for an exemption (Andersen 2007). Jacobsen (2007) mentions that some of the environmental issues the constructors focus on in their work are:

- Reduction of standby energy consumption, due to environmental mandatory requirements
- Reduction of on-mode energy consumption, due to the capacity of the power supply
- Noise, due to mandatory requirements
- Reduction of hazardous substances, due to environmental mandatory requirements
- Reduction of material, due to cost and volume considerations
- Long life time of products, due to expectations of the costumers

As seen from the list, some of the issues do not originate from the mandatory environmental requirements. However, they are still obligatory to incorporate due to other reasons.

Non-Obligatory Incorporation

The level of interaction between Lone Nielsen and project members in this stage varies, but typically she is in contact with mechanics constructors, the mechanics coordinator and the project manager (Nielsen 2007a). Jacobsen (2007) comments that it primarily is the coordinators who deal with the mandatory requirements, and who thus have the most contact with Lone Nielsen. Nielsen (2007a) elaborates that it is the needs and experiences of the individual coordinator that determine the number of questions they ask (Nielsen 2007a). In the case of BeoVision 7, Nielsen (2007a) recalls that it happened a few times in the implementation phase, where questions related to how the requirements should be interpreted, and what types of materials to use were raised. She further explains that she can take the initiative when a new constructor is involved or if it is her experience that a particular requirement is forgotten in the process. It is seldom that Lone Nielsen receives questions about standby, as this requirement is very well known. This is stressed when Nielsen (2007a) refers to her colleagues in T&A Department:

> '*The constructors strive and strive to make it happen; some of the others in T&A are almost envious that it is so well integrated.*'

Jacobsen (2007) stresses that the skilled constructor always strives to perform well, on all areas in focus. When asked how environmental aspects are seen in this regard he states:

> '*If environment was a more visible aspect, and if there was a code of practise we should work from, then people would naturally try to be in the best part.*'

Examples exist where environmental improvements have been made without any mandatory requirements being involved. This is for instance the case for aluminium surfaces, where the fixations are constructed to leave as clean aluminium as possible when the product is dismantled. This is the result of recommendations from Lone Nielsen, who stresses the importance of commenting informally on both good and bad solutions made by the constructors (Nielsen 2007a).

As for interactions with external partners, it is not as informal as within B&O. If Lone Nielsen needs to talk to someone from the external developing team, she would have to go through a coordinator in T&A Department. If the suppliers want to contact her, it often happens through the Purchasing Department (Nielsen 2007a).

4.3.4 The Realisation phase

In the realisation phase compliance with the different requirements set up previously are verified. Unless exemptions are made, few product related environmental impacts are determined in this phase. The phase is however important in a manufacturing environment perspective, given that manufacturing material and procedures are prepared.

Obligatory Incorporation
Release for production is an important time in the development process. It is at this point that the mandatory requirements set up in the specification commitment report have to be verified. This means that Lone Nielsen questions the methods used, and ensures that measurements have been used in the verification (Nielsen 2007a). An external contractor carries out a disassembly test to determine any difficulties related to the product disassembly.

In the case of BeoMedia 1 it became evident that the mandatory requirements for standby in the use phase could not be met. This happened, as BeoMedia 1 was a new type of product for which no previous experiences existed (Andersen 2007). The project team was aware of the non-compliance risk at an early point in time, but since the product is an intermixture of off-the-shelf items produced by external partners, it was not possible to ensure compliance with the requirements for standby, which is an internal B&O requirement (Andersen 2007). It is expected that if BeoMedia 1 at some point is to be launched in an updated version, also the internal mandatory requirements will be met. Thus an exemption from the mandatory requirements group will not be needed. Andersen (2007) concludes that in the future a closely collaboration with T&A will be launched at an earlier point, given that, '*we have definitely learned a great deal, the whole house has*'.

Non-Obligatory Incorporation
Nielsen (2007a) explains that she occasionally uses the disassembly tests to underpin for project members which solutions that are expedient and which are not. This could for instance be related to how the product is assembled, and whether or not this has negative consequences in the dismantling stage.

Also when prototypes are being produced and procedures for the future production are being settled, environmental aspects are influenced accordingly. This is for exampled related to the selection of glue types, which the constructors in the development phase do not have a final saying on. According to Farving (2007), B&O have experts on glue types located in the production area, who selects the most expedient type according to both production and environment. The glue is purchased through the normal purchase procedures, and hence environmental considerations are made.

It is usually in this phase that the project management gathers the experiences to be used in future development projects. These are however detached from the environmental experiences as Nielsen (2007a) states, '*if anyone is to gather the environmental experiences, then it is me*'. She does not have any procedures for doing so, but it is rather a question of her remembering previous experiences when entering new product development processes (Nielsen 2007a).

4.3.5 The Operation Phase
In the operation phase the products are produced, distributed, sold and repaired, and as such this stage is not part of the development process. Environmental impacts and considerations are related to both product environment and factory environment.

Obligatory Incorporation
In the operation phase most environmental impacts related to the internal and external environment at the production plants are determined. Besides production related aspects, also information to end-users occurs in this phase. No obligatory knowledge about environmental issues is required by the sales personal (Nielsen 2007a). However, the user manual contains a few topics related to environmental considerations, which for example is the case for the information required as a consequence of the WEEE Directive (Bruhn-Jensen 2007).

As for the distribution part of the operating phase, the Packaging Directive requires B&O to consider the amount of packaging used and thus the volume of the packages. However, as the television produced increases in size, more difficulties become related to the issue.

For most products service is provided until 12 years after the last product has been produced. B&O uses a module concept where the entire malfunctioning module is replaced. The broken part is brought back, repaired and used in another product at a later time. Due to the RoHS Directive currently two service loops exists, which makes it possible to ensure RoHS compliance in new products (Nielsen 2007a).

Non-Obligatory Incorporation
Occasionally, an issue becomes topical in the media, which have resulted in the preparation of Question & Answers sheets, a list of questions and related answers for the sales personal. The Q&A sheets are concerned with various topics of relevance for many products at a time. A Q&A sheet has for instance been prepared on EMC[5]. Lone Nielsen or Mette Juhl will typical be responsible for preparing the Q&A sheets, which subsequently are sent to the retail personal through the retail system (Nielsen 2007a). Despite the good environmental stories presented in *Down to the Smallest Detail*, these are usually not known by the sales personal (Nielsen 2007a).

4.3.6 Environmental Considerations throughout the Process
This section presents an overview of the environmental considerations in the product development process. Figure 4.5, shown on the opposite page, illustrates a simplification of the considerations.

From Figure 4.5 it is clear that the obligatory incorporation of environmental considerations occurs as a consequence of the mandatory requirements. The non-obligatory incorporation also evolves around the mandatory requirements. Despite the foundation of the analysis being BeoVision 7 and BeoMedia 1, it is assessed that expanding the scope of the analysis to include other B&O products would not have revealed significant differences. This is due to the broad and general character of the findings, where the only significant exception appears to concern BeoMedia 1, where an exemption from the mandatory requirements was found.

[5] EMC is an abbreviation for Electro Magnetic Compatibility, and is the ability of electrical products to resist being influenced by or influence other electrical products (Rosner & Rosner 2007).

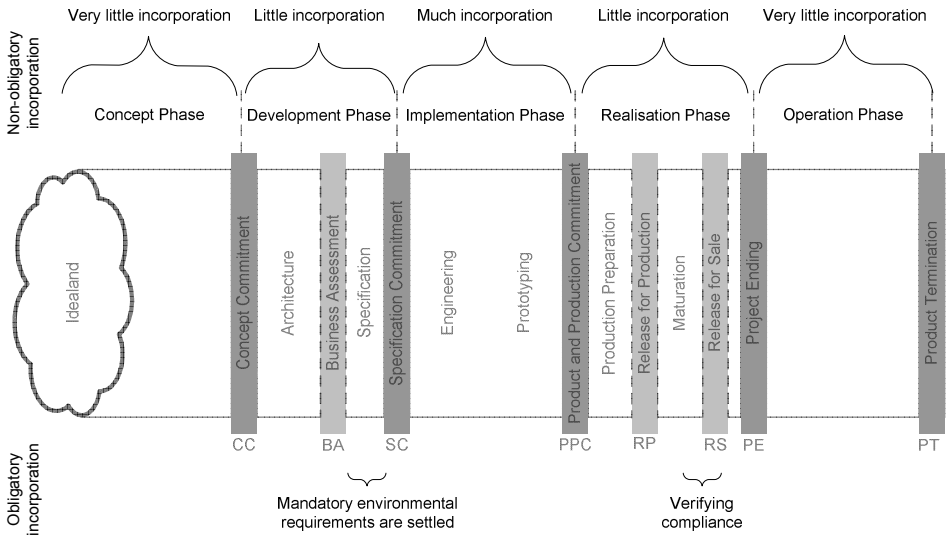


Figure 4.5 Simplified illustration of the incorporation of environmental considerations throughout the product development process. The upper part illustrates in which phases of the product development the non-obligatory incorporation is strongest, and the lower part illustrates in which phases the obligatory incorporation of environmental considerations take place.

Regarding the product related environmental performance, it appears evident that the mandatory requirements define the agenda. Looking beyond these, three issues are assessed especially influential;

- The extent of environmental considerations in the design of the products
- The extent of non-obligatory interactions in the product development
- The procedures for transmitting experiences between projects

It appears that overall environmental considerations in the product design process are absent. To what extent inputs on environmental issues from external sources, including new technologies or changes in marked behaviour, are incorporated is uncertain, however no evidence point to the existence of established procedures for gathering such information.

The extent of non-obligatory interaction, as regards environmental considerations differs from project to project. The interaction seems to function moderately well, which is assessed to be due to a large degree of self-responsibility by the involved actors. It furthermore appears that more environmental considerations could be incorporated, if a more clear code of practice was integrated in the daily routines. Additionally, the current form of operation seems vulnerable with regards to redeployment, as the experience of single employees seems to form how environmental considerations are integrated. Especially for new employees involved in the product development, it is assessed difficult to determine to what extent the product oriented environmental performance should be prioritised.

The procedures for transmitting knowledge between projects, as regard environmental issues, are also characterised by not being based on standard procedures, which influence the consistency in the gathering of experiences. In situations where key persons deviate from their responsibility much is based on coincidental solutions.

After having analysed the incorporation of environmental considerations in the product development, the following section presents the identification and analysis of the communities of practice related to this incorporation.

4.4 Identification of Communities of Practice

Four significant communities of practice can be identified from the analysis above. These communities are engaged in the following different issues:

- The product concept
- The realisation of projects
- The mandatory requirements
- Environmental management

When identifying communities of practice it is important to distinguish between organisational relations between actors and communities of practice, as these not necessarily are identical. Actors' organisational belonging does not necessarily mean that the actors have a shared domain of interest and the opposite; more actors may belong to a community of practice than there are actors in the organisational setup. Furthermore, actors can also belong to several communities at a time. In the following each of the communities of practice identified are analysed according to the questions set up in the analytical framework in the dividing leaf. The analytical framework is based on the theory developed by Wenger (1998), and a further presentation of the theory is given in Appendix B. For each community it is analysed who constitutes the community, what their domain and shared practice is, how the communities integrate environmental considerations in their work and further, what the communities regards as meaningful using different types of participation and reification. The analysis does not go into detail with the dynamics within the community, as the focus of this study is the interaction with other communities in order to clarify how environmental considerations are integrated. The section ends with a discussion of how links are established between the communities in terms of boundary objects and brokers, and what the explicit and tacit elements are in the communities. Also the historical context and the way in which the communities are sustained are discussed.

4.4.1 Engagement in the Product Concept

The first community identified is engaged in the product concept. The employees in Idealand constitute the community together with external designers, project managers and occasionally project members. The community's core shared domain of interest is assessed to be creativity and the de-

sign of high-class products, and great emphasis is placed on the freedom to create. However, the analysis shows that project members from time to time bring in considerations that need to be taken if the project should not be delayed at a later point.

The community is free from integrating any environmental considerations. It is assessed to be a significant community of practice as many decisions about the product life are taken within this community, and as will be clear from Chapter 5, it is a clear aim of the EuP Directive to influence these types of communities. Figure 4.6 illustrates the core domain of interest of the community and what the participation and reification of the community is.

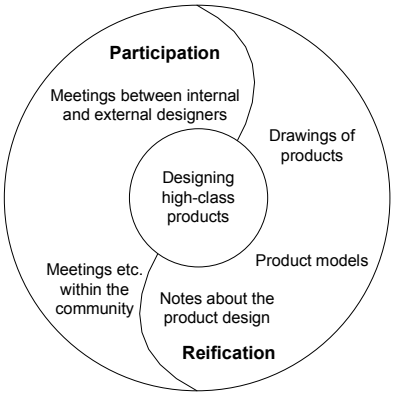


Figure 4.6 The duality of participation and reification for the community engaged in the product concept.

The figure illustrates some of the most central aspects related to the community. The reification of the community through models, drawings and notes is important to notice, as these are central when working on the concept. A further reification is the folder or models that are handed over to the project management when ending the concept phase.

4.4.2 Engagement in the Realisation of Projects

The second significant community of practice is engaged with the realisation of projects. The community is constituted by the members of the project management, the internal actors and external partners. Also representatives of the Purchasing Department take part in this community. The community is rather large, and many of the members also participate in other communities. One example of this is the representatives of the Purchasing Department, which also participates in a community engaged in finding the best quality components for the lowest price. The community's core shared domain of interest is the realisation of specific projects, meaning the transformation of concepts into products.

With regards to integrating environmental considerations the community is rather complex. Throughout the analysis it appears that environmental considerations often not are especially considered, rather these are routinely integrated through complying with the mandatory requirements. On the other hand, the constructors always strive to perform well, which also can include environ-

mental aspects. A keyword in the community's integration of environmental considerations seems to be experience, as the integration of environmental considerations often seems to happen on the basis of previous experiences. Figure 4.7 illustrates the core domain of interest of the community and what the participation and reification of the community is.

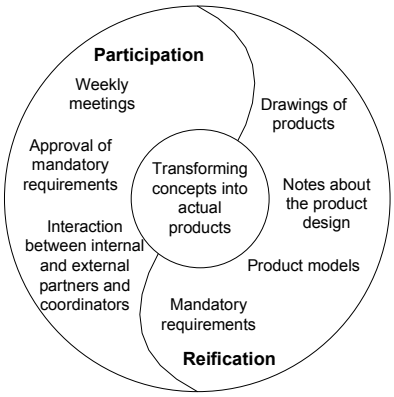


Figure 4.7 The duality of participation and reification for the community engaged in project realisation.

Figure 4.7 illustrates some of the most central aspects related to the community, for instance the different sorts of meetings and interactions between the members of the community. The reification is concentrated around the product that is developed. The first reification is the documents and models that are handed over from the concept development, but later in the process other documents, drawings, product models and prototypes are used.

4.4.3 Engagement in the Mandatory Requirements

The third community is engaged in the mandatory requirements. Employees in the T&A Department, the mandatory requirements group and environmental consultant Lone Nielsen constitute the community. The community's core shared domain of interest is to ensure that the products are in compliance with relevant mandatory requirements.

With regards to integrating environmental considerations in the work of the community, there is not a specific emphasis on the environment. Environmental considerations are one part of the mandatory requirements, and as the manager of the T&A Department Jesper Olesen states, these are assigned equal weight with the other mandatory requirements (Olesen 2007). Figure 4.8 illustrates the core domain of interest of the community and what the participation and reification of the community is.

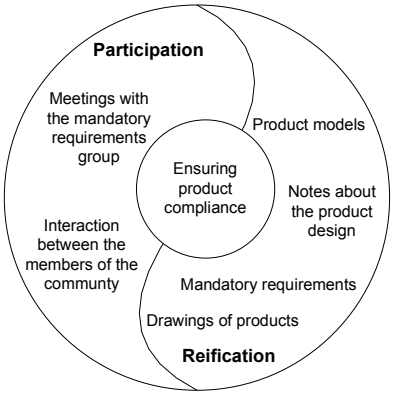


Figure 4.8 The duality of participation and reification for the community of the mandatory requirements.

The figure illustrates that interactions does happen within the community where the central reification is the mandatory requirements. Also product models and so forth are used in the determination of which requirements that are relevant for the specific products.

4.4.4 Engagement in Environmental Management

The fourth and final identified community of practice is engaged with environmental management. Members are Lone Nielsen, Mette Juhl, Lars Farving, all employees of the SHE Department, and their manager Rikke Højer.

It is noticeable that Lone Nielsen spends most of her time in the community engaged in the mandatory requirements, and her work related to the community engaged in environmental management is restrained to activities not related to the mandatory requirements. The community's core shared domain of interest is their environmental understanding and their endeavour to improve the environmental performance of B&O. The community is not a strong community in the product development process. The community's only connection to the product development is dependent on one person's interaction with other communities in the development process.

With regards to integrating product oriented environmental considerations in the community, the mandatory requirements are also in this community part of the environmental understanding. However, the environmental understanding is more diverse and covers more than just product related performance, and improving environmental performance is therefore fully integrated in the work of each individual. Figure 4.9 illustrates the core domain of interest of the community, and its participation and reification.

Figure 4.9 The duality of participation and reification in the community of environmental management.

Various external networks are also related to the community, and serve a supportive role for the practices of the community. The reifications of the community are first of all different documents where *Down to the Smallest Detail* in particular is important. Also the mandatory requirements, the environmental policy and the EMS are important to notice.

The following section discusses the interaction between the different communities more in detail. Further, it is discussed how the communities are sustained, what is explicit and tacit in these, as well as what the historical and social context of the communities is.

4.4.5 Links between the Communities of Practice

As regards the interaction between the communities of practice for integrating product oriented environmental considerations, some communities are particular important, namely the community engaged in the realisation of products and the community engaged in the mandatory requirements. First of all, much interaction takes place between these two groups, and secondly, these are also the link to other communities. A clear example of their interaction is that one community sets up requirements, which the other community must follow. As the analysis in Section 4.3.3 revealed, it is primarily the coordinators and constructors from the community engaged in the realisation of projects that use the requirements directly, and Lone Nielsen is a key person in the interaction between the communities. It is important to emphasise that much of the interaction between the two communities happens informally; the constructors can for instance meet Lone Nielsen in the hallway and asks questions.

As mentioned, both communities are also important links to other communities. First of all, both communities interact with the community engaged in the product concept, in terms of integrating environmental considerations in this community. It is however important to emphasise that participation solely has informal character and that it does not happen when every single product is designed. Rather, it happens occasionally and is highly dependent on the persons in community engaged in the realisation of projects and the participation of Lone Nielsen. When these interactions happen, the reifications used are often either descriptions of the new product, drawings or models of the products. Both communities do also interact with the community engaged in environmental

management, albeit one person, Lone Nielsen, primarily manages this. The interaction has an informal character, often with questions asked in the hallway or spontaneous meetings. There is also a more formal interaction between the community engaged in the mandatory requirements and the community engaged in environmental management, as Lone Nielsen is part of both communities.

These formal and informal interactions between the four communities of practice described above are illustrated in Figure 4.10. For the purpose of clarity, in the figure the brokers and boundary objects are drawn in the most direct line between the communities, without considerations to the fact that brokers are related to the participation part and boundary objects to the reification part of the duality of the communities.

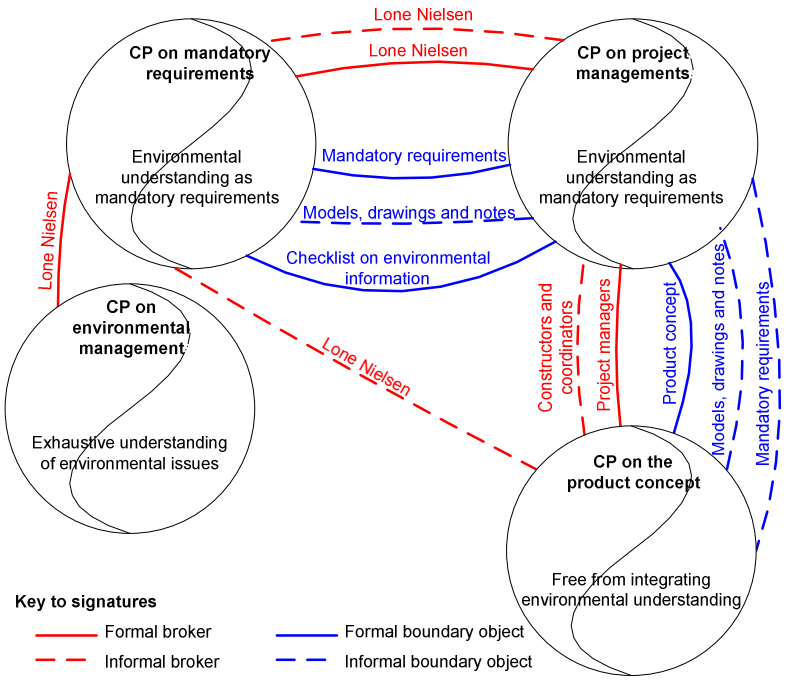


Figure 4.10 The interaction between the communities of practice in the product development process in relation to integration of environmental considerations.

What is interesting to notice from the figure is the rather small interaction the community engaged in environmental management has with other communities in the product development, and it does primarily gain influence through the community on mandatory requirements. Furthermore, many of the environmental considerations are of informal character.

The analysis also reveals that there to some degree appears to exist tacit knowledge in the product development. As an example the constructors independently consider the standby energy consumption in the development of the products, meaning that Lone Nielsen does not need to point it out.

The B&O culture is described in Chapter 3 with key words such as pride, well-performing and laid back. This is assessed to have a significant influence on the existing communities of practice, and is

directly linked to the high degree of informal interaction. The employees do not seem to be in need for many formal procedures, rather challenges are handled along the way. When looking at what B&O does to sustain its communities of practice on product environment, the analysis has not revealed any significant activities. On the contrary, it seems as if environmental issues are not significantly prioritised, which among other places is recognisable in that environmental performance is not even part of the core values of the organisation. It should be mentioned that Lone Nielsen, although her formal participation in two communities, has a stronger physical relation to one of these as her desk is placed in one of these. This could be regarded as sustaining her belonging to the community of the mandatory requirements, but it does not appear to strengthen her participation in the community of environmental management.

4.5 Discussion of Environmental Considerations in Product Development

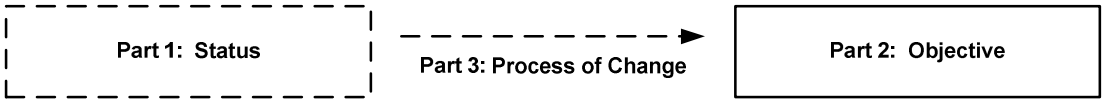
A primary finding of the analysis is that the mandatory requirements define the level of environmental considerations in the product development. This appears to be the case for both obligatory and non-obligatory incorporation. The notion appears to be that when the mandatory requirements are fulfilled, the environmental performance is satisfactory. It is evident in this regard that fulfilling the mandatory requirements are done with a desire to perform well, which then becomes a driving force along with the engagement of different individuals in the process. Despite these efforts, environmental considerations appear to be seen as a limiting factor and not as a possibility for seeking new opportunities.

The findings in the analysis of involved communities of practice illustrates that Lone Nielsen interacts both formally and informally with all four identified communities in her endeavour to improve the environmental performance of the products, which stresses that the current form of operation is vulnerable. If a key person deviates from her obligations it can have a significant impact on how the remaining communities of practice integrate environmental considerations.

The analysis of communities of practice further illustrates how the practice in the different communities bears the stamp of the mandatory requirements as defining the scope of environmental considerations. There is a duality in this practice constituted by reification in the form of the TOP-model as well as the mandatory requirements, and participation in the form of fulfilment of the requirements. It appears that B&O has gained thorough experiences with this practice, emphasising that it is found meaningful for the involved actors. This is further stressed by the fact that no employees appear to question the practice for integrating environmental considerations.

The question is then whether the current practice is sufficient in order to comply with the demands of the EuP Directive, or whether new communities are needed. This is assessed in the next part of the report, which the following dividing leaf presents the analytical framework for and the content of.

Part 2: Objective



This part of the report constitutes the objective part, with the purpose of analysing and presenting how the environmental performance of products can be improved. First, the EuP Directive is analysed, with the aim of investigating which potential requirements B&O can be met with. This is used as a point of departure for a discussing of two strategies: a compliance strategy which entails the measures B&O should set up in order to comply with the Directive, and a proactive strategy which emphasises how a company can be more proactive and long-term oriented in improving the environmental product performance. Three research questions are related to this part:

- Which requirements will the EuP Directive most likely pose on B&O as a company and the products produced by B&O?
- Which measures can support B&O in the process of ensuring compliance with the EuP Directive?
- Which measures can support the incorporation of a proactive strategy for improving product performance?

Analytical Framework – Part 2

This dividing leaf serves the purpose of presenting the framework applied in the analysis of the EuP Directive, and the development of the two strategies for improving product related environmental performance. Chapter 5 and Chapter 6 constitute Part 2 of the report.

Chapter 5 analyses the potential requirements on companies, with a point of departure in the different policy instruments applied by the EuP Directive. Christensen (200, 33-7) divides these into four categories:

- Normative regulation: legally binding rules which determines what is allowed and requested
- Economic instruments: fees, charges and support which seek to influence behaviour
- Infrastructural instruments: structures in society, for instance sewers and roads, which encourage certain behaviour. This is also supported with information
- Informative instruments: knowledge and education, which also encourages self regulation

These categories are used to explain how the Directive will be implemented, and which general requirements for company performance that can be expected. Furthermore, potential requirements related to the product performance are also analysed.

Chapter 6 goes more into depth with different measures for improving the environmental performance of products. The chapter takes a point of departure in the current environmental management at B&O related to aspects of the EuP Directive, and identifies various challenges related to complying. Using this as a foundation, suggestions are given for how B&O could comply with the EuP Directive. Furthermore, a more proactive and long-term strategy is also adopted, in order to investigate how further environmental improvements can be created through adopting various measures. The differences in the approach of these two strategies are emphasised in Chapter 6 by relating them to the different regulation types, as presented by Rubik (2005) and Remmen (2005).

As two result of this part, a list of measures to be considered when following the compliance strategy is given, and a model for how companies can adopt a proactive strategy for improving product performance is developed.

Requirements of the EuP Directive

5

This chapter answers the research question: which requirements will the EuP Directive most likely pose on B&O as a company and the products produced by B&O? First, an overview of the objectives of the Directive is given. Secondly, elements of the Directive describing overall requirements for companies are identified and discussed according to different categories. Thirdly, the potential requirements for product performance are analysed, and finally the Directive is discussed from an overall perspective.

5.1 Objectives and Policy Instruments of the EuP Directive

The European Commission adopted the EuP Directive on July 6, 2005[6]. The Directive establishes a framework for the setting of ecodesign requirements for energy-using products, to obtain the overall objective of integrating environmental considerations in the design stage of these products. This is expected to improve the environmental performance of products and services, and increase the security of the energy supply (European Commission 2005; Eifel 2006a, 2).

It is underlined in the Directive that different national laws and regulations in the member states could be an obstacle for the integration of environmental considerations, as it could lead to trade barriers and distortion of competition. Hence, an objective of the Directive is to harmonise the member states' legislation in order to avoid such distortions and ensure the free movement of products within the internal market. To support free movement, energy-using products covered by implementing measures must be marked with the CE conformity marking. The mark indicates that the product complies with the existing EU legislation, and that it can be sold in all countries within the EU. The EuP Directive therefore attempts to influence market conditions, as the products must fulfil certain environmental requirements before placed on the market. The most central events in the process of implementing the Directive and the transposing into Danish law are presented in Appendix D.

[6] Before the adoption of the EuP Directive, several attempts were made especially by the European Commission's Industry Department to introduce regulation on ecodesign.

5.1.1 Implementing Measures or Voluntary Agreements

The EuP Directive is a framework directive, which must be implemented either through implementing measures or voluntary agreements[7] for each product type (Eifel 2006a, 8). Implementing measures are not adopted if voluntary agreements exist, as these are preferred in the Directive, but the implementing measures are the primary focus of the Directive. It is the responsibility of the manufacturer to investigate which requirements the products must fulfil, and if the manufacturer is located outside of the EU, the responsibility is handed over to the importer (EuroCenter 2002, 3; European Commission 2005).

The implementing measures can be seen as the core of the EuP Directive as they lay down specific and generic ecodesign requirements for the products to comply with, taking the full life cycle of the products into consideration. Furthermore, the implementing measures also include requirements related to information and documenting compliance. The process of preparing the implementing measures has been initiated, and the first are expected to enter into force in 2008.

5.1.2 Conformity Assessment

If a company chooses to comply with the implementing measures, a conformity assessment should be carried out to document compliance. In this, the producers have the choice between two approaches: an internal design control and a management system. These will help the company to ensure and declare that the product satisfies the requirements of the given implementing measure.

The implementing measures are supported by harmonised standards, which are technical specifications that give information on how the requirements in the implementing measures could be met. The harmonised standards are voluntary instruments, but a company will be presumed as conforming to the requirements of the implementing measures if the harmonised standards are followed. At the moment, no harmonised standards have been prepared. Conformity is also presumed in another case, as energy-using products marked with the eco-label of the EU is presumed to be in compliance with the implementing measures, if the requirements of the implementing measure are met by the eco-label. In all, this gives a number of choices, which a company can make in the initial process of complying with the EuP Directive; these are presented in Figure 5.1.

[7] The Directive refers to self regulation measures, but only voluntary agreements are part of these.

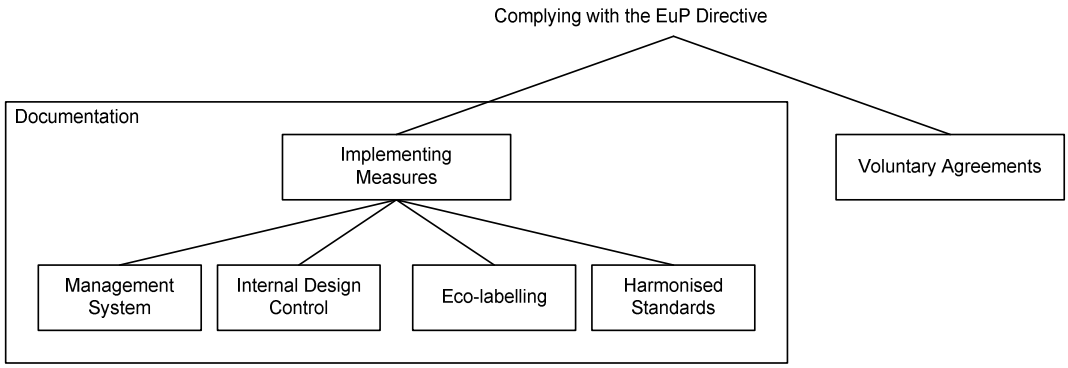


Figure 5.1 The approaches a company can adopt in order to comply with the EuP Directive.

The figure represents the initiating decisions a company should make in order to comply with the Directive. The requirements that a company can expect following the implementing measures are further investigated in the following sections.

5.2 Requirements for Company Performance

This section investigates and discusses the elements of the Directive that set overall requirements on companies for complying.

The identification of the most important elements is based on an analysis of the articles and annexes of the EuP Directive, presented in Appendix E. The result of this analysis is a comprehensive range of elements, which are found to be of potential importance for companies when facing the process of complying with the requirements of the EuP Directive.

This list of elements can be grouped into seven different categories, in order to give an overview of the related requirements. Three categories are given directly from Figure 5.1, as elements first of all are related to the voluntary agreement, to the choice between internal design control or management system and to the possibility of using eco-labelling to show compliance. No elements are related to the harmonised standards, and this is not included as a category. Three categories are given by the overall content of the implementing measures, as elements are related to the specific and generic ecodesign requirements, to information and to control of compliance. Finally, elements are related to the responsibility and influence of the producer, and this is included as the last category. To summarise the categories these are:

- Voluntary agreements
- Internal design control and management system
- Ecodesign requirements: specific and generic
- Control of compliance: documentation and testing of products
- Information: from suppliers and to end-users
- Eco-labelling
- Responsibility and influence of the producer

These categories are discussed in the following sections, in order to clarify what possible requirements and following challenges for companies will be. This discussion is supported by statements of selected interviewees, as presented in Section 2.3.1 as well as responses to the public hearing of the Danish legislation.

Voluntary Agreements

Voluntary agreements in the shape of unilateral commitments by industry are mentioned as a self regulation measure to comply with the Directive. The most important elements related to voluntary agreements are listed in Table 5.1.

Article/Annex	Voluntary Agreements
17	Self regulation in the shape of voluntary agreements can be alternatives to the implementing measures
VIII	If self regulation is to be used as a strategy for compliance a range of criteria is to be considered to ensure that the strategy is expedient

Table 5.1 Elements of potential importance for companies in relation to voluntary agreements.

As seen from Table 5.1, the voluntary agreements have to be evaluated according to a number of criteria. These criteria include the openness of participation, the added value of the agreement, and quantified and staged objectives of the agreement. There is no knowledge of any branches forming such agreements, neither in Denmark nor in Europe (Traberg 2007, Sternest 2007a).

Internal Design Control and Management System

As mentioned, a company should choose between two approaches; either internal design control or a management system as part of a conformity assessment. The management system is sometimes part of a company's self regulation measures for reducing environmental impacts, but in the EuP Directive this becomes a normative regulation. The elements relevant for this category are shown in Table 5.2.

Article/Annex	Internal Design Control and Management System
8	The manufacturer can choose between two overall approaches for compliance: internal design control and a management system in accordance with Annex IV and V respectively
8	The management system of a company which is either EMAS registered, including the design function, or having another management system, including the design functions, set up in accordance with relevant harmonised standards is presumed to be in compliance with Annex V
IV	When internal design control has been chosen as an approach for compliance, the requirements for documentation can vary and include issues like which environmental assessments are made on similar products, the ecological profile and a description of the solutions chosen to comply with the requirements
V	When a management system has been chosen as a strategy for compliance, the system should contain a range of needed procedures, including preparation of an environmental product performance policy, planning, implementation, documentation and checking as well as corrective actions

Table 5.2 Elements of potential importance for companies in relation to internal design control and management system.

As seen from Table 5.2, the requirements related to the internal design control is addressing technical aspects of improving product performance, whereas the management system is more focused on the procedures necessary to improve performance. EMAS registered management systems are presumed to be in compliance with the requirements of Annex V if the design function is included. Also other management systems, set up in accordance with relevant harmonised standards and including the design function, are also presumed to be in compliance with Annex V (Traberg 2007).

Poll (2007a) points to the use of a management system as diluting the requirements, as procedures do not guarantee improvements seen in relation to the implementing measures. Representatives of the Confederation of Danish Industries and the Environmental Protection Agency do not stress one strategy before the other (Sternest 2007a; Traberg 2007).

Ecodesign Requirements: Specific and Generic

Part of the implementing measures is the specific and generic ecodesign requirements. Both types are normative regulation, but it should be noted that the generic requirements do not impose limit values for product performance. The relevant elements related to ecodesign requirements are presented in Table 5.3.

Article/Annex	Ecodesign Requirements: Specific and Generic
15	The manufacturer can be subjected to generic and/or specific ecodesign requirements according to Annex I and/or II
15	A list of criteria, including the amount produced and potential environmental impacts, determines if a product type is subjected to the Directive and consequently if implementing measures can be expected for the given product type
I	The products can be subjected to life cycle based generic requirements related to resource consumption, expected emissions, noise, vibrations, radiation, electromagnetic fields, generation of waste and recycling potential
I	A list of criteria, including mass, volume, resource consumption in the production, use of recycled materials, service life, waste and emissions, can be included in the consideration of the improvement potentials of the products
I	It can become mandatory to perform an assessment of the environmental aspects related to the energy-using product throughout its lifetime
I	It can become mandatory to perform an ecological profile of the products
I	It can become mandatory to assess alternative design solutions
II	The products can be subjected to various specific requirements
VII	The company should have knowledge about the content of the implementing measures

Table 5.3 Elements of potential importance for companies in relation to specific and generic ecodesign requirements.

As seen from the table, many elements relate to the potential content of the requirements, which will have direct influence on product performance, and these are therefore a core part of the Directive. The third and the fourth row of the table show the product related aspects, which might be covered by the specific and generic requirements. It should be mentioned that the implementing measures might not regulate all relevant environmental impacts. The specific content of the ecodesign requirements are further discussed in Section 5.3.

The specific ecodesign requirements are preferred in the implementing measures given their straightforward nature, whereas the generic requirements involve the largest focus on life cycle considerations. Due to among other things the unclear boundaries and expectations of the generic requirements, Nielsen (2007b) foresees that the use of these will be rather limited in the initiating phase. However, Traberg (2007) mentions that proactive companies will benefit from previous experiences with ecodesign.

Following the primary focus on specific requirements, a result might be that companies are not encouraged to improve their products more than required, but instead could apply minor and simple optimisations to meet the limit values given by the implementing measures.

Control of Compliance: Documentation and Testing of Products

Another part of the implementing measures is the control of compliance. The control mainly relies on normative regulation, but instruments of a more informative and economic characters are also used. The relevant elements are listed in Table 5.4

Article/Annex	Control of Compliance: Documentation and Testing of Products
3	Energy-using products must be in compliance with the relevant implementing measures and marked with the CE marking before being placed on the market
5	A conformity declaration should be conducted and issued in accordance with Annex VI
5	Energy-using products must bear the CE conformity marking before it can be placed on the market
6	The companies cannot be prevented from placing their energy-using products on the market as long as these are in compliance with the relevant implementing measures and marked accordingly
6	It is possible for the company to exhibit energy-using products that are not in compliance with the relevant implementing measures
7	In case of continuous non-compliance it is a possibility that the energy-using products will be prohibited on the market until compliance is obtained
15	The process of compliance should not result in significant negative changes in the product functionality or cost
15	When controlling for compliance the authorities can either test the product directly or require additional information depending on the implementing measures
VI	The company should have knowledge about what the declaration of conformity is to contain

Table 5.4 Elements of potential importance for companies in relation to control of compliance.

A central aspect of Table 5.4 is the CE conformity marking, which a product must bear before it is placed on the market. The table also presents an exception, namely that energy-using products can be exhibited without complying with the implementing measures. Following this exception it can be discussed whether ecodesign considerations actually have been integrated in the design phase, which is a primary objective of the Directive. The point is that the product can be assumed to be almost ready for sale when exhibited at trade fairs, exhibitions and demonstrations, and then it might be too late in the process for considering environmental aspects in the design phase. Other central elements of the table are testing and documentation, and the declaration of conformity which should be issued before the energy-using product is placed on the market.

The implementing measures have to be awaited, in order to determine the extent and type of necessary documentation to control compliance, but the need for documenting compliance is mentioned as being a primary challenge for the Danish companies (Sternest 2007a; Poll 2007a; Traberg 2007). Some mention the need for standardised procedures for documentation, and expect the Commission to give mandate to the European certifying bodies to provide such forms (Traberg 2007; Nielsen 2007b).

Not all product parameters are easily testable; examples are considerations about reuse and disassembly. Both Traberg (2007) and Nielsen (2007b) mention that testing energy efficiency and noise most likely will be used as a supplement when controlling compliance.

Information: From Suppliers and to End-users

Informative aspects are also part of the implementing measures. It is a normative regulation to provide the information needed, but the information can give guidance to consumers and thereby influence market conditions. The most important elements for companies in this regard are listed in Table 5.5.

Article/Annex	Information: From Suppliers and to End-users
5	The member states can, in the national legislation, make different requirements about the type of information to be provided by the companies
8	The company must keep the information on the conformity assessment for ten years after the last energy-using product has been manufactured
8	The company must be able to gather and provide relevant information within ten days on request of competent authority
11	It can be required that producers of components are obliged to provide the relevant information to the manufacturer of an energy-using product
14	It can be required to inform the end-user about the ecological profile of the product along with the advantages of ecodesign
14	In accordance with the implementing measures the company determines the type of information needed for the end-user to clarify their role in the sustainable use of the given product
I	It can become mandatory to provide information about, among other things, design considerations, environmental impacts related to the product, correct use of the products and methods for disassembly, to different actors in the product chain handling the product

Table 5.5 Elements of potential importance for companies in relation to information from suppliers and to end-users.

The specific requirements related to this category also depend on the implementing measures. As seen from the table, an already given requirement is though that the company should be able to gather and provide relevant information within ten days after being requested. This will require that the companies gather the needed information continuously and thus not await specific enquiries (Poll 2007b).

As for information to end-users, it is clear from Table 5.5 that the implementing measures will clarify how much information the companies are to provide. According to Poll (2007a) and Traberg

(2007a) however, some companies might use the information proactively to support their image and marketing arguments.

Many of the elements in Table 5.5 also relate to control of compliance, as presented above, in this context the collection of information and data from suppliers to document performance. All interviewees see this as a challenging task, which also is commented in all reviewed responses to the public hearing. As mentioned, the responsibility for complying with the implementing measures is handed over to the importer if the manufacturer is located outside the European Union, and in these cases it is important to obtain the necessary documentation and information from suppliers. Some expect particular difficulties in obtaining information from developing countries (Sternest 2007b; Traberg 2007).

Eco-labelling

Following the Directive, energy-using products market with certain eco-labels should be presumed in compliance with the implementing measures. Hereby it is sought to influence companies to become part of voluntary eco-labelling schemes. The eco-labelling option derives from Table 5.6, which stresses the presumptions related to products bearing the CE marking or an eco-label.

Article/Annex	Eco-labelling
9	Both products bearing the CE marking and certain eco-labels are presumed to be in compliance if these are assessed to be in accordance with the implementing measures

Figure 5.6 Elements of potential importance for companies in relation to eco-labelling.

The Directive in particular refers to products bearing the eco-label of the EU, but eco-labelling criteria are not available for all product groups. The eco-labelling scheme and the implementing measures are two different regimes, which might not contain uniform requirements from the beginning. Poll (2007a) however expects the two regimes to be aligned over time, and one regime will strengthen the other. According to Traberg (2007), the requirements of the EU Flower might be stricter than those of the EuP Directive, as the flower should represent the products in the market with the best environmental performance.

Responsibility and Influence of the Producer

This category mainly relates to self regulation, as the companies are given opportunities to seek influence on the regulatory requirements, but it is their own choice whether to use these options or not. It is a normative regulation that the producer has the responsibility to comply with the regulations set up. The elements of importance are shown in Table 5.7.

Article/Annex	Responsibility of the Producer
4	The responsibility is handed over to the importer if the manufacturer is located outside of the Community
10	There is a possibility for seeking influence in the drafting of the standards
18	The companies can seek influence in the process of preparing the implementing measures

Table 5.7 Elements of potential importance for companies in relation to producer responsibility.

A primary element of Table 5.7 is that the importer takes over the responsibility if the manufacturer is located outside of the European Union, and this element is therefore crucial for companies with import. The other elements give a company the opportunity to influence the requirements, meaning that a company could also strive for stricter requirements, which its competitors cannot fulfil, but the company itself can.

5.2.1 Life Cycle Perspective and Ecodesign

A fundamental idea and objective behind the Directive is to increase environmental performance of products in a life cycle perspective through for instance the use of ecodesign, but the analysis shows that many of the requirements given by the Directive are related to administrative issues. One explanation for this might be that no requirements for product performance have been established, whereas the administrative challenges are much clearer, as these are given directly by the Directive and its annexes.

It is expected that the ecodesign requirements mainly will impose specific limit values for product performance, which it furthermore might not be difficult for a company to comply with. It can also be assumed that regardless of the requirements given by the implementing measures, it will always be possible for a company to do more in order to reduce the environmental impacts related to the products being produced.

The following section will investigate which actual requirements for product performance B&O could be met with.

5.3 Potential Requirements for Product Performance

The potential requirements for product performance are investigated through an analysis of different preparatory studies of relevance for BeoVision 7 and BeoMedia 1. The preparatory studies are part of the process for implementing the EuP Directive, as described in Appendix D, and they provide valuable information to the implementing measures regarding which product aspects and environmental impacts it could be relevant to focus on.

The section will elaborate on the following three questions:

- Which preparatory studies are relevant in the case of B&O?
- What is the methodology for the preparatory studies?
- What are the possible requirements on product performance?

5.3.1 Selection of Preparatory Studies

Of the 14 preparatory studies under preparation, only four are relevant for B&O. In the following the arguments for the choice of preparatory studies are given.

The preparatory study covering BeoVision 7 is *Lot 5 on Consumer Electronics: televisions*. It analyses three types of televisions: Plasma Display Panel (PDP), Liquid Crystal Display (LCD) and Cathode Ray Tubes (CRT). As the technology of BeoVision 7 is LCD, the focus in this analysis is on the base case of a 32" LCD television.

Two preparatory studies are relevant for BeoMedia 1: *Lot 3 on Personal Computers and Computer Monitors*, and *Lot 7 on Battery Chargers and External Power Supplies*. Several computer types and monitors are represented in Lot 3, but only elements of relevance for BeoMedia 1 are included in this analysis. It is important to notice that in terms of hardware BeoMedia 1 has large resemblance with the computers included in Lot 3, but in terms of function BeoMedia 1 resembles game consoles, which are excluded from the preparatory study. In this analysis however, it is assessed that BeoMedia 1 is within the scope of the preparatory study, but it is recommended that this is further investigated[8]. With regards to the preparatory study on Lot 7, only the data on external power supplies with resemblance to the power supply of BeoMedia 1 are included in this analysis.

The final preparatory study of relevance for BeoVision 7 and BeoMedia 1 is *Lot 6 on Standby and Off-mode losses*, which covers all products with standby and off-mode energy consumption. This study, however, is not included in this analysis for several reasons. First, it is assessed that the study will not reveal new aspects, as its scope also is included in the other preparatory studies. Secondly, several stakeholders have according to Sternest (2007a) opposed against the study on Lot 6 due to confusion about its relationship with other preparatory studies, and its data are older than those used in other preparatory studies.

5.3.2 Methodology of the Preparatory Studies

As mentioned, the preparatory studies are completed with the aim of providing technical information to the implementing measures. The preparation of the studies is divided into eight successive tasks, which are thoroughly documented. These documents together constitute one preparatory study. Currently, 12 preparatory studies are ongoing, two have finished and more studies are coming. Regarding the studies relevant for this project, seven tasks are completed for Lot 3 and Lot 5,

[8] According to Andersen (2007) B&O themselves are discussing whether BeoMedia 1 should be defined as a computer or an audio product.

and all tasks for Lot 7 are completed. The different tasks of the studies are illustrated in the ordered list, and briefly explained in the following:

- Task 1: Definition of product groups
- Task 2: Economic and market analysis
- Task 3: Consumer analysis and local infrastructure
- Task 4: Technical analysis of existing products
- Task 5: Definition of base-case
- Task 6: Technical analysis of best available technology
- Task 7: Improvement potentials
- Task 8: Policy, impact and sensitivity analysis

5.3.3 Possible Requirements from the Preparatory Studies

The analysis of the studies can be divided into two perspectives: what the causes of the environmental impacts are, and what the product related improvement potentials are.

For each product, a table illustrates the causes of the environmental impacts, and the stages of the product life cycle that these are related to. The improvement potentials are focused on improvements in the development stage, but these improvements also influence the environmental impacts occurring in other stages of the product life cycle. Hence, even though no improvement suggestions are listed for a stage, it is possible to improve these through changes made in the development stage. There are some differences in the level of detail in the different preparatory studies, which also appears in the following sections that discuss impacts and improvement potentials related specifically to BeoVision 7 and BeoMedia 1.

BeoVision 7

Table 5.8, shown on the following side, gives an overview of the causes of environmental impacts and the improvement potentials, as given in the preparatory study of Lot 5.

It appears from Table 5.8 that the environmental impacts are related to very specific components in the television, such as printed circuit boards and the amounts of caps and coils. However, it is emphasised in the preparatory study that also the energy consumption, especially in the use stage, has a significantly high impact, both with regards to on-mode and standby energy consumption.

The improvement potentials are concentrated around changes in the development, as these have impacts in the full product life cycle. Very specific suggestions are listed, of which several concern the backlight unit, as this potentially can reduce the energy consumption in the use stage significantly. Other improvement potentials concern the use of more efficient components and reduction in the number of product parts. Reducing parts and materials that need special treatment when disposed, and designing for recycling in general, also make environmental improvements occur at the disposal stage.

Stage	Causes of Impacts	Improvement Potentials
Development	• Bulk plastics in the chassis • Ferro metals in the frame and stand • Printed circuit boards • Mass of electric boards • Amount of caps and coils in the power supply unit (PSU) • Amount of non-ferro metals in the PSU • Advanced components in the PSU LCD panel	• Improvement or change of backlight unit (BLU) driver • Complete or partial dimming of BLU • Use of more efficient polariser leading to use of fewer lamps • Use of efficient switched PSU • Use of a direct power supply for BLU • Use of high efficient PSU • Fewer voltage convertion stages • Reduction of energy consumption of tuner and plasma display • Reduction of energy consumption in active and passive standby • Miniaturisation of electronic boards • Reduction in the number of parts for instance screws and plastic parts • Reduction of product weight • Utilisation of hybrid or full bio plastics • Utilisation of recycled materials • Avoidance of colour layered (painted) or sandwiched plastics • Improvement of component lifetime and repair friendliness • Reduction of packaging material and volume • Reduction of parts and materials that need special treatment at the product end-of-life • Design for recycling
Use	• On-mode energy consumption • Standby energy consumption	
Disposal	• High volume of discarded televisions • Mercury containing backlight systems	

Table 5.8 Causes of environmental impacts and improvement potentials related to BeoVision 7, as highlighted in Lot 5. Further information on improvement potentials can be found in (Fraunhofer 2007, 7-21, 31-36).

Based on the preparatory studies, the requirements set up in the implementing measures will most likely concern energy consumption in the use stage as the main requirement. Both on-mode and standby consumption will very likely be comprised. Further requirements might concern material consumption, product and component lifetime, and product weight.

BeoMedia 1

Table 5.9 gives an overview of the causes of environmental impacts and the improvement potentials, as given in the preparatory study of Lot 5.

Table 5.9 also lists very specific causes of environmental impacts. Examples of causes are integrated circuits, caps and coils. In both preparatory studies it is emphasised that the single most important impact is the energy consumption. With regard to computers it is the general use stage, whereas it is the no-load losses for external power supplies.

Stage	Causes of Impacts	Improvement Potentials
Development	Computer • Integrated circuits • Surface mounted devices • Big caps and coils • Printed Wiring Board (PWB) manufacturing • Sheet metal manufacturing External power supply • Big cap and coils • PWB • Copper wire • Plugs • Capacitors • Transformers • Aluminium heat sink	• Improvement of energy efficiency of processor • Improvement of the energy efficiency of power supply • Reduction in energy consumption through introduction of adaptive clock frequency • Improvement of energy efficiency of motherboard • Improvement of energy efficiency of power supply • Noise reduction and improvement of energy efficiency by choosing the right hard drive such as a flash drive or hybrid drive • Noise reduction by choosing liquid cooling technologies • Replacing linear technology with switch-mode technology in the power supply • Utilisation of energy efficient diodes • Reduction of material consumption • Preparation of Eco-profiles • Extension of product lifetime through standardisation of interfaces • Display of consumer information
Use	Computer • Energy consumption External power supply • Energy consumption (no-load losses)	• Education of the marketing organisations • Information campaigns towards consumers • Changes in consumer behaviour towards no no-load losses
Disposal	External power supply • Incineration of plastics and PWB • Disassembling of PWB	

Table 5.9 Causes of environmental impacts and improvement potentials related to BeoMedia 1, as highlighted in Lot 3 and Lot 7. Further information on improvement potentials can be found in (European Commission DG TREN 2007a, VII1-VII37) and (European Commission DG TREN 2007b, 165-170).

When looking at the improvement potentials, also very specific elements are listed, such as introduction of adaptive clock frequency and liquid cooling technologies for computers. With regard to the external power supplies, improvement potentials focus on for instance utilisation of efficient diodes, reduction in material consumption and display of consumer information. In overall terms the improvement potentials focuses on reduction of energy consumption, noise reductions, extension of product lifetime, and consumer information.

On this basis, it is assessed that possible requirements in the implementing measures will be focused on energy consumption in the use stage and no-load losses for external power supplies. Further, requirements might be set up for noise, material consumption, extension of product life and information provided to consumers.

5.4 Discussion of the EuP Directive and its Requirements

The objective of the Directive is to integrate environmental consideration in the design stage of energy-using products, and to ensure free movements of these products on the European markets. The Directive is primarily to be implemented through implementing measures, though companies have the possibility to form voluntary agreements. This option however, is at present considered an unlikely outcome, as no branches yet have formed any agreements. The Directive makes use of different policy instruments, though mainly normative regulation in the form of requirements, both on companies and their products.

In relation to the theory of determinants for eco-innovation of Rubik (2005), as presented in Chapter 1, it is clear that the EuP Directive as an IPP-approach mainly seeks to influence innovation through public regulation. A central point in the theory is that innovation also is influenced through a market pull, a technology push and a company's self regulation measures. This means that the EuP Directive cannot stand alone as it is one approach among several possibilities. Other means to promote innovation could be economic support to develop better technologies, creating incentives in the market for greener products for instance through public green procurement or supporting companies in their self regulation activities, for instance through information.

The recommendations of all three preparatory studies are in line with the expectations of several interviewees. Even though the recommendations are found through the analysis of the preparatory studies relevant for BeoVision 7 and BeoMedia 1 it is assessed that given their general character they are applicable for other B&O products as well. Traberg (2007) also mentions material use, recycled materials and waste as aspects that are likely to become part of generic ecodesign requirements. There appears to be no doubt that the specific requirements will encompass energy efficiency (Nielsen 2007b; Traberg 2007; Sternest 2007a; Poll 2007a). Nielsen (2007b) states that the reason is given by the background of the Directive, which was a wish for reduction of the energy consumption, and the EuP Directive is a fairly simple measure to achieve these reductions. Furthermore, Nielsen (2007b) and Traberg (2007) also consider noise as being an aspect likely to be regulated, as it is possible to make clear testable limit values. A tightening of requirements could for instance happen as technologies improve, or as a broader political consensus within the Community is achieved.

All interviewees are confident that it will be manageable for Danish companies to comply with the product related requirements of the Directive (Nielsen 2007b; Poll 2007a; Sternest 2007a; Traberg 2007). Traberg (2007) further believes that the areas in which the companies might not be able to comply with or where long term limits are made will function as a point of orientation and show in which direction the companies should move. All interviewees however, point to a number of significant administrative challenges. Nielsen (2007b) mentions the bureaucracy that might follow, related to the declaration of conformity, and the testing and documenting of product performance. Poll (2007a) foresees the availability of data and documentation as a major challenge, as European companies are not interested in providing these data. He finds that especially European companies act very protective towards their company data, and this might hinder competition with for instance

Asian companies, which operates in a more open manner. Giving consumers more information about product related environmental impact is also seen by Poll (2007a) as a way to make environmental performance a competitive parameter. Traberg (2007) additionally mentions challenges in relation to information gathering from suppliers outside the EU, but finds that many companies already have some experiences in this regard following the RoHS Directive.

The implementing measures will give minimum requirements, minimum in the sense that they represent the minimum level of environmental work that companies must establish for complying. In many cases, it can be assumed that the minimum requirements not will be difficult to live up to, especially for Danish companies, and it is questionable whether the EuP Directive actually will lead to the integration of environmental considerations in the design stage. As the implementing measures are still to be completed, no requirements are yet certain. However, the analysis completed in this chapter presents an assessment of the likely requirements for the two products, and thus the changes in product performance, which needs to be initiated. It is assessed that the mentioned requirements for the two products will resemble those to be included in other implementing measures. The following gives an estimate of the challenges the companies initially should expect to focus on:

- Selecting one out of five strategies for compliance, based on current company experiences
- Specific requirements: standby in particular, and most likely on-mode and noise
- Gathering of data from suppliers located outside the Community
- Documenting compliance

Based on the statements and the analysis in this chapter, it is found that companies most likely will benefit from adopting a proactive and more long-term stance in relation to compliance. This is also a further opportunity to get more focus on ecodesign and product improvements in the design stage, than what appears to become the consequences of the EuP Directive. By being proactive, a company would not only be better prepared if new requirements are introduced, but it could also give some first-mover benefits, and send a positive signal to the market and the consumers. A company being a frontrunner in ecodesign might ensure a better fulfilment of the objectives of the Directive than the Directive will provide itself. Proactive actions could thus evolve around ecodesign, but could also be communication in the product chain and within all departments.

The considerations mentioned in this section, both regarding specific requirements, the potentials for a more encompassing legislation to come, and the shortcomings of the EuP Directive, form the point of departure for Chapter 6. This chapter describes how B&O can comply with the requirements of the Directive, and how a more proactive strategy for improving product performance can be incorporated.

Improving the Environmental Performance of Products

6

This chapter answers the following research questions: which measures can support B&O in the process of ensuring compliance with the EuP Directive? And additionally, which measures can support the incorporation of a proactive strategy for improving product performance? First, an analysis of B&O in relation to the requirements of the Directive is presented. Secondly, recommendations are made for complying with the different identified requirements, and thirdly a model for a more proactive strategy is presented.

The first part of the chapter takes a point of departure in the present environmental management at B&O, to identify challenges for complying with the requirements of the EuP Directive. Based on this, the project group gives recommendations for different measures, which B&O could consider in order to achieve compliance. In the second part of the chapter, it is investigated how B&O could adopt a more proactive strategy in order to improve product oriented environmental performance. The project group also gives recommendations for measures to apply in this regard, and these are summarised in an overall model.

6.1 B&O in Relation to the EuP Directive

This section gives an overview of the environmental management at B&O, based on the descriptions and analyses presented in Chapter 3 and 4. From this a number of challenges related to the implementation of the EuP Directive are identified.

The overview is presented in Table 6.1, where the character of the environmental considerations are arranged according to four categories; are the considerations obligatory or non-obligatory, are the considerations related to specific environmental projects or has there been an intentionally deselection of environmental considerations. Secondly, it is highlighted which category of the EuP Directive the considerations are related to. This categorisation is helpful in order to determine the challenges for B&O to achieve compliance.

Character	Key points in environmental considerations	Category
Obligatory	• Mandatory requirements covering certain aspects	• Ecodesign requirements
	• Procedures established for controlling compliance with mandatory requirements	• Ecodesign requirements
	• Checklists regarding packaging, WEEE and batteries are to be filled out	• Information/control of compliance
	• Procedures are established to document performance in other CE related areas	• Control of compliance
	• Contact with and evaluation of suppliers	• Information/control of compliance
Non-obligatory	• Going beyond mandatory requirements in product development	• Ecodesign requirements
	• Using the guide for environmental friendly product design	• Ecodesign requirements
	• Product developers, in particular constructors are supported during product development	• Ecodesign requirements
	• Environmental considerations enter Idealand	• Ecodesign requirements
Specific environmental projects	• Implementation of an EMS	• Management system
	• Data has been provided for the eco-labelling criteria for televisions	• Eco-labelling
	• Data provided for the preparatory study for Lot 5, and B&O represented at meetings where the studies are discussed	• Responsibility and influence of the producer
	• The leaflet Down to the Smallest Detail is prepared annually	• Information
	• Preparation of Q&A-sheets	• Information
Intentional de-selection	• B&O is not interested in additional labels on the products, including eco-labels	• Eco-labelling
	• Idealand is free of any environmental requirements	• Ecodesign requirements
	• Environmental information is not used as a marketing parameter	• Information

Table 6.1 Key points of the environmental management taking place at B&O, in relation to the EuP Directive.

As the table shows, B&O is working with many different aspects relevant for the implementation of the EuP Directive. Intentional de-selections have however been made, which might hinder or complicate compliance with the Directive. A primary objective of the Directive is the integration of environmental considerations in the design stage, and at B&O it is obligatory to consider environmental aspects through the mandatory requirements. These however only cover certain aspects, and do not apply directly to Idealand.

The existing procedures and strategies can be used as a point of departure for complying with the requirements of the EuP Directive. The challenges, which a company initially should focus on, are presented in the unordered list in Section 5.4. These are also relevant for B&O to consider when initiating the process of achieving compliance, and a slightly alteration of these to the case of B&O gives the following list of potential challenges:

- Choosing a strategy for compliance
- Setting up procedures needed for implementing the chosen strategy

- Meeting ecodesign requirements beyond what is already included in the present mandatory requirements
- Documenting compliance
- Gathering of data from suppliers located outside the EU

These five points are used as a guiding principle for the following section that presents a number of measures, which the project group recommends B&O to apply in order to ease the process of achieving compliance with the EuP Directive.

6.2 Ensuring Compliance with the EuP Directive

The recommendations take a point of departure in the existing environmental management, to make the compliance with the EuP Directive integrated in existing activities. It should be noted that other measures could be relevant as well, but those recommended in this section are found to be most expedient, based on knowledge gained through the different analyses. The recommended measures are used as a point of departure for Chapter 7.

6.2.1 Choosing a Strategy for Compliance

A first step in the compliance process is to decide for one of the five compliance strategies, as this choice becomes decisive for the further actions needed to ensure compliance. The following list presents some considerations in this regard:

- A voluntary agreement for television and DVD producers, which B&O was part of, has recently been dissolved to exclude the free rider opportunity (Nielsen 2007a)
- Eco-labelling could be an opportunity, but the product manager Torben Kyed states that B&O is not interested in marking the products with labels, as this will confuse customers (Kyed 2007)
- The harmonised standards are not yet prepared
- B&O does not fulfil any of the requirements for internal design control given by Annex IV of the Directive
- B&O has begun the implementation of an EMS

Based on these broad considerations, either the management system or following the harmonised standards could be possible solutions, as the other strategies are found incompatible with the existing environmental management at B&O. Since the harmonised standards have not been prepared, it is not yet possible to base a compliance strategy on these. It is therefore recommended that a management system in compliance with Annex V of the Directive is chosen as a compliance strategy.

6.2.2 Setting up Procedures

Different approaches can be applied to comply with Annex V. First, the company can implement a management system that follows Annex V. Secondly, EMAS registered management systems, and according to Traberg (2007) also ISO 14001 certified companies are presumed to be in compliance if the design function is included.

B&O is currently implementing an EMS to be certified according to ISO 14001, also including the design function. However, this is not yet systematised, and it will not be certified until a couple of years (Nielsen 2007a). The following elements, as given by Annex V of the EuP Directive, should be considered in the management system:

- Environmental product performance policy
- Planning
- Implementation and documentation
- Checking and corrective action

These four points are all related to the plan-do-check-act cycle, a central structure of management systems. This cycle has a helix structure, meaning that results from one passage serve as input for the next. Going through the elements of the cycle therefore creates a foundation for continuous improvements, which is the core strength of the cycle (Fussler, Cramer and van der Vegt (eds.) 2004, 57).

6.2.3 Meeting Ecodesign Requirements

The analysis of the preparatory studies shows that the specific requirements most likely will focus on standby energy consumption, on-mode energy consumption and noise, which B&O does have experiences with. The first aspect is part of the mandatory requirements, regulated with specific limit values. The second aspect is also part of the mandatory requirements though only monitored, and the third aspect is measured for each product as part of a quality assessment. To achieve compliance, it is recommended that the requirements given by the implementing measures become part of the mandatory requirements, and considering these specific requirements during product development is not expected to become a major difficulty.

6.2.4 Documenting Compliance, Gathering Data and Administrative Issues

To achieve compliance, B&O should issue a declaration of conformity each time a new product is developed. In this regard it is recommended that procedures are established to make sure that the declaration is issued, and that relevant information regarding the mandatory requirements is included in the documentation.

In cases where B&O imports from manufacturers outside the EU, B&O takes over the responsibility for ensuring that the product is in compliance with the implementing measures before placed on the market. This means that B&O in these cases needs to obtain information and data from suppli-

ers in order to document compliance. A small share of the suppliers is located outside the EU, but it should be noted that even few suppliers could cause large challenges. It is therefore recommended that B&O establishes procedures for gathering information from suppliers and ensure supplier compliance. In relation to B&O, it is recommended that the required information to consumers becomes part of the user manual. This could happen through the set up of a mandatory requirement.

In summary, when looking at the recommended measures given throughout Section 6.2 it does not appear to become an overwhelming task for B&O to follow these directions. One of the reasons is that the compliance process is focused on creating reifications in the form of various procedures. As a result, achieving compliance with the EuP Directive give limited incentives for participation, besides following the procedures. All companies should comply with the requirements of the Directive, and following the recommended measures will therefore not result in any particular first-mover benefits for B&O, besides ensuring a smooth compliance. In the following sections a more proactive strategy is discussed.

6.3 From Compliance to Product Improvements

It can be questioned, whether the EuP Directive will obtain its objective of significantly improving a product's environmental performance, based on the arguments presented in the previous sections. This seems at least to be the case for the first generation of requirements. In relation to the EuP Directive, the primary challenge for B&O is therefore not to achieve compliance with the Directive's requirements; rather it will be to achieve the Directive's objective. This challenge is the focus of this and the following section, which investigates which measures a company could establish in order to proactively address product oriented environmental performance. In this sense, a proactive company can set the agenda for environmental management, and thereby influence the pace of pollution prevention, which in the long run can be reflected in the regulatory setup and even in the market conditions. The measures are all recommendations, and it is up to B&O to decide whether these actually should be implemented.

The proactive strategy can also be seen in relation to the development of the environmental awareness in industry, as presented in Chapter 1. In this regard, the objective of the EuP Directive is to create cleaner products, which is the second last step on the stair presented in Figure 1.1. In reality however, it seems that the EuP Directive is more an administrative matter, and more a first step in a process. Figure 6.1 presents the steps to reach product related environmental improvements, which are further explained in the following.

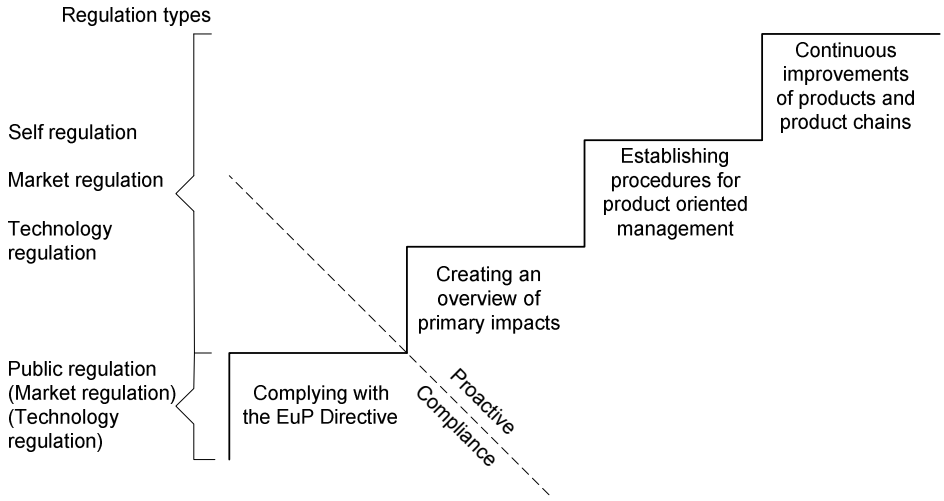


Figure 6.1 Achieving product related environmental improvements can be seen as a process of taking different steps on a stair, where complying with the EuP Directive can be seen as the first step. The figure is inspired by Remmen and Münster (2002, 9, 18-22) and Remmen (2001, 57-9).

Figure 6.1 presents different steps found necessary in the development towards continuous improvements of products and product chains. For each step, a number of measures can be applied in order to guide and assist the management carried out by a company. The measures related to complying with the EuP Directive, the first step, are presented in Section 6.2.

A central element in Figure 6.1 is the dotted line that separates complying with the EuP Directive from the other steps of the stair. The line illustrates a paradigm shift, since the two parts of the stair have very different levels of ambition. The paradigm shift also becomes clear when looking at the regulation types applied for the two strategies: the compliance strategy is relying on public regulation, and to some degree market and technology regulation, whereas self regulation combined with market and technology regulation become significant in a proactive strategy. The compliance strategy is primarily concerned with meeting legislative demands, whereas the proactive strategy is concerned with how to achieve first-mover benefits, and how to create environmental improvements which can benefit the company as well. A central aspect in the proactive strategy is the focus on co-operation in the product chain.

In the following section, the project group gives recommendations for the measures which B&O could apply when climbing the steps presented in Figure 6.1.

6.4 Measures for Improving Product Performance

The three upper steps of Figure 6.1 are used as a structuring principle, and for each step a number of measures are recommended. These recommended measures are used as a point of departure for Chapter 8. Compared to the recommendations given in relation to the compliance strategy, the recommended measures of this section are broader and less definitive. B&O is currently implementing an EMS, and it is sought to structure the recommendations in line with this. The recommendation

of measures are based on studies of various literatures, which all apply a broad and all-inclusive perspective on companies' product oriented environmental management, and which therefore gives a broad understanding of challenges and specific possibilities related to this. It has not been the ambition to show a complete picture of all possibilities related to pollution prevention, instead it is chosen to apply a broad and conceptual view, picturing how a company could strive for product oriented environmental improvements through a systematic approach.

6.4.1 Creating an Overview of Opportunities

The purpose of this step is to establish a basis for decisions about priorities and activities by creating an overview of the impacts related to a product, and by identifying the possibilities to improve performance. Inspired by Schmidt and others (2000, 37) and Remmen and Münster (2002, 14-5, 19) the following measures are recommended as part of the step:

- Investigate environmental impacts
- Identify improvement potentials
- Identify internal driving forces
- Identify external driving forces

These measures are part of an analytical approach, which is supported by different procedures. Some examples common for different sources are presented in Figure 6.2. The four overall measures are further explained in the following.

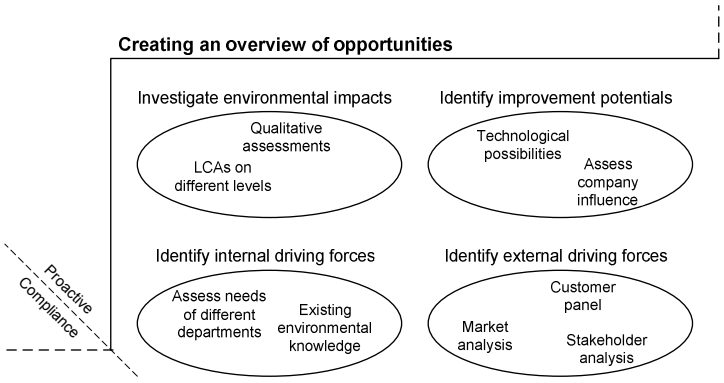


Figure 6.2 Different examples of procedures that can be applied under the recommended measures to create an overview of the primary impacts and thereby establishing a basis for decision. Procedures are inspired by (Schmidt 2000, 37-68, 87; Remmen and Münster 2002, 19-20).

The purpose of investigating the environmental impacts is to get a picture of the product life cycle. In this regard it is also relevant to investigate the potentials for improving performance, both looking at the company's influence and the possibilities related to new technologies. The identification of driving forces can give a view to what motivates the effort to improve product performance, and organising the environmental management to benefit from these driving forces would be expedient.

Some companies might have several products in their portfolio, and then it is relevant to decide if one product, a product group or impacts in common for several products should be in focus.

From the investigations priority areas should be identified, both related to the most significant impacts, and also related to the company's actual influence on these. At this point it is also recommended to investigate whether some actors in the product chain should be influenced to improve their performance. It is important that the company does not get lost in analyses and calculations, and in some cases it can be most expedient to start with the product aspects that seem easiest to improve.

The overview can be used as a point of departure for the formulation of a strategy that specifies what being proactive means for B&O. According to Hatch (1997, 101), a strategy refers to management's planned effort to influence organisational outcomes. An important aspect in relation to the success of the strategy is the management support, for instance through allocation of resources or management being open for employees' suggestions (Schmidt et al. 2000, 88-9). The strategy can be seen as the link between the overview of opportunities and a plan of action specifying how to reach the opportunities. This is the focus of the following section.

6.4.2 Establishing Procedures for Product Oriented EMS

The purpose of this step is to establish procedures and activities needed to realise the strategy. Inspired by Remmen and Münster (2002, 20), Jørgensen and Remmen (2005, 64) and the Danish Standards Association (2004, 5), it is recommended that the following measures are included in this step:

- Define improvement objectives and targets
- Describe activities for improving environmental product performance
- Prepare time schedule
- Define roles and responsibilities
- Build up competencies
- Set up systems for documentation
- Determine how and when the product oriented EMS should be evaluated

These measures have to be developed with participation of relevant employees, in order to make sure that the measures become part of the employees' mindset and routines. Focusing on participation might hinder that the measures only become reifications. Measures for establishing product oriented procedures are included in Figure 6.3, with a further specification of the variety of project activities to create product oriented environmental improvements. The activities included are all highlighted by several sources, for instance Schmidt and others (2000, 87). The recommendations include many different departments, as the product oriented approach often seeks a larger participation of several departments. The specific choice of activities is influenced by the strategy formulated in the previous step.

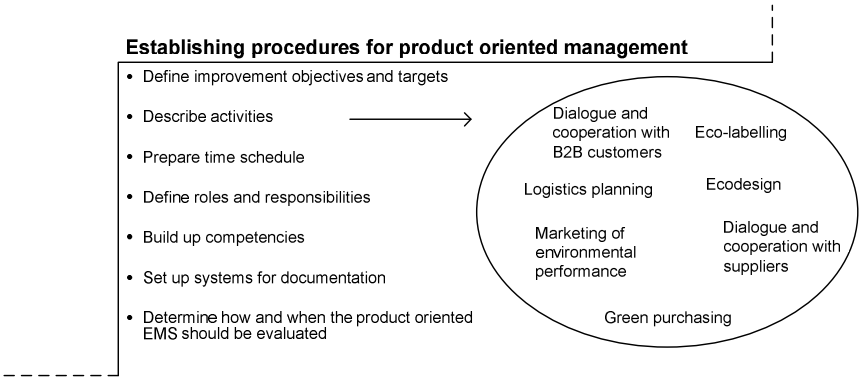


Figure 6.3 Different measures to include when establishing product oriented procedures. Project activities are further specified, in order to give an impression of the range of possibilities. Inspired by Schmidt and others (2000, 87) and Remmen and Münster (2002, 25).

The purpose of the measures presented in the left side of Figure 6.3 is to establish a frame for the product oriented EMS. This should ensure that the management is structured; both to make it clear what should be taking place, and that participating employees know what their roles and responsibilities are. In other words, this step creates a platform to meet objectives and targets. As seen from the right side of Figure 6.3, a number of activities are relevant for improving product performance. In Chapter 8 it is further elaborated how some of the activities highlighted can be initiated and implemented at B&O.

6.4.3 Continuous Improvements of Products and Product Chains

The final step on the stair presented in Figure 6.1 serves the purpose of ensuring continuous improvements. A central aspect is that the procedures and activities developed in the previous step are brought into play, and following these are evaluated against the objectives and targets as the work progresses. Figure 6.4 recommends some measures, which it is relevant for B&O to consider for ensuring continuous improvements.

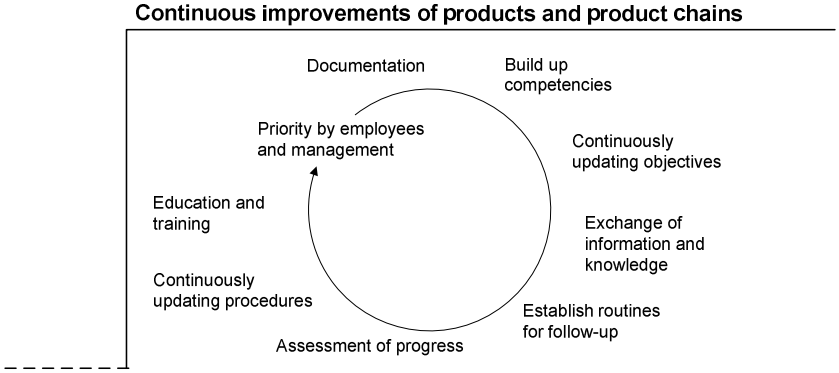


Figure 6.4 Examples of measures that can be applied to ensure continuous improvements. The loop is an illustration of the continuous improvement, and management is seen as a core driver in this regard. The measures are inspired by Schmidt and others (2000, 85, 128, 143), Remmen and Münster (2002, 22) and Danish Standards Association (2004, 7-9).

The priority and support given by employees and management through their participation is a core driver for creating continuous improvements, and it is therefore placed in the loop in Figure 6.4. In this regard it is also important that the systems for documentation are applied, as to make sure that experiences and efforts are documented. Another central point of the figure is the continuous evaluations and exchange of knowledge, in order to further develop activities and update focus areas. One example is that procedures for transferring experiences from one product development process to the next should be established. In this regard, the continued training and education of employees is important. Internal and external driving forces can also help ensuring the continuous development of products and product chain.

6.5 Discussion of Strategies

In line with the problem definition, two different strategies for improving environmental product performance are discussed throughout this chapter: a compliance strategy, and a proactive strategy for improving the environmental performance of products.

The recommended measures related to the compliance strategy are summarised in the following list:

- Choose the management system as a strategy for compliance
- Comply with mandatory requirements for standby, on-mode energy consumption and noise limits
- Establish procedures for and complete declarations of conformity
- Establish procedures for gathering information and ensure supplier compliance
- Comply with mandatory requirements on customer information in user-manuals

As seen from the list, the compliance strategy is focused on setting up reifications in the form of procedures and administrative alterations. As a result the participation might be limited, besides those employees following the procedures in order to meet the specific requirements. The mandatory requirements are important reifications of this strategy, but only few employees at B&O have to consider and react on these. Even though the reifications in the form of various measures might not be implemented over night, it does not appear to be an overwhelming task to follow these.

The measures recommended for a more proactive strategy on improving product performance are summarised in the model presented in Figure 6.5.

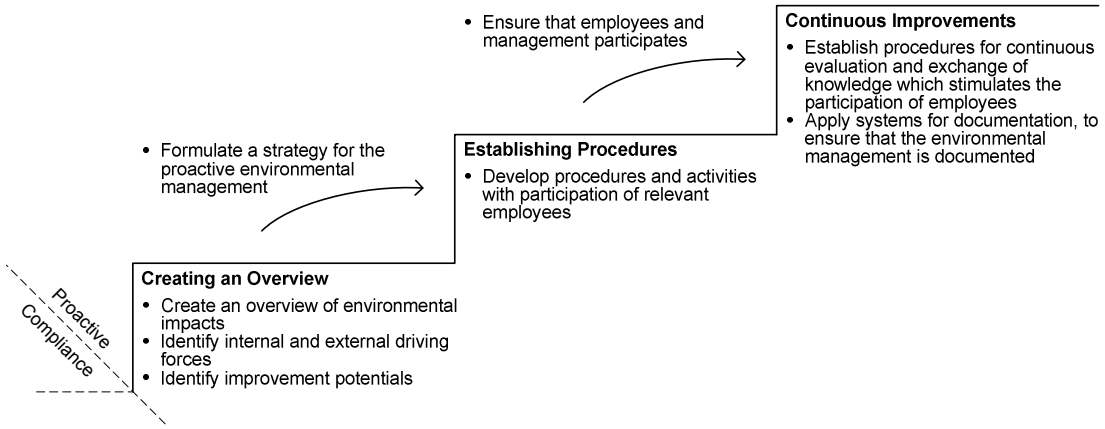


Figure 6.5 Model showing the measures recommended for a proactive strategy as regards improvements of product performance.

Figure 6.5 can be perceived as an overall model, which shows how a company can develop a product oriented EMS. The arrows show how a company, in theory, uses the knowledge created in one step to get to the next. Compared to the compliance strategy, the recommended measures for a proactive strategy are much broader and aimed at different departments and levels in the company. The strategy also gives room for a broader participation, and also ensures that reifications are created to establish a well-functioning product oriented EMS. The actual participation however is determined as the system evolves, by ensuring the participation of relevant employees. If participation not is given priority, the management system might only be reification, which in itself is of no benefit for the company. To establish a community of practice related to the product oriented environmental management, it is therefore important to focus both on the reification and participation related to the process.

In the following part of the report, the specific actions, which can be recommended in order to climb the stairs presented in Figure 6.1, are in focus. This is further explained in the following dividing leaf.

Part 3: Process of Change

This part of the report constitutes the process of change part, and is thereby the final part of the trisection. The purpose of this part is to give recommendations for how B&O can achieve the objectives outlined in the second part, by specifying the measures presented in the second part into a number of more concrete actions. This part should therefore illustrate the path towards the objective. Two research questions are related to this part:

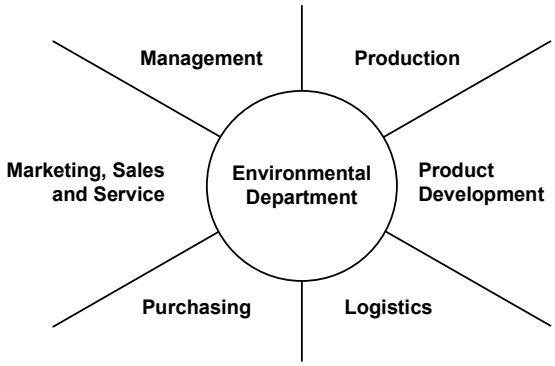
- Which actions should be initiated at B&O for ensuring compliance with the EuP Directive?
- Which actions should be initiated in order for B&O to introduce and implement a proactive strategy for improving the product related environmental performance?

Analytical Framework – Part 3

This dividing leaf serves the purpose of presenting the framework used to apply the measures presented in Part 2 into the context of B&O. This is presented in Chapter 7 and Chapter 8, which constitute Part 3 of the report.

Chapter 7 specifies how the strategy for complying with the EuP Directive could be implemented, while Chapter 8 specifies how a proactive strategy for improving the environmental performance of products can be implemented.

Both chapters use a figure developed by Schmidt and others (2000, 87), which shows different measures a company can apply in various departments to work with the product related environmental impacts. The figure is presented below, though without any suggested measures.



The logic of the figure is applied to ensure that all relevant departments are covered when developing actions and the figure is used to give an overview of the recommendations given. The idea behind the figure is that the environmental department becomes the focal point when working with product oriented environmental issues, as the department often will play a central role in terms of coordination and education. However, depending on the scale of the organisation's environmental management and the specific project, the environmental department can be more or less central. Around the environmental department other departments involved in management of product related environmental issues are placed. In the following two chapters, the figure is specified for the situation at B&O, meaning that the involved departments and actions are adapted to suit the recommendations given.

The recommended actions are formulated with a point of departure in existing practices and culture at B&O, and inspiration for the actions is sought in various literature. For both strategies the theory on communities of practice, presented in Appendix B is also applied in order to give an overview of the scope of the changes needed to implement the two strategies.

A Strategy for Complying with the EuP Directive

7

This chapter answers the research question: which actions should be initiated at B&O for ensuring compliance with the EuP Directive? First, recommendations are given for each of the identified requirements in the Directive and secondly, the recommendations are analysed according to the needed changes in communities of practice.

The recommended measures for the compliance strategy, as given in Chapter 6, are summarised in Table 7.1, supplemented with information on the assessed level of experience at B&O in regards to the specific measures. This assessment is based on the analysis of the integration of environmental aspects in the product development process.

Recommended Measures	B&O's experiences with topic
Choose the management system as a strategy for compliance	Little
Make and comply with mandatory requirements on standby	Many
Make and comply with mandatory requirements on on-mode energy consumption	None
Make and comply with mandatory requirements on noise limits	Many
Make and comply with mandatory requirements on needed customer information in user-manuals	Many
Establish procedures for gathering information from suppliers and ensure supplier compliance	Little
Establish procedures for and complete declarations of conformity	Little

Table 7.1 Suggestions for actions to ensure compliance, including an indication of B&O's level of experience related to the specific measure.

The measures listed in Table 7.1 are operationalised through a range of recommended actions of relevance for different groups and departments. The recommended actions are based on existing practices and culture at B&O, to make the recommendations in accordance with already implemented procedures. The focus is therefore also how the process of complying with the EuP Directive could be carried out as straight forward as possible. The process of formulating the actions is structured according to the following points:

- What are the experiences at B&O with regards to each measure?
- What actions are recommended in order to operationalise the different measures?

- Which departments should be involved in the needed actions?

Following, the influence on communities of practice is discussed on an overall level. In the end of the chapter it is discussed how expedient the recommended actions are, taking a point of departure in their adaptability for future requirements.

7.1 Management System

The EMS currently being implemented at B&O is assessed to be in compliance with the requirements of Annex V of the Directive, as long as the design function is included and the system is certified according to ISO 14001. The experiences are however limited, as the implementation process has just been initiated. The following actions are therefore recommended for complying:

- Complete current implementation of an EMS
- Ensure that the design function is incorporated through objectives, targets and procedures
- Achieve ISO 14001 certification

Lone Nielsen and Mette Juhl of the SHE Department[9] should assume the primary responsibility for these actions, following their present responsibility for the on-going work to implement the EMS. This means that they are responsible for writing instructions and procedures, and ensuring communication and development in the process. Especially the design function, that is Idealand and the Product Development Department, is crucial following the requirements of the EuP Directive. Attention should therefore be given to ensure that this function is included; both through specific objectives and targets approved by management, but also through the involvement of employees representing these functions. These employees could be made responsible for implementing the EMS in their departments, in collaboration with the SHE Department.

7.2 Mandatory Requirements

Four of the suggested measures in Table 7.1 concern the need for establishment of new or alteration of existing mandatory requirements. Each is assessed in the following, and the recommended actions are discussed for each. The specific requirements should be approved by the mandatory requirements group, and following become part of the responsibility of the T&A Department. Following, it is the responsibility of the Product Development Department to comply with the requirements.

[9] When referring to the SHE Department in this chapter, there is specifically referred to the employees of the department concerned with product environment.

7.2.1 Energy Consumption in Standby

Energy consumption in standby is a well-known issue at B&O, and is thus seldom a topic of discussion. This is the case for both setting up the requirements and complying with them. The constructers are aware that the requirements exist and, though it can be challenging, they are familiar with how to optimise the products to ensure compliance. This is assessed to be a clear advantage, as it is assumed that B&O already at this point can comply with the requirements for standby. The following action is recommended for complying:

- Administrative alteration of standby requirements from being internally given to being externally given

The administrative alteration is a minor operation, especially as the procedures for complying with the mandatory requirement, given by the milestones in the TOP-model, would remain the same.

7.2.2 Energy Consumption in On-Mode

Currently an internal mandatory requirement is that the energy consumption in on-mode should be measured for all products, but there is no demand for minimizing the energy consumption. There has, however, been an internal focus on the issue, as it has been a desire to increase the efficiency of the needed power supply (Nielsen 2007a). Besides this, many components are purchased from suppliers and B&O does therefore not have a direct influence on the performance of these components. Taking a television as an example, 80% of the on-mode energy consumption is related to the monitor, which is purchased from a supplier, and B&O has therefore only direct influence over the components causing 20% of a television's on-mode energy consumption. B&O faces a further challenge related to their televisions: a special anti-reflection coating is used on television monitors, and as a result the on-mode energy consumption of the televisions is larger than for other similar television produced by competitors. The potential requirement for on-mode energy consumption therefore appears to be the most challenging requirement, depending on the final scope of the requirement. This means that the actions recommended for complying, presented in the unordered list, will vary accordingly:

- Adopt a mandatory requirement on on-mode consumption
- Focus on the on-mode energy consumption of components which B&O can directly influence
- Set up specific demands to energy efficiency, and collaborate with partners and suppliers to achieve this

To implement these actions, the Product Development Department should strengthen its focus on the on-mode consumption, for instance trough various projects. The primary challenge related to this requirement is assessed to occur in situations where a stronger collaboration with partners and suppliers becomes a necessity in order to meet the requirements.

7.2.3 Noise Limits

Noise is currently not a mandatory environmental requirement, but it is an issue with significant focus due to the overall quality experience of the product. Actions are thus being conducted and compliance is not seen as a challenge. The following actions are therefore recommended for complying:

- Adopt a mandatory requirement on noise limits

At the moment, product environment at B&O does not encompass noise from the products, but the recommended action would entail a broadening of this understanding. In practice it would mean that noise measurements could be conducted as usual. The results should be transferred to the person responsible for the mandatory environmental requirements, who should assess whether the product is in compliance with the requirements.

7.2.4 Information in User-Manuals

The Service Department is responsible for adding information in user-manuals. As for environmental information, one example is related to the information required through the WEEE Directive, where a mandatory requirement was adopted. The following actions are thus recommended for complying:

- Adopt a mandatory requirement on information to the end-users about their role in the sustainable use of the product

It appears that adopting this mandatory requirement is a one time task, and incorporating the required information in the user-manuals appears to be a rather uncomplicated task. Furthermore, the needed information would be similar for many products.

7.3 Information from Suppliers

The Purchasing Department has previously collected environmental information from the suppliers. A recent example was during the RoHS compliance process, where the Purchasing Department completed the process in minor collaboration with the SHE Department. Langergaard (2007) has expressed concern about the speed in which the information was gathered. Despite this being an exhaustive process, the method is well known, and in order to ensure compliance the following actions are recommended:

- Gather information on energy consumption in the use phase for all imported components, using the same procedures as in the RoHS compliance process
- Collect and integrate the information in the declarations of conformity

Using the same approach for gathering information as applied in the RoHS compliance process does not require significant changes in working procedures; however a stronger collaboration between the Purchasing Department and the SHE Department might be needed. The SHE Department should also support the purchasers, to ensure that the interactions with suppliers regarding environmental issues are in coherence with the policies B&O has on environmental matters.

7.4 Documenting Compliance

A variety of legislation imposes B&O to document compliance. This is for instance the case with regards to RoHS compliance where documents showing compliance must be kept for a minimum of four years (European Commission 2003a). Another example is related to the EMC and safety requirements, as a part of the CE marking, where B&O stores the information in a folder. In both cases the documents are kept until requested by the authorities. In relation to the EuP Directive, standardised procedures for documentation are expected to be prepared. The following action is recommended in order to comply:

- Apply the standardised procedures for documentation

By following the standardised procedures, it is assessed that the process for documenting compliance will be rather simple. Furthermore, the storage of the compliance documents could be integrated with other already existing systems. Since information is to be provided by suppliers through the purchasers, it is also in this situation recommended to strengthen the interrelations between the Purchasing Department and the SHE Department, for instance through regular briefing meetings and exchange of various policy and assessment documents.

7.5 Departments Involved in the Compliance Strategy

In summary, Figure 7.1, shown on the following page, illustrates which actions the different departments of B&O are recommended to implement as part of complying with the requirements of the EuP Directive. It is expected that many of the actions recommended, can be integrated in already existing activities through the experiences possessed by the involved employees. This means that few changes in practices are needed, and it can be questioned whether the compliance strategy will significantly improve the environmental performance of products. Furthermore, the recommended actions can be implemented through the TOP-model, meaning that the understanding of environmental considerations as requirements does not have to change. The following section discusses how the compliance strategy will influence the communities of practice at B&O.

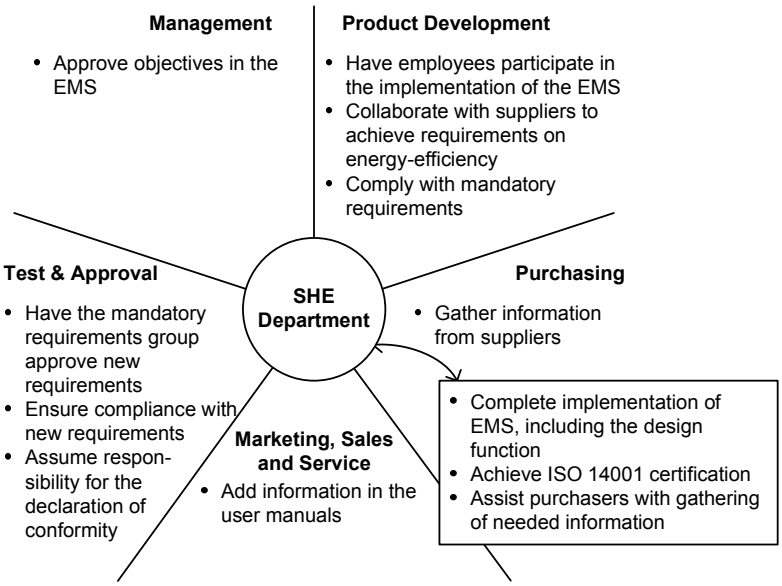


Figure 7.1 Actions recommended for the different departments, in order to comply with the requirements of the EuP Directive.

7.6 Communities of Practice

It is expected that some form of a community of practice engaged in the implementation of the EMS will arise following the current implementation process and the actions recommended. Given that mainly two persons are involved in the bottom-up implementation process, and as environmental considerations not are part of B&O's core values, it is not expected that the community will be strong. The core shared domain of interest for the community is to get the EMS up and running, which could involve an understanding of environmental issues as more than mandatory requirements. When solely viewing the EMS as part of a compliance strategy, it does not appear that there is a strong need for cultivating the community. A reification of this community could be written procedures and the ISO 14001 certification, which illustrates the compliance. The ISO 14001 standard often entails a focus on production sites, which would have to be expanded to include the Product Development Department. Other reifications could be procedures, objectives and targets, which also should function as boundary objects towards other departments of B&O. Besides the two employees currently being the primary responsible, also employees from various departments of the company participates to assist the implementation, though only little participation is assessed necessary to have the EMS comply with the requirements of the Directive. The community and its practise is illustrated in Figure 7.2.

Figure 7.2 Illustration of participation and reification for the community engaged in the implementation of the EMS.

As regards the existing communities of practise, as identified and described in Section 4.4, it does not appear that the implementation of the EuP Directive will give rise to significant changes. Rather minor alterations and additions in reification and participation will be needed, which are summarised in the following list:

- New mandatory requirements should become reifications in the community engaged in the mandatory requirements, as well as in the community engaged in realisation of projects. The participation could happen around discussions of projects, models and types of measurements
- If the requirements of the EuP Directive cannot be met, the community engaged in realisation of projects would need to request suppliers to improve performance. Reifications could for instance be technical drawings or specific limit values, whereas the participation could be meetings or contact over telephone or email
- The information provided from suppliers is a reification in the community engaged in purchasing, and this serves as input to other communities

The recommended alterations and additions as regards participation and reification are not assessed as entailing a change in the usual practice in the communities involved. In contrast, the EuP Directive is assessed to cultivate the current practice for incorporating environmental considerations.

7.7 Discussion of the Compliance Strategy

The recommendations given in this chapter are based on the requirements of the EuP Directive, as identified in Chapter 5. This means that no considerations have been made about how expedient the compliance strategy and related recommendations are in a long-term perspective, reaching beyond the initiating challenges of complying with the EuP Directive. It does however seem expedient to consider whether the compliance strategy is sufficient in relation to the future development. Issues in this regards are:

- Is the approach previously used for gathering information from suppliers sufficient? Or should collaboration with suppliers be strengthened and the methods made applicable to future requirements on supplier information?
- Is it expedient to only include information to customers in user-manuals? Or should customers be given the opportunity to seek environmental information elsewhere?
- Will the understanding of environmental issues as mandatory requirements strengthen the focus on improving the products environmental performance? Or would it be beneficial if employees were getting accustomed to consider environmental issues beyond mandatory requirements?

At this point, there does not appear to be clear answers to these questions. However, it does seem likely that benefits could be gained from viewing the matter of compliance in a broader perspective, including considerations on possible future events. These are arguments leading to the focus of the following chapter, which gives suggestions for how a proactive strategy for improving environmental performance of the products can be implemented at B&O.

A Proactive Strategy for Improving Performance

8

This chapter answers the research question: which actions could be initiated in order for B&O to introduce and implement a proactive strategy for improving the product related environmental performance? First, reasons are given for why B&O should initiate such a process. Secondly, recommendations are given for which different steps that could be initiated in the process, including which departments that should be involved. Thirdly, the changes in communities of practice, following the recommended actions are presented.

The proactive strategy takes a point of departure in the three steps and related measures showing how a company can develop a product oriented EMS, summarised in the model presented in Figure 6.5. The measures are operationalised through a range of recommended actions aimed at different groups and departments of B&O. The recommendations are first of all based on already existing practices and understandings at B&O, and take a point of departure in the EMS currently being implemented, though not taking resources presently allocated for environmental management into account. Secondly, the recommended actions are also expanding the actions recommended as part of the compliance strategy. In all, the recommendations should support B&O to make the EMS product oriented.

In the end of the chapter, it is discussed how the proactive strategy will affect various communities of practice at B&O. As a point of departure however, the environmental management at B&O is discussed in relation to a proactive strategy.

8.1 Why Should B&O Adopt a Proactive Strategy?

B&O has an objective of being between the best third of the electronics companies as regards environmental performance. This ambition however, is not equal to being proactive in the sense of setting the agenda for environmental management. The following list shows different arguments for why B&O is different from proactive companies, revealed through the analyses conducted in this report:

- B&O is mainly reacting upon legislation. In some cases however, they are more proactive, one example is related to the RoHS Directive, where B&O had phased out brominated flame retardants before it became a regulatory demand

- Environmental considerations are seen as mandatory requirements and constraints
- Environmental considerations does not appear to be applied when discovering new technological possibilities for improving product performance
- Environmental considerations are not part of the stories generally told about products, even in product cases where good environmental stories are evident
- The perceptions above do not appear to be questioned by the majority of employees

Remembering the vision of B&O, which is to '*constantly question the ordinary in search of surprising, long-lasting experiences*' and relating it to the points above, it is clear that the vision does not apply to the product oriented environmental management at B&O. It is therefore questionable whether the vision is followed consequently as long as the perception of environmental issues is only focused on complying with mandatory requirements and not much more. In relation to the environmental work of B&O it is stated that everything has to be in order, but this is also rather incoherent with the vision, which talks about going beyond the ordinary. The prevailing perception is being challenged from several sides, and some of the tendencies are presented in the following list:

- Some customers have started to request information about the CO_2 emissions related to the products in order to plant trees to compensate
- Society appears to increasingly hold companies responsible for their impacts, and many of B&O's primary competitors have taken up this challenge
- More and more EU directives are aimed at improving product performance and many resources are used to ensure compliance
- B&O has experienced that business customers are focusing on environmental issues and request some level of environmental considerations and performance
- B&O has been ranked on a fifth place in a recent image survey of 111 Danish companies for their considerations of the surrounding society (Hansen 2007b, 106), indicating that people have certain expectations to their performance even though this is not clearly reflected in B&O's existing environmental management

Based on these tendencies, as well as the arguments questioning whether a compliance strategy is sufficient, it is recommended that the perception of environmental considerations at B&O is renewed to better match the company vision and expectations of society. In other words, proactively improving product related environmental performance should preferably also be inevitable when stating that high quality products are produced. The focus of this chapter is therefore how B&O could adopt a proactive strategy for improving the environmental performance of products, by focusing on the possibilities related to environmental considerations rather than the constraints.

When rethinking the perception of product related environmental performance, both management and employees play an important role, as the needed changes are rather widespread in the com-

pany. A starting point is therefore to consider how management and employees can participate in the process, which is the focus of the following section.

8.1.1 Involving Management and Employees

The purpose of involving management and employees is to help ensuring that a community of practice focusing on improving the environmental performance of products is created. In some sense the needed reification, for instance in the form of procedures and specific activities, are easier to create than the participation, which requires that a shared domain of interest for making the improvements is created.

When the product oriented EMS is to be initiated, the leader of the SHE Department and the employees of the SHE Department[10] concerned with product environment will be primary actors, though as an iterative process including more employees and departments.

A group of mid-level managers also with participation of the head of the SHE Department, should be formed in order to further the participation of the different departments. This is also an approach applied by for instance Grundfos (Grundfos 2007, 10). The group should be concerned with environmental issues on a more strategic level, and function as a link between management and employees. In this sense the group should help redefine the current understanding of environmental considerations as a question of compliance and mandatory requirements, to become a question of rethinking and proactively improving B&O's products. The following actions are recommended as part of the roles and responsibilities of the group:

- Formulate objectives for the product oriented EMS
- Assume the overall responsibility for the continuous improvement of the environmental performance
- Stay informed about the overall progress and challenges in the various departments

Throughout the chapter further actions are recommended to be included in the work of this group, which plays a major role for introducing and implementing the proactive strategy.

8.2 Creating an Overview of Opportunities

The purpose of this step is to establish a basis for the formulation of a strategy, and the identification of priority areas.

8.2.1 Investigate Environmental Impacts

B&O has several products in their portfolio, but according to Nielsen (2007a) many environmental aspects are shared by all products or within product groups. From the participation in the EDIP pro-

[10] When referring to the SHE Department in this chapter, there is specifically referred to the employees of the department concerned with product environment.

ject and the preparation of the leaflet *Down to the Smallest Detail*, B&O has some overview of the environmental impacts related to their products. According to Nielsen (2007a), energy consumption in the use phase always appears to be a significant impact in a life cycle perspective. Following the preparatory studies of the EuP Directive, also the use of certain substances and materials, as well as impacts related to the final disposal can be highlighted as significant environmental impacts related to electronic products[11] (Höglund, Freiesleben and Nielsen 1999a, 2). The following actions are recommended:

- Update the overview of environmental impacts, eventually downplaying energy consumption, which appears to eclipse other impacts
- Study other sources to identify primary impacts

It is not regarded a significant challenge for B&O to follow these recommendations, as similar practices already have been implemented. It is also important that the calculations and analyses are kept at a minimum, to avoid loosing the drive because of exhaustive data collection, where the investigation of environmental impacts becomes a pretext for doing nothing to improve product performance besides gathering data.

8.2.2 Identify Internal and External Driving Forces

Based on the interviews conducted for this report, it is found that the primary driving forces for B&O to apply a proactive strategy are related to the areas illustrated in Figure 8.1, which is explained in the following. Not all drivers are equally strong at the moment.

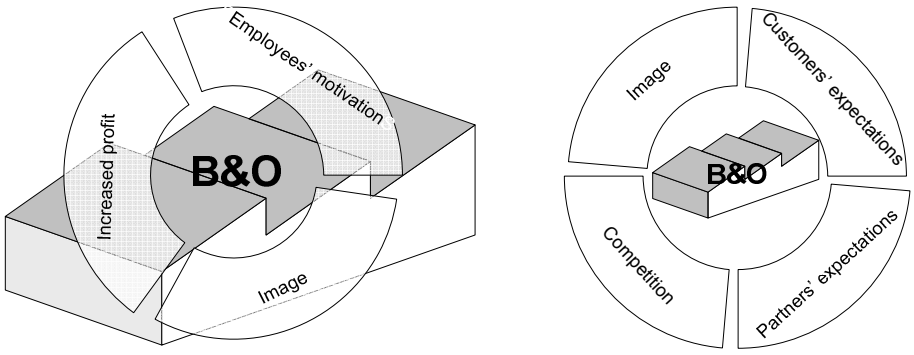


Figure 8.1 Internal and external driving forces at B&O for applying a more proactive perspective on improving product performance. Internal driving forces are illustrated on the left, whereas external driving forces are illustrated on the right.

[11] In addition, the continued use of some materials, in particular copper and aluminium in the case of B&O might not be beneficial from an economic point of view, as the price for these metals has been constantly rising over the last years (London Metal Exchange 2007a; 2007b).

During the project period a number of employees engaged in a proactive strategy have been identified. These are for example Lone Nielsen, Gert Yde Jacobsen, the leader of the production plant in Struer, representatives of Automotive and the SHE Department. Furthermore, Jan Tækker, who is the manager of the Department for Cross Functional Quality and Environment, participates in the newly founded Danish Council for Sustainable Business Development. He could be a broker for bringing in experiences from this forum to strengthen the focus and commitment on environmental issues on the strategic level. Image-related considerations become drivers when discussing how to attract and retain employees, and drivers are also related to the prosper of increased profit, either due to potential cost reductions or increased sale of improved products.

The primary external driving forces are related to the expectations of partners and customers. Langergaard (2007) states that partners, as well as suppliers, larger than B&O often are more advanced in their environmental management. This could influence B&O to improve their performance as well. For customer's expectations, especially demands from business customers are found to be a driving force. Competitive and image-related aspects can also entail some driving forces for further focus on product performance, especially if the market becomes more interested in environmental performance. To benefit from the driving forces outlined above, the following actions are recommended:

- Form a task force of the employees, which have expressed positive interest in a proactive strategy
- Discuss how partners and the most important suppliers manage their environmental impacts to learn from experiences and identify possibilities for co-operation
- Investigate customers demands regarding product performance and discuss if there are unmet demands

To form the task force, employees from different departments should be brought together and one of their first tasks is to act as fiery souls towards other employees. Over time the task force can be expanded, focusing on various aspects of improving product environment. Compared to the group of mid-level managers, the task force is more practical oriented, and can for instance also be consulted on specific challenges. For the further co-operation with partners, suppliers and customers, a closer collaboration is needed between the Purchasing Department, the Product Development Department, the Sales Department and the SHE Department, which at the moment is rather limited.

8.2.3 Identify Priority Areas

To identify priority areas, the identification of environmental impacts can be combined with considerations of improvement potentials and the company's influence (Remmen and Münster 2002, 20). The improvement potentials can for instance be related to unexploited technological potentials. Figure 8.2 shows how priority areas could be identified from looking at company influence and importance for the environment, which is a combination of environmental impacts and improvement potentials.

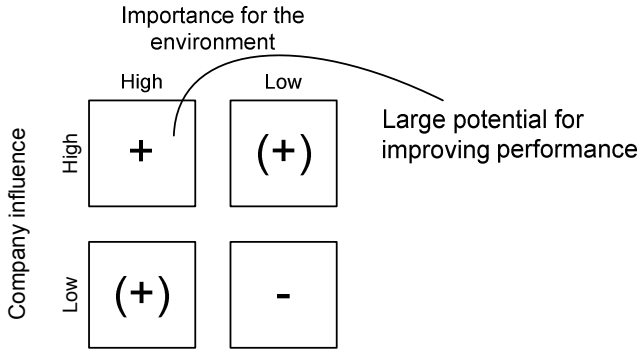


Figure 8.2 A logic that can be applied to identify priority areas (Remmen and Münster 2002, 20).

In some cases the aspects of highest importance for the environment are related to components provided by suppliers. In these cases B&O should instead focus on the product aspects that they actually can change even though these are not the most important aspects. This approach would give some experiences and results to base further activities on. In many cases however, B&O has the opportunity to influence its suppliers to improve the components. The actions recommended are:

- Focus on product aspects which B&O has a direct influence on to achieve product improvements
- Have a policy of prioritising components with the best possible environmental performance, which could give suppliers incentives to focus on environmental improvements and reductions of energy consumption
- Discuss environmental product performance with partners and suppliers
- Provide customers with information on the ecological profile of the product
- Identify specific priority areas in each department in collaboration with the SHE Department and the group of mid-level managers
- Seek influence through participation in environmental projects initiated by external actors such as ministries, universities and branch organisations
- Seek influence on upcoming regulatory demands, and argue in favour of performance targets based on the application of BAT

It can become a challenge to introduce these actions, depending on whether the employees who assume responsibility for the actions are provided with the adequate knowledge to identify priority areas. The SHE Department plays an important role, as their responsibility will be to educate other departments and ensure they have the necessary tools. Following this, a further co-operation between the SHE Department, the Product Development Department and the Purchasing Department is needed.

8.2.4 Specify the Strategy for Being Proactive

Following the identification of priority areas, a strategy specifying what being proactive means for B&O should be formulated, focusing on how to create environmental, economic and maybe even social possibilities related to environmental considerations. The following points seek to give some broad ideas for how points of the strategy could be formulated:

- An inevitable aspect of high quality is to proactively improve environmental performance of all B&O products
- In line with the company vision, B&O products should be the best in the market also in terms of environmental performance
- Environmental considerations should create opportunities for the continuous development of business and customer relations

Top management, which could be M1, is responsible for the formulation of the strategy, but can seek support in the group of mid-level managers or the head of the SHE Department.

In summary, Figure 8.3 shows which responsibilities and actions the different departments of B&O could carry out during the first step. As seen from the figure, especially the SHE Department plays a major role, but the participation of other departments, the mid-level group of managers and the task force is also significant, as possibilities for actions should be discussed and priority areas should be identified.

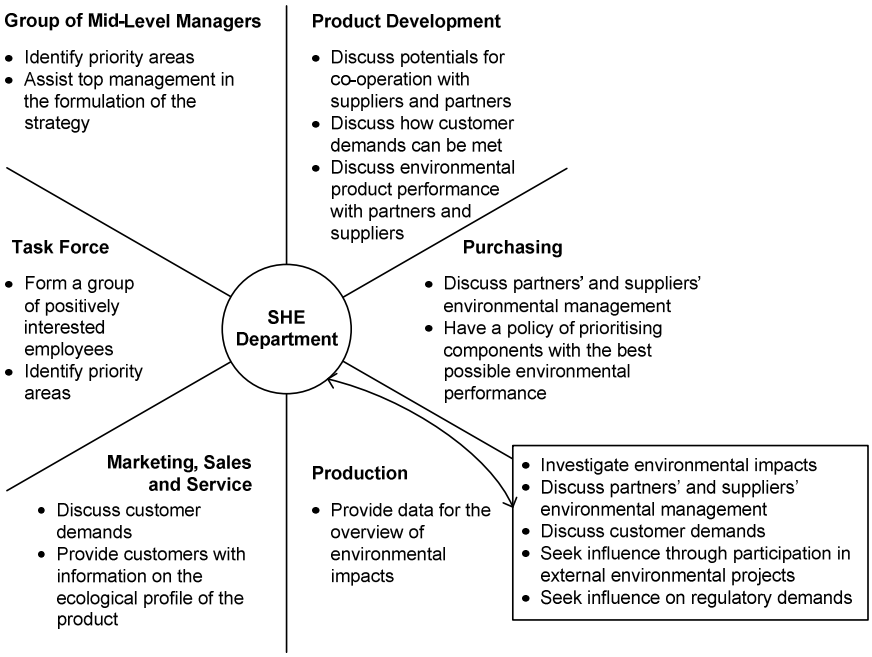


Figure 8.3 Overview of the responsibilities and actions needed in the different departments as part of creating an overview of opportunities.

Identifying priority areas and formulating the strategy is not the only challenge, also to walk the talk is a challenge, which is the focus of the following section.

8.3 Establishing Procedures for Product Oriented EMS

The purpose of this step is to establish procedures and activities for realising the strategy by specifying improvement objectives and targets, as well as ensuring the participation of various departments. According to Nielsen (2007a), B&O is not much interested in writing many procedures, and finds guidelines or mandatory requirements best suited for implementing considerations. The following section is therefore focused on how to ensure participation. Still it is also found important that some procedures are formulated, at least to create a systematic overview and document performance. Following the ISO 14001 standard or the EMAS regulation could help create the systematic overview, and the guidelines of the Global Reporting Initiative (GRI), could support the documentation. This should help to ensure that good initiatives not are lost on the Intranet.

8.3.1 Define Improvement Objectives and Targets

The objectives and targets should be formulated with a point of departure in the strategy, and the priority areas identified as part of the previous step. Using terms related to EMS, objectives are overall environmental goals consistent with the strategy, which the company sets itself to achieve, while targets are detailed performance requirements which should be set and met to achieve the objectives (Danish Standards Association 2004, 2-3). The actions recommended for defining objectives and targets are:

- Have the group of mid-level managers define objectives, which should be approved by top management, which in this case could be M1
- Specify targets for product oriented environmental performance in each department, supported by the SHE Department
- Approve targets in the group of mid-level managers

Table 8.1 lists proposals for the specific objectives, and the targets that could be related to these. The content of the proposals is inspired by experiences gained through the study of B&O. Inspiration for how to formulate targets is sought in the environmental reports of Grundfos (2007) who is considered a proactive company, and Aalborg Portland (2007) who has been awarded for a well-arranged and clear report. The table should be seen as inspiration, and more objectives and targets could be added, based on the capabilities and ambitions of B&O. Furthermore, the table only gives suggestions related to product improvements, and objectives and targets for improving the environmental performance of production sites could be added as well.

Objectives	Targets
The environmental product performance is improved on a continued basis	• The on-mode energy consumption for a new product should be reduced with x %, compared to the latest product of the same type which has been released for sale • The materials consumption should constantly be reduced • The employees should be educated on a continuous basis to keep their knowledge on the environmental product performance updated • Awareness and use of the letter box should be increased • When suggestions for product improvements are given through the letter box for employee suggestions, these should be followed up within x days • It should be clear which employees that carry the responsibility for the suggestions given
Co-operation with suppliers is evident for improving environmental performance	• The number of suppliers having an EMS certified according to ISO 14001 or being EMAS registered should be increasing • The consumption of aluminium should constantly be reduced, as long as it does not jeopardise the look of the product • Key and system suppliers should be evaluated yearly on their environmental performance
The technological development is followed closely to identify new improvement potentials and design possibilities	• The number of electronic components based on BAT being integrated in the products should be increasing • Each time a development project starts up, it should be evaluated how potentials for introducing new and cleaner technologies have been considered
Environmental considerations are part of the good stories told about products	• Each time a product is released for sale, a positive story of how environmental considerations were taken should be released as well • The knowledge of B&O's product oriented environmental management should be increasing among retailers and customers

Table 8.1 Proposals for the objectives and related targets for operationalise a proactive strategy for product oriented improvements.

For some of these targets, it is a challenge to avoid sub-optimisations, which therefore should be given attention. Following the definition of improvement objectives and targets, specific activities should be initiated. In many cases however, activities might already be implemented, and the objectives and targets are then formulated with a point of departure in the existing work.

8.3.2 Describe Activities for Improving Environmental Performance of Products

As part of the management system, various activities should also be defined, and these are the means to achieve the objectives and targets. Following the objectives, the most relevant activities are found related to product development, co-operation with suppliers and partners, the technological development and the environmental stories related to products.

Activities in the Product Development Department

To improve environmental product performance, the focus on environmental considerations in the Product Development Department should be strengthened. The following actions are recommended in this regard:

- Form an environmental unit of employees within the Product Development Department to be concerned with product environment
- Set up ecodesign criteria to be applied throughout development projects

- Have meetings where the environmental performance of new concepts is discussed between Idealand, project management, constructors and the environmental unit
- Establish procedures to ensure that new technologies are identified and considered
- Update the guideline for environmental design with the ecodesign criteria and pictures of good and bad examples of choices made by constructors

Especially the first action is found important, as it would place an environmental unit in the Product Development Department. This unit would strengthen the link between environmental considerations and product development as it would support the product development process, reduce the distance between the Product Development Department and the SHE Department, and the employees concerned with product environment become more visible during product development. Furthermore, this unit should also assist in the implementation of the recommended activities.

Two actors are considered to have primary influence on the product performance, namely Idealand and the constructors. Starting with Idealand, the following actions are recommended:

- Priority areas for the product oriented EMS should also be known in Idealand
- Take user behaviour and disposal into account when working on the concept
- Bring in advisors to collaborate with Idealand on how to make environmental considerations become platforms for new product ideas

Advisors could for instance be a designer entitled as an eco-designer, representatives of companies in other branches that proactively consider environmental issues in the concept development, university persons having a broad knowledge of product development and environment or NGOs. As regards the constructors, the following actions are recommended:

- Educate constructors in environmental considerations via seminars or workshops
- Make sure that constructors know where to find the guideline and how to use it
- Ask constructors for input to the guideline for environmental design

As the constructors are among those who have a direct influence on the product and its internals, it is very important that this group participates in the improvement work. These also have a comprehensive knowledge about specific product aspects, a knowledge that could be used to identify further improvement potentials. Some of these may also be in direct contact with suppliers and partners during the product development process.

Co-operation with Suppliers and Partners

The purpose of co-operating with suppliers and partners is both to improve product performance, but also to develop new product concepts of benefit for B&O as well as suppliers and partners. In this regard the following actions are recommended:

- Discuss product related environmental performance with suppliers and partners
- Develop guidelines for greener purchasing, which includes environmental criteria to be considered when choosing key and system suppliers
- Expand the audit system to also focus on environmental product performance
- Evaluate suppliers of aluminium to identify suppliers with the best environmental performance
- Update the list of banned substances with a list of restricted materials and substances and give this to purchasers

In some cases, the priority areas could be identified together with suppliers and partners to avoid sup-optimisation. As seen from the work with the code of conduct, the audit system is one way of introducing environmental considerations in the product chain. As it is now, the system is however more focused on the performance of supplier's production sites than the performance of products, but the recommended actions could help encompassing both.

Even though B&O is of neglectable size for some partners and suppliers, both Langergaard (2007) and Jacobsen (2007) mentions that in many cases it is possible to influence these. Partners and suppliers are for instance often interested in working together with B&O, as B&O possesses knowledge for mutual benefits. As the largest suppliers and partners often are more advanced in their environmental work, they are assumed to be open for suggestions. If the suppliers are not willing to change, it should be considered to use another supplier, which according to Langergaard (2007) is a possibility.

Benefit from the Technological Development

A successful example of how B&O has benefited from being ahead of the technological development is given by the example of the ICEpower amplifier, and B&O is therefore not unfamiliar with how to achieve first-mover benefits of the technological development. Important to notice is that environmental improvements can be an unintentional side effect when improving other product parameters, as seen from the case of the ICEpower amplifier. The environmental innovations applied in relation to most other products however, appear to be incremental following the arguments on innovations presented in Section 4.2. The recommended actions are therefore:

- Monitor the technological development to identify new opportunities with environmental benefits
- Participate in projects with external actors, for instance universities, to create new technological possibilities with improved environmental performance

Another development worth following is related to product/service systems. According to Wiegand (2007), more and more B&O products will be turned into platforms for services, also denoted as product/service systems. This means that the focus shifts from the specific product to the service that it provides, for instance good sound. A central point of product/service systems is that the

physical products remain the responsibility of the company, and the producer therefore becomes more interested in making the products more durable, which often also is positive from an environmental perspective.

Environment as Part of Product Stories

A number of positive stories concerning the environmental performance of B&O products can be told, but this is not dominant in internal or in external relations. As an example the retailers do not have copies of the leaflet *Down to the Smallest Detail*, and good initiatives are thereby not given significant attention (Nielsen 2007a). The purpose of telling these environmental stories is first of all to raise the internal awareness of environmental performance by putting environmental considerations on the agenda, and secondly also to make sure that interested customers can find more information about the environmental performance of B&O products. The following actions are recommended:

- Give retailers information about the environmental performance of products, either as part of their visits at B&O, or make the training materials include environmental information
- Provide retailers with copies of *Down to the Smallest Detail* and information about environmentally friendly use of the product, both to be handed over to customers
- Communicate with business customers about B&O's product oriented EMS
- Make it easy to find environmental information on the B&O website

It is a clear strategy from B&O not to use environmental performance as an argument in marketing, as the brand itself should reflect that all aspects of their environmental performance are in order. However, especially towards business customers it might be beneficial also to stress the environmental performance of products. As an example, B&O has already experienced how automotive customers have posed certain demands. Other business customers are hotels, one is the Hotel Hilton Copenhagen Airport, which is eco-labelled according to the Nordic Swan. As part of the optional labelling criteria[12], one point is given if minimum 10% of a durable consumer good purchased for the hotel is eco-labelled (Ecolabelling Denmark 2004, 92; Nordic Ecolabelling 2006, 14). Eco-label criteria exist for both televisions and specific types of audio systems. It is therefore possible that eco-labelled hotels, before purchasing new electronic products, start asking B&O whether an eco-labelled alternative is available. In these situations it would be a positive signal, if B&O were capable of delivering this alternative. In relation to the EuP Directive, this would also ease the process of documenting compliance.

[12] Eco-labelling criteria for hotels exist both within the Nordic Swan and the EU Flower schemes. For both schemes, some criteria are mandatory to comply with, whereas others are optional. From the optional part, the hotel should obtain a certain number of points to be awarded with the eco-label, and can then choose the criteria best suited for the specific hotel (Ecolabelling Denmark 2004, 51).

In summary, Figure 8.4 shows which responsibilities and actions the different departments of B&O could carry out as part of the second step. It is not possible for B&O to implement all activities at a time; rather a step-by-step approach should be applied, where inspiration can be found in the recommendations of this section. As seen from the figure, especially the Product Development Department, the Purchasing Department and the Marketing, Sales and Service Departments play a major role for the actions recommended.

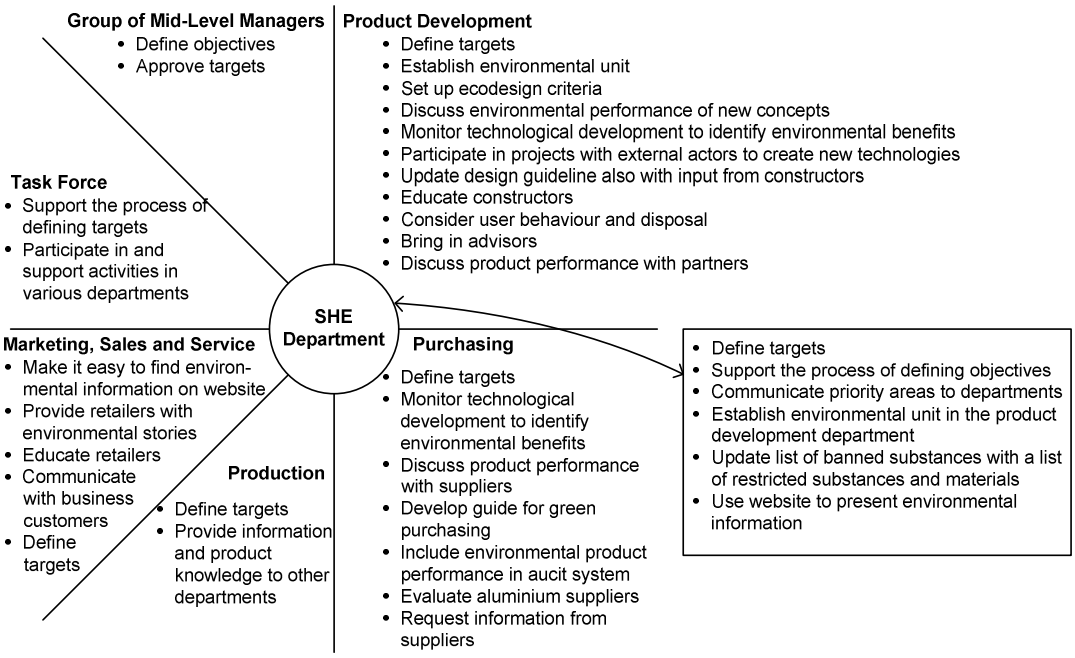


Figure 8.4 Overview of the responsibilities and actions needed in the different departments as part of establishing procedures for product oriented EMS

As the four overall activities described above get implemented, further activities should be added, and more departments should be involved. For all activities it is important that roles and especially responsibilities are defined and that progress is evaluated.

8.4 Continuous Improvements of Products and Product Chains

The purpose of this step is to ensure that product performance and product chains are continuously improved, for instance by following up on the objectives and targets, to make sure that they are fulfilled. The step therefore serves the purpose of making sure that the work constantly evolves, and that experiences are gathered. In this regard the continuous improvement of the product oriented EMS, as well as procedures to document performance are considered important. These are discussed in the following section.

8.4.1 Continuing to Improve the Product Oriented EMS

It is sought to have the measures and actions recommended for the proactive strategy aligned with the logic of an EMS. Currently, much of the environmental management at B&O is of an informal character, and experiences are therefore not documented and made available to all employees. As a result, there is not a systematic monitoring and follow-up on existing objectives and targets. As part of the continuous improvements, the continuous evaluation and exchange of knowledge and experiences should therefore also be ensured, in order to make sure that activities and focus areas are updated. The following actions are therefore recommended:

- The group of mid-level managers assume the practical responsibility for achieving the objectives, whereas the manager for each department assumes responsibility for reaching the targets defined for the department in question
- Communicate to management about the progress of the product oriented EMS, to enable management to review the suitability and effectiveness of the system
- Establish procedures for evaluation and development of the management system
- Ensure that information and documentation is gathered across the company
- Use electronic means, for instance the Intranet, to ease the documentation part
- Establish procedures for transferring experiences related to environmental product performance from one product development process to the next, such as meetings in the first phase of new development projects where experiences from similar previous projects are discussed

With these recommended actions it is sought to document performance and ensure that experiences are carried over, which could give basis for continuous improvements of the performance of the company. The product oriented EMS described in this chapter sets the stage for the environmental improvements, but this does not mean that the system in itself will create the improvements. Rather the improvements are created as the involved employees starts to reflect upon the system, and find use of the information and knowledge embodied in the system, both in their own work, but also in collaboration with others.

In summary, Figure 8.5, found on the opposite page, shows which responsibilities and actions the different departments of B&O could carry out as part of the third step. As seen from the figure, many departments play a major role for the actions recommended, which is not surprising, as the aim is to ensure improvements in all departments of the company.

At this step it could also be assessed whether new priority areas should be added in the product oriented EMS. B&O could then go back to the first step again, to identify new opportunities, and from that describe further activities, set up new objectives and target, and make the improvements happen based on the participation of employees.

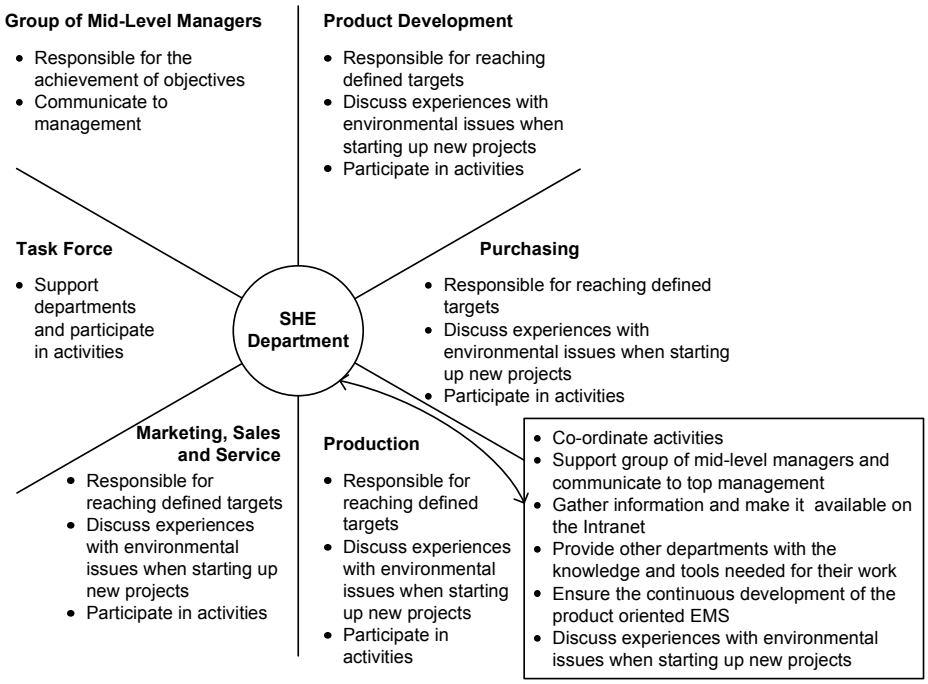


Figure 8.5 Overview of the responsibilities and actions needed in the different departments as part of ensuring the continuous improvements of products and product chains.

8.5 Communities of Practice

Many changes are needed in the communities of practice to follow the actions recommended in this chapter. Compared to the community engaged in EMS suggested for the compliance strategy, a larger community encompassing a larger crowd of employees and the different departments will be needed. The community's core shared domain of interest is that making high quality products also is to proactively improve environmental performance of all B&O products. The community is illustrated in Figure 8.6, which shows participation and reification related to this community, as suggested throughout this chapter. Only the main aspects of participation and reification are included, as this chapter gives numerous recommendations for possible actions.

Figure 8.6 Illustration of the participation and reification for the community, which share the core domain of interest that high quality also is to proactively improve environmental performance.

Links to external communities can also be found, some examples are that suppliers and partners should be involved in creating the product related environmental improvements, and external advisors should be consulted to give inspiration for Idealand on how environmental considerations can be used to develop new products. As regards the external relations, the participation in the form of social interactions should be strong, as this could help remove barriers between external and internal actors.

8.5.1 Communities within the Community

Some actors in this community are found to be of significant importance, as they are key driving forces. These actors all form smaller communities with a shared domain of interest in various aspects of the product oriented environmental work, these communities are:

- The group of mid-level managers from various departments
- The employees of the SHE Department concerned with product environment
- The environmental unit established in the Product Development Department
- Task force concerned with various aspects related to product environment

In each community, some practices for participation and reification are dominant, which is the focus of the following sections.

The Group of Mid-Level Managers

The engagement in the strategic environmental considerations is the core shared domain of interest for this community. A number of mid-level managers from various departments participate in the community, and these are brought together some times during the year. Their discussions could for instance be focused on significant challenges faced, management evaluations of activities or how to meet and challenge upcoming environmental trends in society. The reifications of the community are for instance objectives or priority areas in the management system or environmental reports.

The group serves a supporting function for top management, and links top management with employees concerned with more practical issues of the environmental work.

The Employees of the SHE Department Concerned with Product Environment
The engagement in co-ordinating the product oriented environmental management is the core shared domain of interest for this community. Employees of the SHE Department concerned with product environment participate. As shown in the figures related to different steps of the proactive strategy, the SHE Department is in the centre of activities, in the sense that an important role for this community is to gather information, provide knowledge to other departments and support the group of mid-level managers, and the interaction with other communities is therefore strong. The participation takes place through meetings or everyday tasks carried out in collaboration between the members. The reification of this community is for example procedures, objectives and targets, but it could also be specific environmental knowledge about products and processes. The community is also linked to communities outside of B&O, for instance environmental networks or research institutions.

The Environmental Unit Established in the Product Development Department
The engagement in the continuous improvement of environmental product performance is the core shared domain of interest for this community. The community members are employed in the SHE Department, but the unit is placed in the Product Development Department some days every week to strengthen the link between environmental considerations and product development. The participation can for instance be discussions with project groups and specific constructors about the environmental performance of products. The unit develops reifications to be used in the product development process; examples of these are guidelines, ecodesign criteria, environmental profiles of certain materials and so forth. The community is primarily focused on operational issues, but can also give suggestions for how to make environmental performance part of positioning characteristics. The community is also linked to suppliers and partners, when environmental performance is discussed during development projects.

Task Force Concerned with Various Aspects related to Environmental Performance
The core shared domain of interest for the task force is to assist in discussions of challenges, solutions and priorities when striving to improve the environmental performance of products. From the start, the employees that have expressed positive interest in a proactive strategy, and want to participate, could be included in the task force. As the environmental work evolves and specific product related problems arise, it will be needed to include more employees from different departments in the community. The participation of all members of the task force is not needed at all time, but depends on the specific project in question. Projects could for instance be focused on eliminating certain chemicals or how to reduce the on-mode energy consumption through a number of different strategies. The task force can for instance be summoned by the group of mid-level managers, but also other departments including, the SHE Department, can seek assistance from the task force. The reification of the task force would for instance be solutions or suggestions for improvements.

8.5.2 Linking Communities of Practice

As indicated, there are many links between the four communities of practice presented above. The brokers between the communities are the employees who participate in more than one community, and therefore can introduce elements from one practice into another. An example is the head of the SHE Department, who also participates in the group of mid-level managers. Another example is the task force, which can have members that also are participating in other communities in the company. Boundary objects can for instance be objectives and targets, or certain environmental documents around which the communities of practice can organise their interconnections. The links between the communities are illustrated by the overlap of the communities in Figure 8.7, in which the main participation and reification for the four communities is summarised. The figure is discussed in the following.

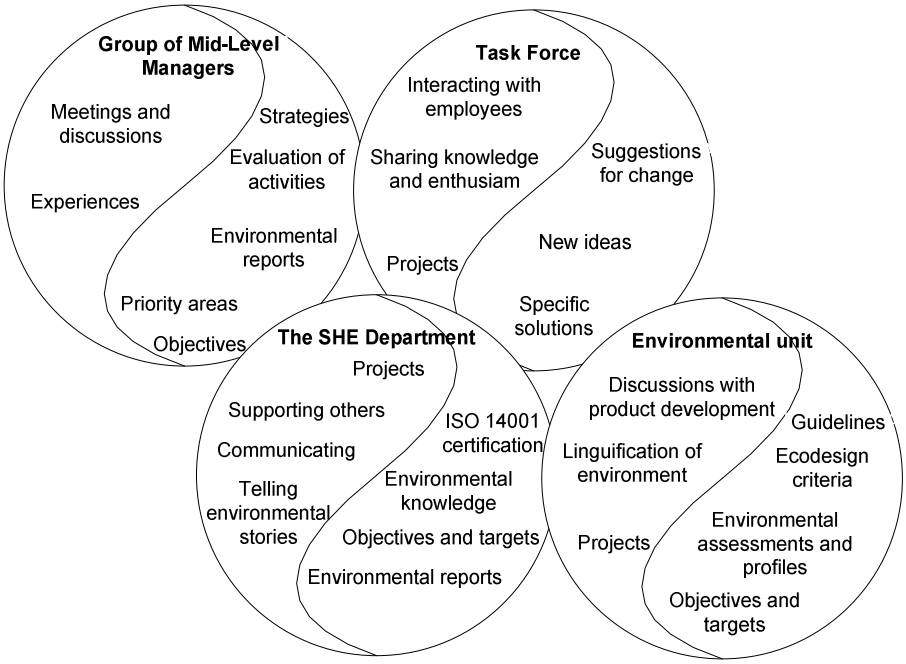


Figure 8.7 The four significant communities of practice including the participation and reification for each community.

As seen from the figure, the participation in the different communities gets more regular and the reifications become more concrete, the more the communities are focused on practical matters. The employees in the environmental unit are also part of the SHE Department. The environmental unit can also have links with the group of mid-level managers; though this contact will go through the SHE Department.

Of the four communities presented, only the community formed by the employees of the SHE Department concerned with product environment already exists. However, to develop into the community outlined above, the community members would have to be supported with for instance

courses in product oriented EMS or to visit the different departments of B&O on a regular basis. Eventually, this would make them better capable of fulfilling their co-ordinating and knowledge providing role. Following the idea of Wenger (1998), it would be needed to cultivate the other communities, as one thing is to establish the functions in an organisational diagram on paper, whereas another is to ensure the participation and interest of people, who might not show interest from the beginning. In this regard several factors are essential, as described in Appendix B:

- Participation is encouraged, for instance by valuing the work of the community
- Time, resources and community space are available
- Remove barriers for participation by making it easy for different people to access and contribute to the community
- Communities are given a voice in decisions and legitimacy in influencing operations

For all communities, even though they are existing in some form today, there will be an on-going process of negotiation within the community. The purpose would be to define not only what is meaningful for the community and how it wish to act, but also its role in relation to other communities and the practice as regards environmental considerations at B&O. Comparing the idea behind these additional communities of practice with how product environment is considered at B&O at the moment, there are some obvious differences. First, more people would be participating following the cultivation of several communities engaged in environmental considerations. Secondly, many brokers and boundary objects would exist, and B&O is therefore assumed to be less vulnerable to staff outflow, compared to the present situation, where the integration of product oriented environmental considerations more or less is depending on the performance of one employee. Thirdly, the mandatory requirements will not solely determine what environmental considerations are, but a broader and more encompassing perspective can be applied. And fourthly, environmental considerations are given voice many places in the company.

As regards the TOP-model, which is a reification of the product development process, it is still considered an expedient structure to apply in the product development process. Some of the environmental considerations related to a proactive strategy should also be implemented in the TOP-model, to make sure that certain demands are followed in all development processes. This could for instance happen through the mandatory requirements or as part of the decision points, which are central in the TOP-model.

8.6 Discussion of the Proactive Strategy

In this chapter a number of actions are recommended, in order for B&O to adopt a proactive strategy, encompassing a range of product oriented objectives and procedures to be aligned with the EMS currently being implemented. The recommendations are built upon knowledge achieved when analysing B&O, and might therefore not be covering all departments and needs of B&O. Furthermore, describing the actions recommended on the different steps is done from the precondition that

the steps are implemented as described in this chapter, assuming that the recommendations are found relevant by the ones involved. Additionally, the experiences and insights employees and management might gain when implementing the proactive strategy are not assessed. Given these arguments, it is likely that continuous alterations of the strategy could be beneficial for B&O, in order to further customise the strategy to the context of B&O.

A starting point could be to consider where the interest, motivation and resources are, and use this as a foundation for initiating specific projects and activities by the employees being interested in a proactive strategy. The experiences gained in these initial projects, supported by for instance the common language by the first-movers in the company could be used as a platform for furthering the participation of other employees. The experiences are therefore crucial in order to develop a shared understanding of the proactive strategy, which gives meaning to the persons involved.

Through the co-operation with B&O, the project group has already challenged some of the practices which earlier have been found meaningful. Some employees have started to question whether the present product oriented environmental work is sufficient, and their considerations could spread to other employees as well.

When initiating a process of customising the proactive strategy and implementing it step-by-step, it is also the hope that it is easier to spread the engagement throughout the company and establish new practices on how environmental considerations are perceived and incorporated at B&O

Conclusion

9

The point of departure of this report is a case study of B&O, and their product oriented environmental management. One challenge which the company currently faces in this regard is to comply with the EuP Directive which sets ecodesign requirements for energy-using products. How this will affect B&O is investigated through answering the following problem definition:

> **How will the EuP Directive create incentives for improving the product related environmental performance at B&O, and how can a proactive strategy for improving product performance be incorporated in the company?**

In the following the problem definition is answered, and in the end of the chapter the research methods are reflected upon.

9.1 Regulation to Ensure Integration of Environmental Considerations in Product Development

Companies and their environmental management are influenced by several factors. The general public debate can influence companies' environmental focus, but can also be regarded as an indicator for coming regulation which companies must respond to. Different types of regulation are also influential on companies' environmental management. One way of defining the influence of regulation is to consider technology regulation, market regulation, self regulation and public regulation.

The EuP Directive is categorised as a public regulation, and is one of the newest regulation types focusing on product related environmental issues. The EuP Directive aims at increasing the integration of environmental considerations in the design stage of the product development process, and further to ensure free movement of products within the EU.

The implementation of the Directive is at an early stage, meaning that no direct requirements have yet been established. Therefore, relevant preparatory studies are analysed and key persons are interviewed in order to determine possible coming requirements. On this basis, it can be concluded that the Directive contains elements that companies at all times must fulfil, for instance that they must inform the end-users about their role in the sustainable use of the product. The Directive also contains elements for which it will differ whether the companies will be affected, it can for instance become mandatory to perform an ecological profile of the product. With regards to concrete re-

quirements, it can be concluded that these most likely will concern energy consumption in standby and on-mode, as well as noise limits. Furthermore, the preparatory studies present many specific improvement potentials, which it is assessed expedient for B&O to consider in their product development. In order to conclude how the EuP Directive creates incentives for B&O for improving the environmental performance of the products, the organisation of B&O and their environmental management is presented in the following.

9.2 The Environmental Management at B&O

B&O is a company that places high emphasis on the product design and quality. B&O has an environmental policy, but environmental issues are typically considered to be part of the quality definition and the environmental performance *'has to be in order'*. When viewing B&O in an environmental perspective it can be concluded that efforts are put in both environmental management and cleaner production, but that a fully proactive strategy is not taken.

The product development is structured around a customised model consisting of five phases with different milestones and decision points. There are indications however, that the actual use of the model is an administrative matter, and primarily the different milestones are used. It can be concluded that integration of environmental considerations primarily happen through complying with mandatory requirements, but some of these can be regarded significantly stricter than the given legislation on the issue. Further, it must be noted that the integration happens both formally and informally. In overall terms, it can be concluded that the environmental considerations are to a large degree perceived as an obligation rather than an opportunity.

It can be concluded that the integration of environmental considerations in the product development process is rather vulnerable. This is due to the fact that currently only one employee in the Department of Safety, Health and Environmental (SHE) is responsible for ensuring the product environment performance, which encompasses both compulsory tasks as well as optional tasks. The vulnerability is further emphasised by the tradition of having few written procedures for improving the environmental performance of the products.

9.3 A Strategy for Complying with the EuP Directive

Based on the current procedures and experiences at B&O and an analysis of the potential requirements of the Directive, it is concluded that the following strategy can be applied in complying with the EuP Directive:

- Choose the management system as a strategy for compliance
- Comply with mandatory requirements for standby, on-mode energy consumption and noise limits
- Comply with mandatory requirements on customer information in user-manuals Establish procedures for gathering information and ensure supplier compliance

- Establish procedures for and complete declarations of conformity

It appears that many of the above recommendations primarily concern the setting up of procedures, and it can be concluded that many of the recommended activities can be integrated in existing procedures with only few needed changes, though with a risk of facing challenges in meeting the requirements for on-mode. Given these considerations, it seems possible for B&O to comply with the EuP Directive without changing the way in which the products are designed or which people that should be involved in the process. Hence, it can be concluded that the EuP Directive does not create much incentive for improving the product related environmental performance at B&O.

It is concluded that applying a compliance strategy is not sufficient to improve the environmental performance of products significantly. Further, arguments point to the advantages of applying a more proactive strategy, and indications are given that certain significant business customers have an increasing focus on environmental aspects. In addition, more EU regulation is expected, focusing on product environmental issues. In order to prepare B&O for the different upcoming challenges, a proactive strategy is suggested and presented in the following section.

9.4 A Proactive Strategy for Improving the Product Related Environmental Performance

The following strategy, to be incorporated in a product oriented environmental management system (EMS), is concluded to be applicable for B&O for improving their product related environmental performance:

- Create an overview of opportunities
- Establish procedures for product oriented EMS
- Ensure continuous improvements of product related environmental performance

In order to adjust the strategy even further to the situation at B&O, recommendations are given to specific measures that B&O can utilise when applying the proactive strategy. The idea is that the strategy takes a point of departure in the structure of the EMS, though with a strong emphasis on product environment in contrast to more traditional factory environment.

As a first step in applying a proactive strategy, it is recommended that B&O form a group of mid-level managers who would further the participation in the process. Secondly, when creating an overview of opportunities it is recommended that B&O would benefit from identifying environmental impacts, identifying internal and external driving forces, identifying priority areas and from that formulate a strategy for product related environmental performance. It is assessed that the establishment of a task force of employees to assist in discussion of challenges, solutions and priorities within the product oriented environmental management. Looking at the employees involved in this first step, it appears that the SHE Department is focal and it is recommended that there is estab-

lished a close collaboration between this department, the Product Development Department and the Purchasing Department.

As the second step, primarily two activities are recommended; define improvement objectives and targets and describe the activities for improving the environmental product performance. The formation of an environmental unit within the Product Development Department is concluded to strengthen the integration of environmental considerations in the product development process. Important departments in this step are assessed to be the Product Development Department, The Purchasing Department and the Marketing, Sales and Service Departments.

For ensuring continuous improvement of the product related environmental performance it is found to be important that procedures and activities are established to ensure that performance is documented, that information and documentation is gathered across the organisation and that experiences from one project is transferred to the next. It is concluded that many departments at B&O play a major role in this step as it is the foundation of continuous improvements.

9.5 Reflections upon Research Methods

The conclusions presented in the above are a result of the methods applied, it is therefore found essential to reflect upon the use of the following four methods of research:

- Using the theory on communities of practice
- The data collection process during visits at B&O
- Interviewing a broad range of people
- The process of pattern matching

For each of the methods, the strengths and weaknesses are discussed along with suggestions for what could have been done to avoid the weaknesses. Furthermore, it is also assessed whether the latter would have been expedient in the current study.

9.5.1 Using the Theory on Communities of Practice

The theory on communities of practice has been used in the analysis of B&O, and for supplementing the two strategies. The strength of the theory is the strong focus on relationships between actors, which has served its purpose well in determining how environmental considerations are integrated in the product development process and who the involved actors are. However, the strong focus on the participating actors has resulted in a lack of focus on the organisational structures related to the product development process. As an example, the Global Product Sourcing Department has not been identified in the analysis. This department is responsible for products bought from a supplier and afterwards modified into a B&O product. Given that the development and production of more and more products are outsourced, this department could be influential when striving for more environmentally friendly products. The lack of focus on the different departments involved in the development process is not only due to the use of the theory on communities of practice, but a

stronger organisational focus could have revealed a different pattern. It would thus have been expedient to investigate the relationships between organisational structures and the incorporation of environmental aspects more closely, though no significant changes in the research results are expected.

9.5.2 The Data Collection Process during Visits at B&O

The focus of the visits at B&O has been to obtain knowledge on different issues related to the environmental management in the product development process. The strengths of the visits have been the amounts of information gathered about the processes, and the few discussions on recommended actions through conversations with primarily Lone Nielsen and Gert Yde Jacobsen. The discussion were however very limited as well as unstructured, and these have thus been insufficient to provide a holistic response to and validation of the suggested strategies. A fourth visit with a specific objective of discussing the suggested strategies could have provided such insights. It could thus have been expedient if the visit cycle had been expanded to include a response and validation process.

9.5.3 Interviewing a Broad Range of People

During the visits at B&O, it has been sought to interview a broad range of people covering the actors involved in the product development process. The strength of this approach has been that the whole product development process, including the involved actors, has been investigated. On the other hand, this means that the analyses are based on the recollections of the interviewees and not on the actual actions in the process. When doing interviews, the risk exists that the interviewer does not ask the questions that might reveal the most relevant information, and that the interviewees unintended hold back information. If studying the actual process, such information would most likely have been revealed through observations. However, due to the time span of development projects at B&O it is not regarded expedient to complete such studies.

9.5.4 The Process of Pattern Matching

When conducting the interviews at B&O it has been sought to use the interview guide for a guiding purpose, with the possibility to adjust the questions along the way. The strength of this approach is that it is possible to elaborate on unexpected and suddenly discovered relevant issues. A weakness is, however, the risk of heading of in a direction that at first seems interesting, but which on second thought is not relevant to the focus of the project. Also it becomes difficult to identify patterns and validate the findings, as the interviewees do not answer the same questions, where a more quantitative approach could have provided more comparable data. However, given the focus of the study, a fully structured approach is not regarded expedient, as the informal and conversation-like interviews have revealed information difficult to obtain using a different approach.

Perspectives 10

The purpose of this chapter is to discuss the findings and recommendations of the report in a broader context, and to give new perspectives on the findings focusing on the following points:

- Which implications will the proactive strategy have for B&O?
- Which are the perspectives in the EuP Directive?

The purpose of investigating these points is to discuss the implications of some of the findings in this report, and in this sense also identify issues for further investigation.

10.1 Implications of the Proactive Strategy for B&O

The process of adopting the proactive strategy at B&O is assessed to be comprehensive. First, many procedural changes are needed, following the extent and number of the recommended actions. Secondly, incorporating environmental considerations is at present seen as being in compliance with mandatory requirements. Implementing the proactive strategy and its underlying understanding of causes and solutions to environmental impacts, will therefore challenge the present culture of how environmental issues are dealt with. Changing viewpoints to make environmental issues become possibilities instead of limitations is found to be the main challenge. To change the deep-rooted traditions and viewpoints, the role of the management is in particular important, as clear announcements would show employees that environmental considerations are prioritised and valued, and that striving to improve performance is inevitable. The role of the employees should, however, not be underestimated, and Busck (2005) have found the following points to be in common for several studies on employee participation:

- Environmental development in companies require organisational changes including the involvement of employees and the development of change capacity, where the employees' positive attitudes, responsibility and adaptability to change is decisive
- There is a large and much unexploited potential among employees for participating in environmental improvements in companies
- Companies which have involved employees, have experienced environmental improvements, and seem to be better prepared for achieving continuous improvements

If B&O chooses to adopt a more proactive strategy, environmental performance would walk more hand-in-hand with design and competent craftsmanship, and give an extended quality concept for the products. Future studies could follow up on the environmental work of B&O, and address whether the company decides to adopt a more proactive strategy and how this gets implemented. Part of this could also be to investigate customers' reactions to the extended quality concept, and which opportunities for profiling B&O this gives rise to. Challenges related to the implementation could also be identified, and suggestions could be given to assist B&O in overcoming these.

10.2 Perspectives of the EuP Directive

As it is now, the Directive does not give many incentives for improving the environmental performance of products, at least not in a Danish context. The actual outcome is however dependent on the content of the implementing measures, the first of which are expected in 2008. Future studies should therefore follow the implementation process, to investigate whether the assessments in this report as regards the lack of incentives being created by the EuP Directive prove correct. This would give a view to the consequences of the EuP Directive, which could be set against the objectives of the Directive. In this regard it would also be interesting to investigate how the possibilities in the generic requirements are used, and what influence it has that the Danish Environmental Protection Agency and the Danish Energy Authority have a shared responsibility for the implementation into Danish law.

The Danish Government has recently announced its position as regards the EuP Directive in its action plan for promoting eco-efficient technologies over the period from 2007-2009[13]. The position is summarised in the list below (The Danish Government 2007, 44):

- Work for ambitious energy demands in the implementing measures
- Continuously assess how synergies could be created between the EuP Directive and other parallel environmental regulation, including EU chemical legislation, the WEEE Directive and the RoHS Directive

Following the current public climate debate, the action plan stresses the need for ambitious demands, with a clear aim of creating benefits for Danish companies and their technologies (The Danish Government 2007, 40). This commitment shows that the requirements might be tightened over time, and it could therefore be interesting to investigate what the consequences are for companies, and how they choose to act on the requirements. Eventually, the wish is that proactive companies seeks influence on the implementing measures, and thereby sets the agenda for the environmental work carried out by other companies.

[13] The purpose of the action plan is to strengthen, renew and focus the efforts to develop and use of eco-efficient technologies, in order to make Denmark and Danish companies play a central role in solving the most urgent environmental problems trough technological innovation (The Danish Government 2007, 9).

The action plan of the Danish Government also sees the EuP Directive in relation to other initiatives, though only regulatory initiatives are highlighted. However, many other activities would be needed as well to further the development and application of more eco-efficient technologies. As an example, projects should focus on how to embed the strive for improving environmental performance in companies. A number of initiatives are described in the action plan to make regulation act in concert with other initiatives.

The EuP Directive is part of the IPP approach, which focuses on strengthening the product oriented environmental policies and assisting the growth of a market for greener products. According to the European Commission (2007b), an integrated policy for products should be based on a mixture of instruments to:

- Getting the prices right for instance through differentiated taxation, or by extending the producer responsibility concept to new areas
- Stimulating demands for greener products for instance by giving consumers easy access to understandable, relevant and credible information, or through an increased use of public green procurement
- Strengthening green production for instance through generation of product information, guidelines for product design, standardisation and product directives

Essentially, the purpose of the integrated product policy is to make companies focus on the environmental impacts related to products, and move up on the awareness stair and adopt a product oriented approach on the causes and solutions for environmental impacts. Some instruments might be better suited for this purpose than others, and future studies could investigate which instruments that show the largest potentials for making companies adopt proactive strategies for reducing the environmental impacts related to their products.

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List of Appendixes

Interview Guides

A

This appendix presents the two interview guides. One is used in relation to the interviews of employees at B&O, while the other is used to interview persons about the potential consequences of the EuP Directive. The interviews were conducted in Danish given that all involved are Danish and thus to have the best preconditions for achieving information. The interview guides are thus presented in Danish.

A.1 Interview Guide for B&O-employees

Introduktion

1. Stilling
2. Ansat hvor længe
3. Primære arbejdsopgaver

Produktudvikling og miljøforhold, enten generelt eller specifikt for BeoMedia 1 og BeoVision 7, afhængig af deres arbejdsopgaver.

4. Hvilke opgaver har du primært i et udviklingsforløb?
5. Forklar eller tegn i TOP-modellen ud fra nedenstående spørgsmål, overordnet´
    a. På hvilke tidspunkter i produktudviklingsforløbet har du været involveret, omkring hvad?
    b. Hvilke afdelinger har du arbejdet du sammen med, omkring hvad?
    c. Hvilke eksterne partnere arbejdede du sammen med, omkring hvad?
6. Vi forklarer, hvad vi forstår ved miljøforhold. Viser desuden en liste over mulige forbedringspotentialer (som givet gennem forundersøgelserne til gennemførelsesforanstaltningerne), samt de forventninger som vores EuP Direktiv interviewpersoner har givet udtryk for
    d. Er du blevet informeret om miljøforhold for de forskellige produktelementer?
    e. Hvem har informeret dig?
    f. Har du arbejdet med produktelementerne, eller andre områder, som har givet anledning til et miljøfokus – hvilket miljøfokus og hvorfor?
    g. Har du inddraget hensyn til at reducere påvirkningerne fra komponenterne i produktudviklingen?
    h. På hvilket stadie i TOP har du arbejdet med dem?

i. Hvem (afdelinger/personer) arbejdede du sammen med omkring det?
j. Hvordan arbejdede I sammen (møder, mails, ...)?
k. Arbejder du med miljøforhold ud over pligtegenskaberne, på hvilken måde?

7. Hvad tror du der skulle til, for at få miljøforbedringer mere i fokus i en tilsvarende produktudviklingsproces?
    l. (Andre prioriteringer i produktviklingen, pligtegenskaberne var opfyldt)
8. Hvis du skulle arbejde mere med miljøforbedringer af produktet, hvad skulle der så til?
    m. (Mere uddannelse og viden, mere samarbejde med andre kolleger, mere fokus på det i udviklingsforløbet, det skulle være en pligtegenskab, mere fokus fra ledelsen)

A.2 Interview Guide for persons related to EuP Directive

Introduktion

1. Stilling
2. Primære arbejdsopgaver i forhold til EuP Direktivet

Indledende spørgsmål

3. Hvad tror du EuP Direktivet kommer til at betyde?
4. Hvilke tror du bliver de største udfordringer i Direktivet?
5. Hvilke tror du bliver de største udfordringer for virksomheder i Direktivet?
6. I hvilken grad tror du Direktivet vil føre til mere ecodesign i virksomhederne?

Fremtidige krav

7. Direktivet lægger op til at der kan stilles både specifikke og generiske krav, tror du, at der for alle produktgrupper vil blive stillet begge typer krav?
8. Hvilke specifikke krav tror du man vil fokusere på?
9. Hvilke generiske krav tror du man vil fokusere på?
10. I forbindelse med de generiske krav, står der at producenten skal udarbejde en miljømæssig vurdering og en miljøprofil af deres produkter. Hvilke udfordringer ser du i den forbindelse?

Intern designkontrol og Management System

11. Direktivet lægger op til at man kan vælge mellem Intern design kontrol og at indføre et management system til at opfylde kravene. Hvilke virksomheder tror du vil vælge hvilken fremgangsmåde?
12. Hvilke fordele og ulemper ser du i de to strategier?

Selvregulering

13. Direktivet lægger op til at selvregulerende foranstaltninger foretrækkes. Hvilke muligheder og begrænsninger ser du i selvregulerende foranstaltninger?
14. I hvor stor udstrækning tror du virksomhederne vil vælge selvregulerende foranstaltninger?

Information om produkter

15. I Direktivet står der at producenten skal skønne hvor meget information de vil give forbrugeren om hvordan de bruger produktet mest hensigtsmæssigt. Hvilken betydning tror du det vil have?
16. Der bliver nævnt at producenterne nogle gange skal informere forbrugeren om fordelene ved ecodesign og om produktets miljøprofil. Hvorfor tror du at de ikke altid skal det
17. Er det noget du tror der vil blive brugt meget?

Leverandører

18. Hvordan tror det kommer til at fungere med informationsudveksling mellem producent og leverandør? (Tror du det kan blive et problem for producenten at indhente alle de data de har brug for?)
19. Hvad tror du det kommer til at betyde for de virksomheder der kommer til at fungere som importører?

Kontrol

20. Tror du det bliver sådan at man skal kunne teste direkte på produktet om det lever op til gennemførelsesforanstaltningerne?

Theory on Communities of Practice

B

This appendix presents the main points of the theory of *Communities of Practice*, as presented by Etienne Wenger (1998). Main elements of the theory are used to guide the analyses in different chapters of the report, and this appendix therefore serves as a reference point, which presents how the theory on Communities of Practice has been read and understood.

B.1 Learning – an Engagement in Social Practices

The point of departure for Etienne Wenger is learning and a discussion of how we learn. He sees learning as social participation, where participation refers to '*an encompassing process of being active participants in the practices of social communities and constructing identities in relation to the communities*' (Wenger 1998, 4). In other words, the groups and activities we take part in are determinant for our learning. Wenger describes four components of a theoretical understanding of learning. These are shown in Figure B.1, and explained in the following section.

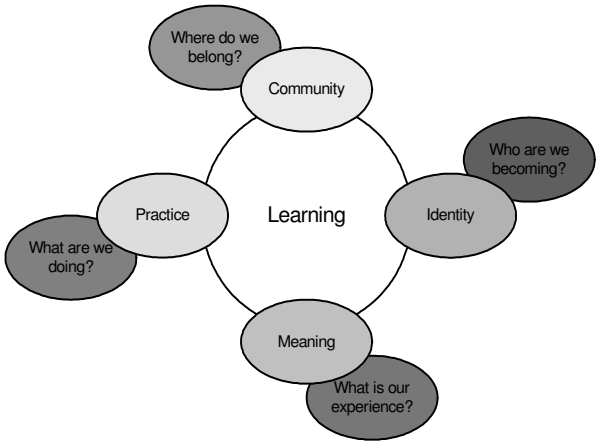

Figure B.1 Four components of a theoretical understanding of learning (Wenger 1998, 5).

Wenger (1998, 5) describes the components as follows: Meaning is learning as *experience*, in the sense that learning is our individual and collective ability to experience our life and the world as meaningful. Practice is learning as *doing*, and it is the shared historical and social resources, frameworks, and perspectives that can sustain mutual engagement in action.

Community is learning as *belonging*, meaning that learning are the social configurations in which our enterprises are defined as worth pursuing and our participation is recognisable as competence. Identity is learning as *becoming*, in the sense that learning changes who we are and creates personal histories of becoming in the context of our communities.

To summarise, learning is a matter of experience, doing, belonging, and becoming. However, as such these words and the associated components seem quite intangible, and it can be difficult to see the relation to communities of practice. Further, one could also ask, what is a community of practice?

B.2 Learning Together – Communities of Practice

A community of practice is formed, when people engage in a process of collective learning in a shared domain of human endeavour (Wenger 2007). Some examples are students working together to solve a problem, a tenants' council discussing social activities for the residents, or a group of employees in a company who are exploring different ways of integrating a new technology in one of the company's products. According to Wenger (2007), communities of practice are groups of people who share a concern or a passion for something they do, and learn how to do it better as they interact regularly; in other words, they share a practice through which they learn. Practice connotes doing in a historical and social context, as this gives structure and meaning to what we do; as Wenger (1998, 47) states, '*practice is always social practice*'.

The concept of practice includes both the explicit and the tacit. The explicit is for instance the language, tools, documents, symbols, well-defined roles, regulations or contracts that is explicit within a practice, whereas the tacit include for instance implicit relations, subtle cues, untold rules of thumb or underlying assumptions (Wenger 1998, 47).

B.2.1 Characteristics: Domain, Community, Practice

There are three main characteristics of communities of practice: domain, community and practice, which are shown in Figure B.2. Some of these seems evident from the notion of communities of practice, but all are further defined and explained in the following section.

Figure B.2 Three characteristics of communities of practice. After Wenger (2004).

A community of practice has an identity defined by a shared *domain* of interest by the persons involved. A member of the community of practice therefore shows a commitment to the domain, and it is a shared competence, which then distinguishes member of the community from other people. The domain is about what we are, and from what the community of practice gets its identity (Wenger 2004; 2007). People engaging in joint activities and discussions, where they for instance help each other and share information, in order to pursue their interest in the domain, form a *community*. The members do not necessarily work together on a daily basis; the interactions taking place are the most important. Also, the members do not necessarily have to work in the same organisation, but can join from different sides to pursue a common interest. The community is about asking who we are, and includes for instance the different roles and knowledge possessions in the community (Wenger 2004). Besides the shared domain of interest, the *practice* should also be in common. As Wenger (2007) states it, '*members of a community of practice are practitioners*'. The members develop some shared practices, for instance experiences, stories or ways of addressing problems, which are in common for that specific community of practice. The practice is about asking what we know, and sustaining this knowledge through shared practices (Wenger 2004; 2007).

B.2.2 Meaning: Participation and Reification

In relation to the notion of practice, Wenger (1998, 51) states that, '*practice is first and foremost, a process by which we can experience the world and our engagement with it as meaningful*'. Meaning is also presented in Section B.1, as a component in a theoretical understanding of learning. Wenger (1998, 52) argues that meaning is located in a process, which he calls *negotiation of meaning*. In institutional theory, negotiation of meaning is referred to as social construction theory. Authors like Berger and Luckman (1966) proposed that our social world is negotiated, organised and constructed by our interpretations of what is happening around us (Hatch and Cunliffe 2006, 43). Wenger (1998) also refers to Weick (1995) as another author to address the social construction of meaning. Weick looks into the sense making in organisations, and suggests that organisations exist largely in the minds of organisation members in the form of cognitive maps, or images of particular aspects of experience (Hatch and Cunliffe 2006, 44). Negotiation of meaning is a constant interaction of two constituent processes which Wenger (1998) calls *participation* and *reification*. Participation is about taking part and living in the social world, and reification is for instance when experiences and meanings are congealed into objects, for instance a document. Berger and Luckman as well as Weick also refer to objectification or reification in order to make sense of actions (Hatch and Cunliffe 2006, 45). Wenger (1998, 62) argues that participation and reification creates a duality, as they enable each other and one cannot replace the other. This duality is presented in Figure B.3 and some elements of participation and reification are shown.

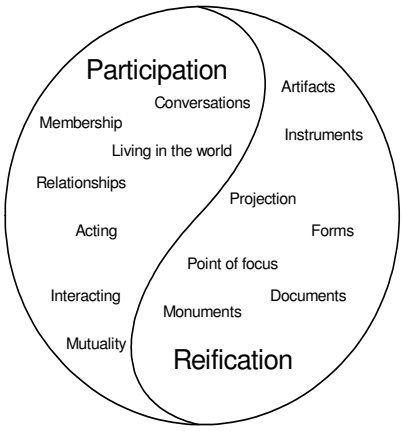

Figure B.3 The duality of participation and reification. After Wenger (1998, 63).

The duality is a fundamental aspect of the constitution of a community of practice, and gives rise to a negotiation of meaning, which can be characterised as a process by which we experience the world and our engagement in it as meaningful (Wenger 1998, 53, 65). The duality also becomes important in order to understand some of the external dynamics of communities of practice.

B.3 External Dynamics

The characteristics of communities of practice in the above-mentioned only focus on the internal dynamics. However, communities of practice are not isolated from other practices, and the external dynamics describes the relations with other communities of practice. Wenger (1998, 103) states that a discontinuity can be created between those who have been participating and those who have not, because members of a community have a shared history. This means that practice can create a boundary, and that moving from one community of practice to another can be rather difficult. However, some types of connections are developed which can bridge across boundaries, and link communities of practice with each other (Wenger 1998, 49-50).

Participation and reification, as presented above, can both create discontinuities and continuities across boundaries. Discontinuities are created, for instance when a certain dress code or jargon has to be followed in order to become member of a community of practice. Continuities, on the hand, can be created when elements of one community of practice cross boundaries and enter other practices. There are two types of connections (Wenger 1998, 105):

- Boundary objects: different forms of reification (e.g. artefacts, documents and terms) around which communities of practice can organise their interconnections.
- Brokering: people act as brokers and create connections as they introduce elements of one practice into another.

B.4 Communities of Practice and Organisations

In relation to organisations, which is a focus of this report, Wenger (1998, 241) argues, that '*communities of practice are key to an organisation's competence and to the evolution of that competence*'. In this, there seems to be two views of organisations: the designed organisation and the practice.

The *designed* organisation refers to policies, procedures, authority relations and other institutional structures, whereas the *practice* refers to when the institutional design becomes effective and produce results (Wenger 1998, 243). An organisation therefore consists of a number of communities of practice; some of these can also exceed the boundaries of the organisation. This also means that the organisation can have some strategies and visions, but each community of practice will have its own enterprise, visions and strategies. Wenger (1998, 244) also states that the existence of a community of practice can be a response to an institutional mandate, but it is the community that produces the practice needed to create the results. In other words, an organisation consists of two structures: the designed structure of the organisation, and the practices that emerges within this. An important aspect for understanding an organisation is therefore to identify and understand its communities of practice.

B.5 Cultivating Communities of Practice

In some situations it might be necessary to cultivate communities of practice, for instance to solve a certain task or to build up some competences in an organisation. Compared to more hierarchical and traditional views of organisations, where new roles and departments can be established on paper rather easy, it can be regarded as more difficult to establish communities of practice, as these involves the participation of different people, who share the same interest in a domain and therefore develops some practices to solve their tasks. However, according to Wenger (2004), it is possible to cultivate communities of practice.

For cultivating communities of practice in organisations Wenger, McDermott and Snyder (2002) suggest that this can be a matter of creating an environment which helps the community to prosper. This includes valuing the earning of the communities, making time and other resources available, encouraging participation, removing barriers and giving communities a voice in decisions and legitimacy in influencing operations.

For cultivating the community of practice itself there are different opportunities. First of all, a community of practice evolves over time. Wenger (2004) uses the words potential, coalescing, maturing, sustaining and transforming to describe the life cycle and development of a community. One way of cultivating the community of practice is to *cultivate participation*, for instance by making it easy for different people to access and contribute to the community. Instead of forcing participation, it should be possible for different people to join in at different levels, from being participants in the leading group to being sideline participants, and still fell like full members (Wenger, McDermott and Snyder 2002, 57). Another approach is to *cultivate leadership*, for instance by as-

signing different roles to different members of the community. A third option is to *cultivate practice*, for instance by engaging practitioners in a task as a way to develop their shared knowledge and bring out their identities as practitioners and participants in the community of practice. A fourth option mentioned by Wenger (2004) is to *cultivate community spaces*, by improving the conditions under which the community of practice performs its activities, for instance by proving meeting and conference facilities, or to strength communication between community members.

Product Development at B&O

C

This appendix presents the main phases and milestones in the product development process, as it is organised at B&O. It is also highlighted, where environmental considerations officially influence the process. The appendix serves as a reference point for Chapter 4, which analyses how environmental considerations actually are integrated in the product development process.

The product development process is organised according to the TOP-model, where TOP is an abbreviation for the Danish terms *Tempo Og Produktivitet* (pace and productivity). The model was introduced in the beginning of the 1990's, as part of the restructuring process, which was presented briefly in Chapter 3. The aim was to reduce the time needed for product development, by making the process more effective, and reducing the number of returns to previous phases. In general, the product development process lasts around 72 weeks (Kirkegård, Olsson and Nielsen 1996, 216). The model is presented in Figure C.1, and is further elaborated in the following sections.

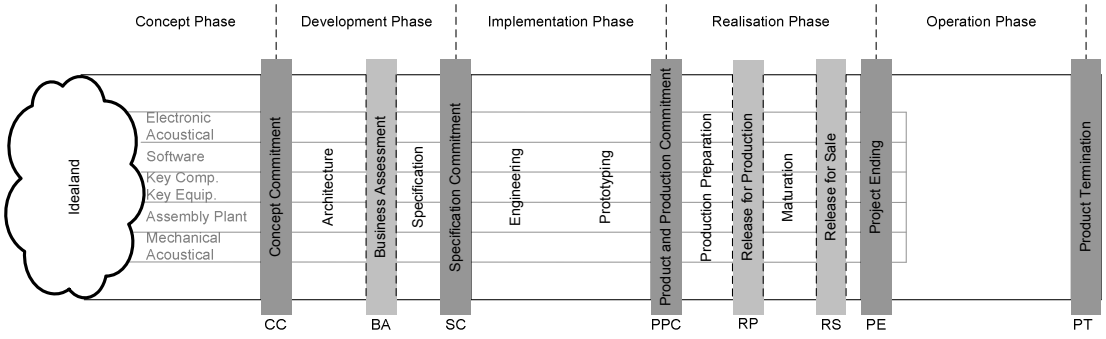

Figure C.1 The TOP-model, according to which the product development process is organised at B&O. After Kirkegaard, Olsson and Nielsen (1996, 217) and B&O (2007b).

As seen in the figure, the product development is structured in five phases with milestones or decision points in the end of each phase, each supported by different tools and checklists. The five horizontal bars framed by the grey lines show the different product aspects that are developed during the process. The parallelism of these indicates that all product aspects are developed simultaneously. The different phases and development activities are further described in the following sections. Throughout the product development process different employees and functions are involved. The most influential employees as well as the most relevant in relation to environmental

aspects are presented in an overall form in Table C.1. It should be noted that the table presents a general picture of the involvement, and this might vary across different development projects. The roles and responsibilities of these employees are further elaborated in the following sections.

Employee	Main responsibilities
Concept manager	Responsible for design and product concept in Idealand
Product manager	Responsible for business perspectives and positioning characteristics and elements of different product lines for instance video or audio
Project manager	Responsible for realisation of specific projects into products for instance BeoVision 9, also responsible for the quality of products (both own and sourced)
Technical product managers	Responsible for the technological aspects of projects, also after the product development process is ended.
Manager of Test & Approval	Responsible for the pool of mandatory requirements
Coordinator	Responsible for a specific technological element for instance software, electronics, mechanics and service
Design Coordinator	Responsible for the contact between designers, constructors and external development partners in the concept phase
Product Architects	Involved in the first stages of the development phase, where the project development phase is planned
Project Management	Group responsible for the overall management of the project, members are: the project manager, and coordinators for different professional groups
Architecture group	Group involved in first discussions about concepts and projects, members are: the project manager and different product architects. Can be supported with other employees or sourcing partners
Constructors	Responsible for solving concrete problems during the product development process
Technicians	Responsible for different sets of quality criteria, which the products should comply with. These relates to product, quality and manufacturing
Marketing and service	Responsible for, among other things, the preparing of user guides and sales material, training materials, spare parts, shop concepts, repairs and market communication
Operations	Operations is an organisation at B&O, and therefore have many responsibilities. In the product development process, operations is responsible for the manufacturing of the product, and the activities needed to prepare manufacturing
User documentation manager	Responsible for securing that documentation and user guides are prepared for all product variations
Method and Process Development Department	Responsible for bringing experiences from one project on to another, and for developing e.g. systems and templates to support the product development process
Sourcing partners	Responsible for development of different product components or process equipment

Table C.1 The most relevant employees in relation to environmental aspects and the employees which are most influential in the product development process.

The appendix is primarily based on information given on the Intranet of B&O, but the product development is also described by for instance Hansen and others (2002) and Kirkegård, Olsson and Nielsen (1996).

C.1 The Concept Phase

The concept phase is the first phase in the product development, and in this phase new concepts and ideas are generated. A key player is Idealand[14], which is described as the meeting between technology and design, where new ideas and concepts are born. According to Hansen and others (2002, 40) the intention is that Idealand should generate more concepts than needed, in order to make it possible to select the best and in a business perspective most interesting ideas.

A main purpose of the concept phase is to make new ideas economic and technological possible. The idea is therefore developed and described through design drawings, design models and design descriptions, and decisions are taken about surface quality, materials and technologies. It is also described how the product should be used and which functions it should include. Critical and difficult functions, which demand new technology, are also tested through dummy models. Different alternatives are developed in parallel, but the aim is to end up with one final product concept through an iterative process. The product concept will look as the final product, but without insides such as electronics. According to Kirkegård, Olsson and Nielsen (1996, 216), the concept is also assessed in relation to already existing products.

Key persons in the concept phase are the designer, who has the decisive influence on the concepts and the design coordinators. In addition, the other staff of Idealand, product managers, project managers, product architects, constructors, environmental consultants and sourcing partners can also be included in the concept phase.

C.1.1 Concept Commitment

The Concept Commitment is a milestone, which ends the concept phase. At this milestone, the concept is handed over to the Research and Development Department (R&D Department), and the design model, the design drawing and the design description are handed over to the project manager.

A central element of the concept commitment is the Concept Commitment Report (CC-report), which constitutes the basis for decisions and the future work on the concept. The subject of the report, together with the responsible employees is presented in Table C.2. Contents related to environmental aspects are underscored.

[14] Two departments exist for initiating product concepts, namely Idealand and Idealab. In this report there is only referred to Idealand.

Subject	Description of content	Responsible employee
Description of concept • Idea • Design	Idea Essential concept elements and ideas, main functionality also for the user, the role of concept in product portfolio and possible break at traditions. Can also include accessories, stands and brackets, functional variants, possible locations in home, what is the concept decided for. Design Physical and graphical design, form, material, surfaces, colours, design ideas, the designer, coherence by separated design elements.	Concept manager
Key figures • Business perspectives • Project key figures	Business perspective The relation to existing portfolio – replacement of other products or supporting these, the background for suggested price and volume figures Description of business scenario: recommended consumer price, yearly going rate, turnover per year, gross profit per year, gross margin and breakeven Project key figures Project schedule, manpower, initial costs and variable costs	Product manager Project manager
Realisation • Technology and technical implementation • Project • Operations • Risk elements	Technology and technical implementation Description of key technology and technical implementation issues. This includes for instance system integration, user interface, software, electrical, mechanics, acoustics and picture. Project A description of project management issues not related to the technical implementation, such as project objectives, decisions about making or buying components, environmental aspects and quality aspects. Operations Description of issues related to the Operations, such at sourcing and manufacturing processes. Risk elements A summary of most significant risk elements related to the realisation of the concept and potential soft faults[15].	Project manager and product responsible technology manager

Table C.2 Main subjects of the Concept Commitment Report, a description of the main content and the responsible employee.

As seen from the table, the content of the CC-report summarises the different discussions and choices made during the concept phase. A central aspect of the CC-report is the project key figures, which are updated as the project progress and evaluated at each milestone. Environmental considerations are part of the CC-report as a description of the environmental aspects related to the project management, and this is the first official point where environmental aspects are taken into considerations. The CC-report is based on a technical concept commitment report, which therefore should be finished at least one week before the CC-report.

[15] At B&O, a soft fault is a discrepancy between the product requirements and the customer's expectations or where customer's expectations have not been specified.

C.2 The Development Phase

The development phase is the second phase of the product development process. At this point the project is started with the establishment of the Project Management. The Project Management consists of the project manager, and the constructions group, represented with coordinators of different professional groups (for instance mechanics, software, and electronics) (Jacobsen 2007). The Project Management first of all designs the development process, in which economy, resources, focus areas, activities, meeting structure, time schedule, documentation, reporting at milestones and checkpoints, prototypes, tests, quality, use of methods and tools are decided for the project. The planning is primarily a top-down activity. In this, it is also considered how the best teamwork constellations during the product development process can be created. The procedures recommend different teambuilding activities in the start-up phase, or later in the project when celebrating success! During the product development process, the Project Management meets every week to discuss various developments, and at each milestone they also approve the reports being conducted.

C.2.1 Architecture

In general, the development phase consists of two activities, namely architecture and specification. Architecture is the first activity, and the purpose is to define a product architecture, which describes functionality and reductions in the product or product family. In addition, the objectives of the project are listed, the project is organised and the project economy is estimated. The project manager and a number of product architectures with different skills are the main drivers of this activity, and they form a core group. Different employees and sourcing partners can support this group, as the primary objective is to consider as many needs as possible. Of the activities taking place in the architecture group can be mentioned:

- Q-days is used in some development processes, where it is discussed how the best quality in the product life time is obtained
- Discussion and selection of alternative solutions
- Elaboration of selected alternatives, and allocation of the products functionality in assembly ready units
- Description of the product's life time performance, to show how the product performs in different phases of its life cycle (design, assembling, use and service), to allow for the architecture to take this into account

Before a final decision is taken about the architecture, a number of reviews are initiated. One review is done by the T&A Department, in order to make sure that the quality is as good as possible, and that the customer perceived quality[16] is obtained.

[16] The customer perceived quality is also denoted as Big Q. This also relates to the product characteristics, which are presented elsewhere in this section. The quality in production is denoted Little q.

Following the architecture, it is the responsibility of the product manager to conduct a Business Assessment Report (BA-report). This forms the basis for deciding whether the project should continue. The BA-report contains a summary of previous decisions, recommendations, the business key figures, the business idea and different aspects related to the product.

C.2.2 Specification

The second main activity of the development phase is the specification, which has the objective of transforming product concepts and the design model into product specifications. A first step in the specification is a further planning of the activities needed to complete the project. An important aspect is also to secure that the plan is realistic and robust, and a risk analysis is prepared to highlight which areas that can delay or close the project, and if necessary action plans to counter critical issues are developed.

The development phase also includes choosing the partners who should deliver or develop the products assembly units, as these are involved in creating the product specifications. Contracts are agreed describing deliveries and agreements between the R&D Department and other partners.

By the end of the phase, all specifications are documented in a product requirement portfolio and in a number of process demands. This means that the description of architecture is transformed into some product requirements, which reflect the product's mandatory, expectation and positioning requirements. These requirements transform the customer's experience of subjective characteristics into objective and measurable technical characteristics. The different characteristics therefore become a central focus of the phase that follows the development phase. The different types of characteristics are explained in the ordered list (Hansen et al. 2002, 42; Kirkegård, Olsson and Nielsen 1996, 180-2):

- Mandatory requirements are to secure the customer a faultless use of the product. These are derived from internal B&O norms, as well as regulatory standards. It follows that the regulatory standards should be followed, whereas the internal norms can be discussed in some cases by the mandatory requirements group[17] (Nielsen 2007a). At B&O, environmental aspects are part of the mandatory requirements. In the view of B&O, the special case about mandatory requirements is that compliance above the mandatory level will not make the customers more satisfied with the product. On the other hand, if the mandatory requirements are not fulfilled, the customers are very unsatisfied. Some of the mandatory requirements are relevant for all B&O products; others are only relevant for a specific type, for instance a telephone.
- Expectation characteristics are those requirements, which give a positive customer satisfaction if further improved. However, there is an upper limit to how much the customers are

[17] The group consists of managers from different departments: Test & Approval, Operations, Service, the quality manager and the Director of Quality and Environment. Besides assessing cases where the mandatory requirements cannot be fulfilled, they also approve new requirements and decide whether old characteristics should be removed from the pool of mandatory requirements (Nielsen 2007a).

willing to pay extra for these characteristics. These characteristics are for instance related to the functionality and the quality of acoustics and picture.

- The positioning characteristics do not imply negative costumer satisfaction if not present, but if these are present they yield a very high customer satisfaction. The positioning characteristics are those who distinguish a B&O television from other products. The positioning characteristics are often developed as part of Idealand, and are key elements of the product concept.

Some of the main persons involved in this phase are the product manager, the project manager, technical product managers, sourcing partners, the manager of Test & Approval (T&A) who is responsible for the mandatory requirements, constructors, product technicians and quality technicians.

C.2.3 Specification Commitment

The phase is ended with the Specification Commitment Report (SC-report), which is basis for a decision about the further continuation of the project. The content of the report is similar to the BA-report. According to Nielsen (2007a), not many projects are stopped after the specification commitment has been reached. However, if resources are lacking, some projects might be put in a standby position, and be taken up later.

According to Jacobsen (2007), all mandatory requirements should be known at this point, including mandatory environmental requirements. As mentioned, the characteristics are presented in the product requirement portfolio. The project management must at this point approve these requirements that is accept that the product must fulfil these requirements (Olesen 2007).The final project manning should also be defined, to make sure that the necessary resources are available to complete the project. The Specification Commitment is ended with a number of project approvals for instance about interfaces, distribution of functionality and design principles.

C.3 The Implementation Phase

The implementation phase is the third phase of the product development process. The main purpose of the phase is to transform the specification and its requirements into a product- and process documentation, which should be used to realise the project (the fourth phase).

In the development phase a complete specification for each unit including the product requirement portfolio has been prepared, and this is now transferred to the implementation phase. Some of the constructors and technicians have been involved in the two previous phases, however, at this point the actual engineering work starts, and the main part of the constructors and technicians are involved from this point. In this phase, the largest number of employees are involved (Jacobsen 2007).

C.3.1 Engineering

As a first step the detailed activities for constructors and technicians are planned, and then the preparation of the first prototype begins. The specifications make it possible to work in parallel on several aspects of the project, as an example both the design and the processes of the modules, which are to be integrated in the product. If a sourcing partner is to develop some of the components to the product, the specification is also handed over to these. During the progress of the implementation phase, close co-ordination is needed between the different partners and employees, to make sure the schedule is followed. Not only the product is developed in this phase, also process equipments and tools, packaging, labels, user guides and sales material are designed and developed. A plan for the expected sale is also prepared.

As mentioned, the purpose of this phase is to transform the product specification and its requirements into a product- and process documentation. To make this process run as smoothly as possible, close collaboration is needed between different professional groups such as constructors, manufacturing- and quality technicians, tool makers and suppliers. This way of developing the project is based on a network between the employees, where one employee addresses another if a common problem is to be solved.

The product elements, as well as the supporting equipment (process tools, packaging, sales materials etc.) are reviewed by T&A as the project progresses, and if these are not in compliance with the specifications in the product requirement portfolio, the development process continues.

C.3.2 Prototyping

When everything has been reviewed and approved, the actual prototyping begins. The prototyping is an iterative process of changing the design and implementing new design elements to solve problems in the design. The purpose is to verify that the different units will work together and also that the complete documentation complies with the product requirements and specifications. The activities taking place are:

- Protection of intellectual properties through prototypes and pictures of the full product
- Field tests of prototypes, both units of the product and a complete system set-up can be tested
- Test of prototype in packaging for the effect of stresses related to transport
- Climatic test where the prototype is exposed to temperature stresses and humidity
- A verification of the product conformity with specifications, for instance through measurements, reviews on manufacturability and serviceability, regulatory requirements, and a review of the user guide
- Prototyping of critical elements in process equipment, tools, measurements or test equipment

Each prototype is evaluated by T&A, who reports back to the project manager if the sample meets the desired quality. An updated documentation is prepared, and the product requirements portfolio is also updated and reviewed. This documentation is released for the next development phase (realisation phase)

C.3.3 Product and Production Commitment

The implementation phase is ended with the Product and Production Commitment Report (PPC-report). The content of the report is similar to the BA-report and the SC-report, and it forms the basis for deciding whether or not the project should continue. At this point, there have been no major investments in tools or production equipment (Kirkegård, Olsson and Nielsen 1996, 218).

C.4 The Realisation phase

As a fourth phase in the product development, the realisation phase is initiated. It consists of two main activities, namely the production preparation and the maturation.

C.4.1 Production Preparation

The overall purpose of the production preparation is to provide the tools, process and production equipment necessary for the production, in order to make sure that the product can be manufactured in a certain quality. The aim is to test the process equipment with items of final quality, but in some cases tests are used. During the product preparation around 20 saleable and producible samples are built in the assembly process that will end up producing the final product in the operation phase (the fifth phase).

The planning of the product preparation involves the project management, Operations, T&A, product suppliers and process and tool suppliers. Key operators, which need to be acquainted with the assembly process, are also involved in the product preparation, and the customer after sales services is involved in the development of spare parts, to make sure that service can be carried out when the products are released for sale.

The samples prepared during the product preparation are tested by T&A, through test similar to those conducted on the prototypes, in order to verify the quality of the products. This also includes verifying the software functionality and a system test where the functionality of the product is tested together with other B&O products. The purpose of testing the samples is to completely measure the products, in order to achieve a final approval before the production of the 0-series could be initiated. The product preparation also includes initiating a regulatory approval of the product and processes. Preferably, this should be finished before the production of the 0-series is initiated, but at the latest before the product is released for sale.

As a final element of the product preparation, sales training material for dealers is produced, the product is implemented in the sales configurator, and marketing is supported with relevant technical documentation. Launch quantity and variant types are also decided.

C.4.2 Release for Production

The product preparation is ended with the milestone release for production. At this point it is verified by T&A that the product complies with the specifications and requirements laid down in the specification commitment. At this point an employee starts to achieve the market approvals needed in order to sell the product in various markets. In Europe this is achieved through the CE marking, while other countries have other procedures (Olesen 2007).

C.4.3 Maturation

When the product is released for production, the production of the 0-series is initiated. Through the 0-series the production equipment, tools and production documentation is tried out in praxis, the operators and production workers are educated and trained according to work instructions. It is also verified that the capacity needed in production is available, and that the quality is preserved even when production is running at full capacity. It is also verified that the product meets strategic quality goals of B&O, and that the customer quality is satisfactory. This also includes an initial test, where around 100 products are functionally tested for 125 hours. The higher demands for quality, the larger number of units has to be tested to make sure that the product performs better than the expected quality.

A purpose of the maturation process is also to have a number of products ready, to meet the demands when the product is released for sale. The stable quality of the 0-series is therefore very important. There are certain demands for the quality of the 0-series:

- It should be possible to make the final verification of the product requirements
- It should be good enough for dealer presentations
- It should be good enough to be released for sale, minor updates could be conducted though

In the maturation the sales configurator is verified, to make sure that lists, prices, and composition of variants are generated as they should. The dealer's configurator is also tested, to verify that this communicates correctly with the production management system. Also the service documentation is verified, and it is verified that all product variants are covered by a user guide.

C.4.4 Release for Sale

Based on the adjustments that have been made during the realisation phase, the documentation is updated, before the product is released for sale. At this point, marketing events are carried out, and dealers are provided with demo-products, sales training material and brochures. The product is now ready for being sold to customers.

C.4.5 Project Ending

The project ending marks the ending of the project, the concept has now been transformed into a final product, and the documentation and specification is handed over to Operations, and the Project Management is dissolved (Jensen 2007). At this point the participants evaluate the project and

the resulting product. The Method and Process Development Department also participates in the evaluation, and these have an important role in passing the project experiences to future projects. Some of the points that are evaluated are:

- The project realisation and collaboration
- Whether targets set up during the architecture and specification phase have been met
- Whether preconditions and expectations have been correct for the different phases of the project development

These experiences are summarised in the Project Ending Report (PE-report). This report summarises the positioning of the product, business key figures, the launch of the product, and key figures and learnings of the project.

C.5 The Operation phase

The fifth phase of the product development phase is the operation phase, where products are produced and sold to customers. As such the operation phase is not part of the product development itself, however the production processes should be continuously optimised and platforms, standard designs, products and supply chain relations should be maintained. An important objective in this regard is to lower the cost of production and increase the product quality. Market and technology developments as well as competitors are also surveyed, and some new positioning characteristics of products might be discovered.

According to Bendix (2007), the aim of B&O is to be order-producing, to avoid large inventories. However, for the most popular product types and colours, they have a buffer production in order to be able to deliver to customers within the time limits that are set up (5 days).

C.5.1 Product Termination

At some point, it might be decided that the product should no longer be part of the B&O product portfolio. If this decision is made, a Product Termination Report (PT-report) is made. This report gives recommendations based on the experiences with this product, describes the product and its category, the timing and sales history as well as arguments for the termination. The report also describes which implications the termination has on the business in general and the portfolio which the product is part of.

It is a B&O norm that it should be possible to provide service for the product as long as 12 years after the termination of production (Bruhn-Jensen 2007a). This has a significant implication for the Service Organisation, as it should be assured that defect products could be repaired, even if these are no longer in production.

The Implementation Process for the EuP Directive

D

The purpose of this appendix is to present the most central events in the implementation of the Directive, and thereby reveal the status of the implementation process. The transposing into Danish law is also described.

D.1 Significant Events of the Implementation Process

The timeline of significant events in the implementation process are illustrated in Figure D.1, and in the following the central events and elements are presented.

Figure D.1 Timeline of events for the implementation of the EuP Directive. The content is based on (European Commission 2005; European Commission 2007a; BIO Intelligence Service n.d.; VITO n.d.; Eifel 2006b, 2).

D.1.1 Preparatory Studies

As the first step after the adoption of the EuP Directive, the European Commission launched an invitation to tender for 14 preparatory studies. The aim of the preparatory studies is to investigate possible ecodesign criteria for the product groups, and hence they provide valuable information to the implementing measures. The intention is that the number of preparatory studies will increase in time until all product groups are covered. The first 14 products group cover a broad range of products, including boilers, refrigerators and freezers, computers, office and street lighting as these are assessed to have the largest greenhouse gas reduction potential (Toth 2006, 2).

After the contractors for the preparatory studies were found, the first projects were launched in the beginning of 2005. The input to the preparatory studies was provided by relevant manufacturers in the different product categories, where B&O has provided information to *Lot 5 on Consumer electronics: televisions*. The preparatory studies of relevance for B&O are further presented in Section 5.3.

D.1.2 Establishment of Forum and Committee

The next step in the implementation of the Directive the European Commission established a Consultation Forum in the first half of 2007. The Consultation Forum consists of representatives of the member states and interested parties, for instance trade unions, traders, retailers, importers, environmental protection groups and consumer organisations (European Commission 2005). The Forum assists the European Commission and contribute '*in particular, to defining and reviewing implementing measures, to examining the effectiveness of the established market surveillance mechanisms, and to assessing voluntary agreements and other self regulation measures*' (European Commission 2005).

A further group to assist the Commission is referred to as the Regulatory Committee. The Regulatory Committee will be informed when it is assessed that an energy-using CE marked product does not fulfil the requirements in the relevant implementing measure. Further, the Committee will be consulted and their opinion will be taken into consideration in the drafting of the implementing measures. Finally, the Committee is assisting the European Commission in the determination of whether the objectives of voluntary agreements are met (European Commission 2005).

D.1.3 Establishment of Working Plan

No later than July 6, 2007 the European Commission must establish a working plan, which gives directions for which products that should be given priority in the preparation if the implementation measures (European Commission 2005, Art. 16). The Consultation Forum will be heard before the establishment of the plan, just as they are heard in relationship to the regular amendments of the plan.

D.1.4 Adoption of Implementing Measures

Finally, it is expected that the first implementing measures, in which the ecodesign requirements are laid down, will be adopted in the first half of 2008 (Eifel 2006b, 2). The Consultation Forum

also assists the Commission in defining and reviewing the implementing measures, and therefore allows companies and other interested parties to seek influence on the requirements for products and services (European Commission 2007b). A recognised standardisation body adopts the standard on a mandate from the European commission.

D.2 Transposing into Danish Law

An important step in the implementation of the EuP Directive is the transposing into national legislation. In the national legislation different elements of importance to companies are determined, for instance the responsible authorities. The transposing must happen on August 11, 2007 at the latest. With the transposing Law No. 94 of February 9, 1994 on Norms on Energy Efficiency in Energy Using Products is repealed (Ministry of Transport and Energy 2007, 15).

In the case of Denmark, draft legislation was submitted for public hearing on February 7, 2007 with a public comment deadline on March 21. Responses were received from among others the Confederation of Danish Industries and different branch organisations that in general were positive. The Danish Society for Nature Conservation and the Ecological Council were more critical and criticised, among other things, the procedure for assessing compliance (Poll 2007b). Finally, the response from the Danish Institute for Informative Labelling expressed concern regarding surveillance procedures and proposed that these should be more in line with the surveillance procedures of the energy label on white goods (Weidlich 2007). The intention was that the draft legislation should have been presented in the Danish Parliament on March 14, which would make it possible to transpose the Directive into Danish legislation in due time. However, this has been postponed until the second half of 2007, as especially the response from the Danish Institute for Informative Labelling could not be carried out in time (Nielsen 2007b). In the following, the Danish draft legislation and choices made in this regard are presented.

D.2.1 The Danish Draft Legislation

Pursuant to Chapter 2 of the Danish draft legislation, it is the Danish Minister for Transport and Energy who is given legal basis to set up rules in accordance with the Danish legislation, but often he must negotiate with the Minister for the Environment. As the requirements of the implementing measures are not yet known, the legal basis in the legislation is made broad enough to entail any coming requirements (Ministry of Transport and Energy 2007, remarks).

Both the Minister for Transport and Energy and the Minister for the Environment are pursuant to Chapter 3 of the draft legislation appointed as surveillance authority, and each can delegate the powers of the legislation to a relevant government agency or minister. It is in the remarks to the draft legislation noted that the responsibility for the surveillance activities very likely will be organised between the Energy Authority and the Environmental Protection Agency. Nielsen (2007b) notes that most likely there will be established an external secretariat, to which the responsibility will be delegated. The surveillance activities are expected to begin in 2008-2009 and will gradually

be expanded. In relation to the delegation of responsibility, this of course have an influence in relation to practical issues.

Pursuant to Section 13, complaints should be filed to either the Energy Board of Appeals or the Environmental Board of Appeals. A specific procedure for filing complaints is not yet in place, but the legal basis is given to ensure the establishment of such procedures (Ministry of Transport and Energy 2007, remarks).

The penalties are defined in Section 14 of the draft legislation. It is laid down that a fine is given to those who refrains from providing or provides incorrect or misleading information to the surveillance authority, who hinder the access to products needed in the market surveillance or who abstains from meeting enforcement orders or bans. In case of any economic advantages of the offence this is confiscated, also if the offence has not caused any harm or threat to the environment.

The EuP Directive and Company Requirements

E

The purpose of this appendix is to analyse the EuP Directive, in order to determine the different aspects of the Directive that influences companies directly. The appendix is used as a point of departure for the analyses conducted in Section 5.2. The directive is analysed using the following steps:

- Identification of primary articles and annexes in relation to companies
- Description of content of article and annex and its relevance for companies
- Primary elements are highlighted

The result of the analysis is a comprehensive range of elements, which are found to be of potential importance for companies. It is thus the elements, which a company should address and consider when facing the process of complying with the EuP Directive.

In the analysis, the term *Companies* refers to companies in general with size similar to B&O. The primary reference for this appendix is the EuP Directive, but other relevant sources of information are used with a specification of reference. Table 5.1 gives an overview of the articles and annexes in the directive.

1 Subject matter and scope	**13 Small and medium-sized enterprises**	25 Implementation
2 Definitions	**14 Consumer information**	26 Entry into force
3 Placing on the market and/or putting into service	**15 Implementing measures**	27 Addressees
4 Responsibilities of the importer	16 Working plan	**Annex 1**
5 Marking and declaration of conformity	**17 Self regulation**	**Annex 2**
6 Free movement	18 Consultation Forum	Annex 3
7 Safeguard clause	19 Committee procedure	**Annex 4**
8 Conformity assessment	20 Penalties	**Annex 5**
9 Presumption of conformity	21 Amendments	**Annex 6**
10 Harmonised standards	22 Repeals	**Annex 7**
11 Requirements for components and sub-assemblies	23 Review	**Annex 8**
12 Administrative co-operation and exchange of information	24 Confidentiality	

Table E.1 Overview of articles and annexes in the EuP Directive where bold text illustrates the ones reviewed in the present appendix.

E.1 Primary Articles and Annexes

Article 3: Placing on the market and/or putting into service
The member states must take the necessary measures to ensure that only energy-using products covered by implementing measures can be placed on the market or put into service if they comply with the given implementing measures, and are marked with the CE marking. The member states appoint the responsible authorities for the market surveillance, ensure that the Commission is informed about the surveillance and make the consumers and other relevant parties aware of their possibilities for informing the member states of any product discrepancy. Relevant for a company in this regard is that:

- Energy-using products must be in compliance with the relevant implementing measures and marked with the CE marking before being placed on the market

Article 4: Responsibilities of the importer
Is the manufacturer located outside the Community, it is the responsibility of the importer to ensure product compliance with the Directive and the relevant implementing measures, and must keep the conformity assessment and the technical documentation. Relevant for a company in this regard is that:

- The responsibility is handed over to the importer if the manufacturer is located outside of the Community

Article 5: Marking and Declaration of Conformity
Before an energy-using product covered by implementing measures is placed on the market or put into service it must be labelled with the CE marking, and a conformity declaration must be issued in accordance with Annex VI. With regards to the requirements for information in accordance with Annex I, part 2, the member states takes the following into account: whether the information can be displayed through the use of harmonised symbols, recognised codes, or other measures, and the type of consumer the energy-using product is addressed to. Further, the member states can require that the information available in accordance with Annex 1, part 2 is issued in the official language of the member state. Relevant for a company in this regard is that:

- Energy-using products must bear the CE conformity marking before it can be placed on the market
- A conformity declaration should be conducted and issued
- It can become an option to make use of harmonised symbols or recognised codes or other measures to be placed on the product when informing the end-user and treatment facilities

Article 6: Free Movement

A member state cannot on their territory hinder or prevent the marketing or the putting into service of energy-using products covered by and compliant with implementing measures and marked with the CE marking. Nor can member states prevent energy-using products, which are not in compliance with implementing measures, from being displayed at trade fairs, exhibitions and demonstrations if it is clearly marked that the given energy-using products will not be placed on the market or put into service before the energy-using products comply with the implementing measures. Relevant for a company in this regard is that:

- The companies cannot be prevented from placing their energy-using products on the market as long as these are in compliance with the relevant implementing measures and marked accordingly
- It is possible for the company to exhibit energy-using products that are not in compliance with the relevant implementing measures

Article 7: Safeguard Clause

Is sufficient information available to determine that an energy-using product is not in compliance with the implementing measure, the member state must take the necessary measures, which in worst case can lead to prohibition of placing the energy-using product on the market until compliance is ensured. If the non-compliance continues the member state must decide to impede or prohibit the placing on the market and putting into service or ensure that the energy-using products are withdrawn from the market. The member state's decision to prohibit or restrict placing energy-using products on the market or putting it into service must be motivated, and the involved actors must be informed immediately. Further, the involved actors are informed about legal remedies available in the given member state and the time limits of these. The member states must immediately inform the Commission of any decision made with regards to this, and the Commission must consult relevant actors, gather the necessary information and take the needed measures. Relevant for companies in this regard is that:

- In case of continuous non-compliance it is a possibility that the energy-using products will be prohibited on the market until compliance is obtained

Article 8: Conformity assessment

Before energy-using products covered by implementing measures can be placed on the market or put into service, the manufacturer is to ensure that a conformity assessment is conducted. The conformity assessment procedures are specified in the implementing measures. The manufacturer can choose between internal design control as defined in Annex IV and the management system defined in Annex V. Is the energy-using product designed by an EMAS registered organisation and is the design function included in the registration, the energy-using product is assessed to be in compliance with the requirements of Annex V. Likewise, is the energy-using product designed by an organisation with an management system that includes product design and is in accordance with

harmonised standards, the management system is assessed to be in compliance with Annex V. The manufacturer must keep the relevant information on the conformity assessment for ten years after the last energy-using product has been manufactured, and in case the competent authority requests it the relevant information must be made available within 10 days. Relevant for a company in this regard is that:

- The manufacturer can choose between two overall approaches for compliance: internal design control and a management system in accordance with Annex IV or V
- The management system of a company which is either EMAS registered, including the design function, or having another management system, including the design functions, set up in accordance with relevant harmonised standards is presumed to be in compliance with Annex V
- The company must keep the information on the conformity assessment for ten years after the last energy-using product has been manufactured
- The company must be able to gather and provide relevant information within ten days on request of competent authority

Article 9: Presumption of conformity

The member states presumes energy-using products to be in compliance with relevant requirements if they are marked with the CE marking, if harmonised standards have been used, or if they bear the European Union eco-label, or other eco-label assessed to be in accordance with Regulation (EC) No 1980/2000. Relevant for a company in this regard is that:

- Both products bearing the CE marking and certain eco-labels are presumed to be in compliance if these are assessed to be in accordance with the implementing measures

Article 10: Harmonised Standards

The member states are to ensure that involved actors can seek influence in the process of preparing the harmonised standards. If a member state of the commission finds that a standard does not meet the provisions intended, they are to inform the Standing Committee which following should take appropriate actions. It is then the task of the Commission to ensure the preparing of a valid standard. Relevant for a company in this regard is that:

- There is a possibility for seeking influence in the drafting of the standards

Article 11: Requirements for components and sub-assemblies

It can be required in the implementing measures that manufactures of components and sub assemblies should inform the manufactures of an energy-using product, in which the parts are used, about relevant information concerning use of energy and other resources. Relevant for a company in this regard is that:

- It can be required that producers of components are obliged to provide the relevant information to the manufacturer of an energy-using product

Article 13: Small and medium-sized enterprises
The commission will take the programs into account that support SMEs and very small firms[18] in their endeavour to integrate environmental aspects, including energy efficiency in their product design.

Article 14: Consumer information
Manufacturers of energy-using products are to determine the appropriate amounts of information given to the end-users about their role in using the product in a sustainable way. When required in the implementing measures they should furthermore inform the end-users about the ecological profile of each product and additionally about the advantages of ecodesign. Relevant for a company in this regard is that:

- In accordance with the implementing measures the company determines the type of information needed for the end-user to clarify their role in the sustainable use of the given product
- It can be required to inform the end-user about the ecological profile of the product a long with the advantages of ecodesign

Article 15: Implementing measures
The energy-using products are covered by implementing measures or self regulation if the following overall criteria are met: more than 200.000 units of the type of product should be sold yearly in the Community; the product type should cause a significant impact on the environment; the energy-using product should have a significant improvement potential without entailing excessive costs for the manufactures.

When the commission drafts the implementing measures they should consider the environmental impacts in the lifecycle of the energy-using product and asses impacts on the environment, the consumers and the manufactures in relation to competitiveness, access to market as well as both costs and benefits. Furthermore, they should consider the national legislation relevant in the member states and consult relevant stakeholders.

The implementing measures are not to result in significant changes in the functionality or the costs of the product, nor have negative impacts on health, safety and the environment. There must be no significant consequences for the competitiveness of the manufacturer and no usage of proprietary

[18] Using the definition given in Commission Recommendation of 6 May 2003 a SME is defined as a company having less than 250 employees and a turnover not exceeding EUR 50 million (European Commission 2003b).

technology should become a necessity. Additionally, no disproportionate administrative burden should be placed on the manufacturers.

Requirements to ecodesign are to be stated in the implementing measures in accordance with Annex I and/or II. The requirements regarding ecodesign are determined for specific environmental aspect with considerable environmental impacts. The implementing measures can also leave out ecodesign requirements in accordance with Annex I, part 1.

The requirements are to be formulated in such a way that the market surveillance authorities are able to determine if the energy-using product is in compliance with the implementing measures. It varies whether a test should demonstrate compliance or if further documentation is needed.

When ecodesign is a requirement they should be followed by a guideline for balancing various environmental impacts which is to be adopted by the commission in accordance with Article 19 of the Directive. Further material could be provided if necessary to assist SMEs in complying with the Directive. Relevant for a company in this regard is that:

- A list of criteria, including the amount produced and potential environmental impacts, determines if a product type is subjected to the Directive and consequently if implementing measures can be expected for the given product type
- The process of compliance should not result in significant negative changes in the product functionality or cost
- The manufacturer can be subjected to generic and/or specific ecodesign requirements according to Annex I and/or II
- When controlling for compliance the authorities can either test the product directly or require additional information depending on the implementing measures

Article 17: Self regulation

Voluntary agreements and other types of self regulation that constitutes alternatives to the implementing measures are as a minimum to be assessed on the basis of Annex VIII. Relevant for a company in this regard is that:

- Self regulation in the shape of voluntary agreements can be alternatives to the implementing measures

Article 18: Consultation Forums

In the process of preparing the implementing measures the commission ensures a balanced participation of member states representatives and other relevant actors including industries, environmental NGOs and consumer organisations. The different actors are to assist in the defining of the implementing measures, investigation of the effectiveness of the marked surveillance and assessments of self regulation measures.

- The companies can seek influence in the process of preparing the implementing measures

Annex I: Method for setting generic Ecodesign requirements

Generic requirements for ecodesign are used in situations where it is inappropriate to use specific requirements. The significant environmental impacts to be considered are determined in the implementing measures along with the relevant ecodesign parameters, information requirements and requirements for the manufacturer.

The ecodesign parameters include considerations about environmental impacts related to all stages of the life cycle of the product. Impacts to consider if relevant include among other things use of various resources, expected emissions, noise, vibrations, radiation, electromagnetic fields, generation of waste and recycling potential. Additionally, a range of parameters, including mass, volume, resource consumption in the production, use of recycled materials, service life, waste and emissions is to be used by the manufacturer in the assessment of improvement potentials for the given product.

As regards to the needed information provided by the manufactures to other players in the product chain various requirements can appear in the implementing measures. These can include information about the design of the product, information about distinct environmental impacts related to the product, information about most expedient handling by the end-user and information about disassembly. If possible the information is to be displayed on the product.

The implementing measures outline environmental aspects related to the life cycle of the products, which can be changed significantly through the design phase. These are to govern the producer in preparing an assessment of the energy-using product throughout its lifetime. The assessment is to lead to the preparation of an environmental profile of the product, which is to be used to assess alternative design solutions. Relevant for a company in this regard is that:

- The products can be subjected to life cycle based generic requirements related to resource consumption, expected emissions, noise, vibrations, radiation, electromagnetic fields, generation of waste and recycling potential
- A list of criteria, including mass, volume, resource consumption in the production, use of recycled materials, service life, waste and emissions, can be included in the consideration of the improvement potentials of the products
- It can become mandatory to provide information about, among other things, design considerations, environmental impacts related to the product, correct use of the products and methods for disassembly, to different actors in the product chain handling the product
- It can become mandatory to perform an assessment of the environmental aspects related to the energy-using product throughout its life time
- It can become mandatory to perform an ecological profile of the products
- It can become mandatory to assess alternative design solutions

Annex II: Method for setting specific ecodesign requirements

Specific requirements can be used in order to improve the environmental profile of a product related to for instance energy efficiency or water consumption. A technological, environmental and economic analysis will be used to identify improvement potentials which will form the basis of concrete measures to minimize the environmental impacts related to a product. Different aspects relevant are to be assessed in relation to each other. Relevant for a company in this regard is that:

- Products can be subjected to various specific requirements

Annex IV: Internal Design Control

In determining the documentation needed in order to demonstrate compliance with the implementing measures, a set of technical information is to be prepared. The technical information must include the following; product description, results of environmental assessments, environmental profile, standards used, relevant design aspects and measurements used to check for compliance. Relevant for a company in this regard is that:

- When internal design control has been chosen as an approach for compliance, the requirements for documentation can vary and include issues like which environmental assessments are made on similar products, the ecological profile and a description of the solutions chosen to comply with the requirements

Annex V: Management System for assessing Conformity

If a management system is chosen as a strategy in the process of complying with the Directive different procedures are to be established. This includes the preparing of an environmental product performance policy supported by objectives and indicators to document any changes made to the product. The management system is also to contain procedures for planning, and through this strive for fulfilment of the objectives and goals set up. Additionally, thorough documentation of the elements of the management system are required along with documentation of the energy-using product including environmental assessments prepared or referred to, standards used, description of results managed and environmental design aspects provided. Finally, the management system is to contain checking and corrective actions, which include reviewing the system and ensuring that the implementing measures are complied with and that the design specifications are used. Relevant for the company in this regard is that:

- When a management system has been chosen as a strategy for compliance, the system should contain a range of needed procedures, including preparation of an environmental product performance policy, planning, implementation, documentation and checking as well as corrective actions

Annex VI: Declaration of conformity
A list of needed content of the EC declaration of conformity must include information about the manufactures, the model specified, if needed the relevant standards used, as well as other relevant national legislation and the person empowered to bind the company. Relevant for a company in this regard is that:

- The company should have knowledge about what the declaration of conformity is to contain

Annex VII: Contents of the Implementing Measures
This Annex sets the requirements for what the implementing measures are to contain. The different elements it is to contain are however described under separate Annexes. The implementing measures are to contain a definition of the product it concerns and the specific and/or the generic requirements set up for the given product type. Furthermore, the methods and standards to be used for measuring should be presented as well as criteria to be used by third parties to control for compliance. Additionally, the requirements for documentation should be presented and finally the dates for needed compliance should be noted. Relevant for a company in this regard is that:

- The company should have knowledge about the content of the implementing measures

Annex VIII
A list of non-exhaustive indicative criteria is listed and can be used to evaluate self regulatory initiatives completed as an alternative to complying with the implementing measures. The initiatives are to allow third country operators to participate, the environmental profile of the products should evolve, a large share of similar producer types should be represented, objectives and indicators should be established, the general public should be given access to the initiatives and the underlying monitoring reports, a clear system for control should be established, the financial burden should be commensurate with the efforts and finally additional influential national legislation should be considered when determining the efficiency of the initiatives. Relevant for companies in this regard is that:

- If self regulation is to be used as a strategy for compliance a range of criteria is to be considered to ensure that the strategy is expedient

E.2 Articles and Annexes of Potential Importance

Following the analysis of the primary articles and annexes of the EuP Directive, the points highlighted in Section E.1 are compiled in Table E.2. These elements will most likely come in force for companies; their exact influence will be given by specific implementing measures for each product type. The table serves as a point of departure for the analyses conducted in Chapter 5, which rearranges the elements according to different categories, and following discuss the potential outcome in relation to each of the categories.

Article	Articles of Potential Importance
3	Energy-using products must be in compliance with the relevant implementing measures and marked with the CE marking before being placed on the market
4	The responsibility is handed over to the importer if the manufacturer is located outside of the Community
5	A conformity declaration should be conducted and issued in accordance with Annex VI
5	Energy-using products must bear the CE conformity marking before it can be placed on the market
5	The member states can, in the national legislation, make different requirements about the type of information to be provided by the companies
6	The companies cannot be prevented from placing their energy-using products on the market as long as these are in compliance with the relevant implementing measures and marked accordingly
6	It is possible for the company to exhibit energy-using products that are not in compliance with the relevant implementing measures
7	In case of continuous non-compliance it is a possibility that the energy-using products will be prohibited on the market until compliance is obtained
8	The manufacturer can choose between two overall approaches for compliance: internal design control and a management system in accordance with Annex IV and V respectively
8	The management system of a company which is either EMAS registered, including the design function, or having another management system, including the design functions, set up in accordance with relevant harmonised standards is presumed to be in compliance with Annex V
8	The company must keep the information on the conformity assessment for ten years after the last energy-using product has been manufactured
8	The company must be able to gather and provide relevant information within ten days on request of competent authority
9	Both products bearing the CE marking and certain eco-labels are presumed to be in compliance if these are assessed to be in accordance with the implementing measures
10	There is a possibility for seeking influence in the drafting of the standards
11	It can be required that producers of components are obliged to provide the relevant information to the manufacturer of an energy-using product
14	It can be required to inform the end-user about the ecological profile of the product a long with the advantages of ecodesign
14	In accordance with the implementing measures the company determines the type of information needed for the end-user to clarify their role in the sustainable use of the given product
15	The manufacturer can be subjected to generic and/or specific ecodesign requirements according to Annex I and/or II
15	A list of criteria, including the amount produced and potential environmental impacts, determines if a product type is subjected to the Directive and consequently if implementing measures can be expected for the given product type
15	The process of compliance should not result in significant negative changes in the product functionality or cost
15	When controlling for compliance the authorities can either test the product directly or require additional information depending on the implementing measures
17	Self regulation in the shape of voluntary agreements can be alternatives to the implementing measures

Annex	Anneces of Potential Importance
I	A list of criteria, including mass, volume, resource consumption in the production, use of recycled materials, service life, waste and emissions, can be included in the consideration of the improvement potentials of the products
I	It can become mandatory to perform an assessment of the environmental aspects related to the energy-using product throughout its lifetime
I	It can become mandatory to perform an ecological profile of the products
I	It can become mandatory to assess alternative design solutions
I	It can become mandatory to provide information about, among other things, design considerations, environmental impacts related to the product, correct use of the products and methods for disassembly, to different actors in the product chain handling the product
II	The products can be subjected to various specific requirements
IV	When internal design control has been chosen as an approach for compliance, the requirements for documentation can vary and include issues like which environmental assessments are made on similar products, the ecological profile and a description of the solutions chosen to comply with the requirements
V	When a management system has been chosen as a strategy for compliance, the system should contain a range of needed procedures, including preparation of an environmental product performance policy, planning, implementation, documentation and checking as well as corrective actions
VI	The company should have knowledge about what the declaration of conformity is to contain
VII	The company should have knowledge about the content of the implementing measures
VIII	If self regulation is to be used as a strategy for compliance a range of criteria is to be considered to ensure that the strategy is expedient

Table E.2 Elements in the EuP Directive of potential influence for companies.