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MULTIPLE ENVIRONMENTAL BENCHMARK DATA SUPPORTING ECODESIGN IN BOTH INDUSTRY AND ACADEMIA

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1. Introduction

For many years now, Philips Consumer Electronics and Delft University of Technology (DUT) have cooperated in a wide range of (applied) ecodesign related research projects. In these projects, the Environmental Competence Centre (ECC) at Philips provides products, product data, research facilities and the business perspective. Staff and students from the Design for Sustainability Programme at the DUT contribute design knowledge, creativity and methodological support where needed. The aim of this cooperation is to balance and bridge scientific theory and methodology development regarding sustainability issues on the one hand, and corporate practices as they exist in the (manufacturing) industry today on the other hand.
One of the main research topics that has been particularly helpful in building the bridge between scientific research and implementing it in the business is the collection, and subsequent utilisation and interpretation, of environmental benchmark data. In recent years, a multitude of environmental benchmark data has been collected on a range of consumer electronics products. Recently, initiatives to exploit benchmark data not only based on individual benchmark reports but rather on the full sample of available benchmark reports have lead to new proposals for ecodesign. The use of multiple environmental benchmark data is reported on in this paper in paragraphs 3 and 4, following a description of regular environmental benchmarking practices at Philips.

2. Environmental Benchmarking

The environmental benchmark method, as recorded in an official Philips document (Ram and Salemink 1998), is laid out in the Environmental Benchmark flowchart as depicted in Figure 1, and explained briefly in this paragraph. The method does not only comprise the benchmarking of products itself, but it positions this activity in an integral approach that facilitates the exploitation of the benchmark results. The flowchart explains that there are three main elements: the actual benchmark procedure itself, the link to Ecodesign and the exploitation of the results in the market. For a more detailed overview a journal article has been prepared (Boks and Stevels 2002).

2.1 The Actual Benchmark

The actual benchmark procedure builds on the work of for example Kotler (Kotler 1994), and consists of four elements: the choice of products, the system definition, comparing and validation of products, and the review of results.
Choice of products
The first element of the actual benchmark procedure is to decide on the products to be benchmarked. In the Philips procedure, a Philips product that will potentially qualify as a ‘Green Flagship’ is

compared with 3 to 4 competitor's products that are selected as either best commercial competitor or as probably scoring well on environmental criteria. Additionally, all products in the same benchmark study should have similar characteristics as regards for example functionality, commercial availability, price/performance ratio, and product generation.

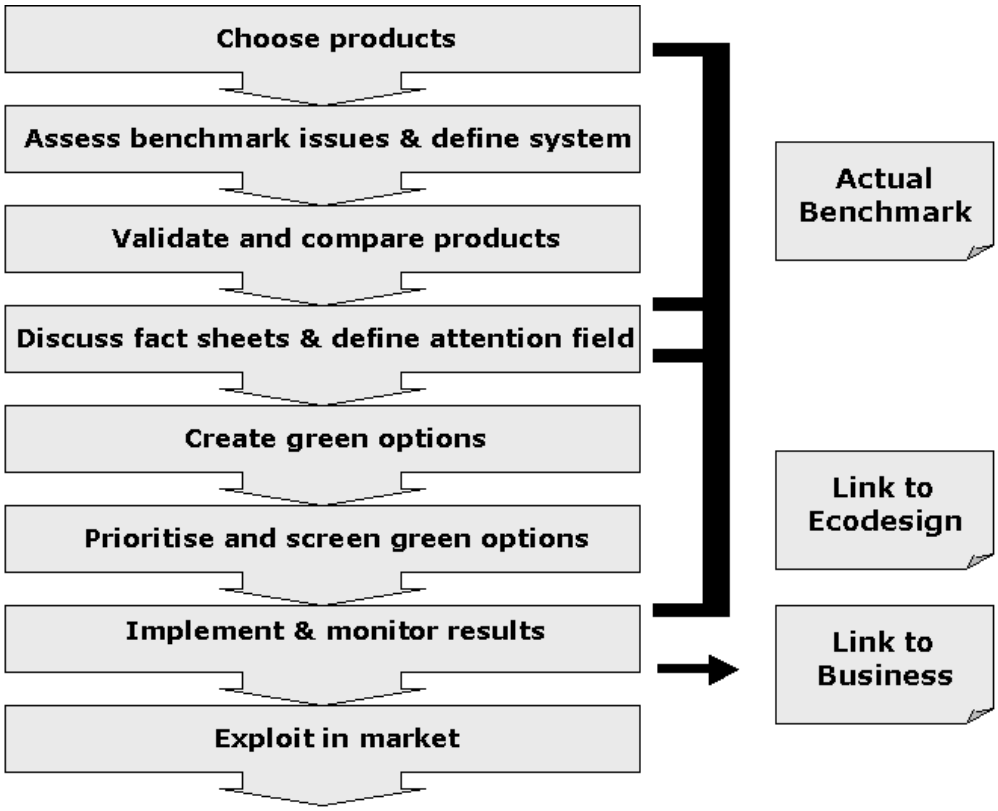

Figure 1. The Philips Environmental Benchmark Methods

Assess benchmark issues and define system

In the Philips procedure, five focal areas (packaging, energy, materials, potentially toxic substances and recyclability) are always included as important benchmark issues, but additional issues can be relevant as well for particular products or product groups. Environmental perception from the consumer market (including consumer test organisations) as well as legislative bodies should be considered an important indication for relevant issues, and are therefore to be used in the definition of the system boundaries and functional units.

Comparison and validation of products

In this step the actual measurements for the criteria laid out in the previous step are done. In Table 1 it is indicated what type of measurements are to be done. In addition to checking the five focal areas, it is recommended to use some Life Cycle Assessment method for the validation of the environmental performance of the benchmarked product. At the ECC, this is always done. The main idea behind this is to include the life cycle perspective in the final assessment of the product, and also to enable the determination of the environmental feasibility, which is one of the steps preceding the prioritization of the green (re)design options as explained below.

Review of results

In the Philips benchmark procedure, fact sheets are made on which the measurements derived in the preceding step are compiled. From these fact sheets, per focal area all measurements for all benchmarked products can be seen at a glance, which makes them easily interpretable.

Table 1. Issues to be checked in the Environmental Benchmark Method

FOCAL AREA	ISSUES CHECKED IN THE BENCHMARK PROCEDURE
Energy	• Consumer behaviour (usage scenarios) • Power consumption of product and accessories in various operation modes
Materials/Weight	• Per (sub)assembly (including embodiment, CRT, drives, electronics, components, accessories, Directions for use, Remote control, functional parts, wiring and connectors.
Packaging	• Weight and volume of packaging (documentation, box, buffer, bags), also in relation to product • Number of materials • Presence of recycled cardboard
Potentially toxic substances	• Type of plastics and metals • Use of recycled materials • Chemical content (check for released and banned components)
Recyclability	• Plastics application (mono-materials, halogenated flame retardants, marking of plastics) • Type of connections, disassembly time for selected components • Check for valuable electronics • Material recycling efficiency • Processing financial yield

2.2 The Link to Ecodesign

The second main part of the Environmental Benchmark Method comprises the creation, prioritisation and implementation of green (re)design options.

Creation of green options: Brainstorms and screening sessions are useful methods to create opportunities for environmental improvements. Two major sources exist for doing so:

- *Learn from competition:* experience tells that in practice, no single product outscores, on all criteria, all other products in the same benchmark. This means that always options for improvement can be generated, based on design solutions found in competitors' products.
- *Smart technological alternatives:* these can include alternative plastics applications, alternative fixing solutions, alternative energy sources, alternative finishes, et cetera.

Prioritisation of green options: Apart from environmental considerations, a multitude of other considerations are to be taken into account in product design. Whereas in the first instance the generation of improvement options should not be hampered by for example financial restrictions, in the second instance the thus generated improvement options are to be assessed for their feasibility. For each option, at least the following aspects should be verified:

- *Environmental feasibility:* a (qualitative) assessment whether the improvement option indeed reduces the impact on the environment, also when the full life cycle is considered.
- *Consumer feasibility:* an assessment whether the consumer is likely to accept the option as a benefit to him or her.
- *Societal feasibility:* an assessment to what extent society as a whole will benefit from the proposed improvement.
- *Company feasibility:* an assessment whether the improvement options are technically feasible in a way that timely implementation can be ensured, and a financial feasibility check that no unwanted costs or investments should be incurred.

For each type of feasibility it is generally possible to indicate a score per improvement option. Depending on the weight factors that can be appointed to the various types of feasibility, an overall score can thus be derived. Based on these scores the improvement options can be ranked. After improvement options have been generated, ranked and validated, the results of this process need to be deployed in the actual core business. An example is presented in (Eenhoorn and Stevels, 2000).

3. The use of multiple environmental benchmark data

So far, the exploitation of environmental benchmark data into the core business of an Original Equipment Manufacturer has mainly been done as depicted in the left part of Figure 2. Individual benchmark studies are usually requested by departments involved in product development, and the results are fed back to them, which leads in practice to (sometimes only minor) improvements in product design. To date, about 40 environmental benchmarks have been performed and reported on at the Philips ECC (see Figure 3). Products covered in these benchmark reports cover most of the brown goods consumer electronics category, ranging from cellular phones to large 55" projection TVs, including audio sets, VCRs, CDRs, DVDs and a large range of TV sets and monitors. This has resulted in a large reservoir of information. It should be noted that individual benchmark reports did in some cases contribute to product improvements, cost reductions and general environmental awareness through the organisation. However, in general the outcomes of individual environmental benchmarks do, at most, not surpass structural improvements for individual product types. Reasons for this limitation are in essence twofold:

- From individual benchmark report only limited data can be derived that is useful for product category-wide feedback;
- Product developers and managers are more likely to dismiss signs of underperformance based on individual benchmark reports as incidental rather than structural.

Based on these arguments, it is suggested that in order to detect and react to structural underperformance, or to exploit opportunities arising from good performance, benchmark results from individual benchmark reports should be combined. This suggestion is based on the assumption that by combining data from different but similar benchmark studies synergetic effects can be achieved, depending on the nature of the various goals for which the use of multiple environmental benchmark data can be useful. These goals can include:

- To perform competitor analysis, not only on product basis but also on product category or product division basis. Here, the utilization of multiple benchmark data can identify structural rather than occasional underperformance compared to best competitor performance;
- To determine trends in product characteristics that are related to environmental issues;
- Determination of degrees of freedom design; to show alternative environmentally preferred solutions for design specific issues.

By addressing these issues, the effects of, as well as the need for, (structural) design improvements can be assessed and priorities can be set for further research. Additionally, it is expected that reporting benchmark data based on multiple rather than individual benchmark studies will facilitate communication with departments other than just product development (see Figure 2).

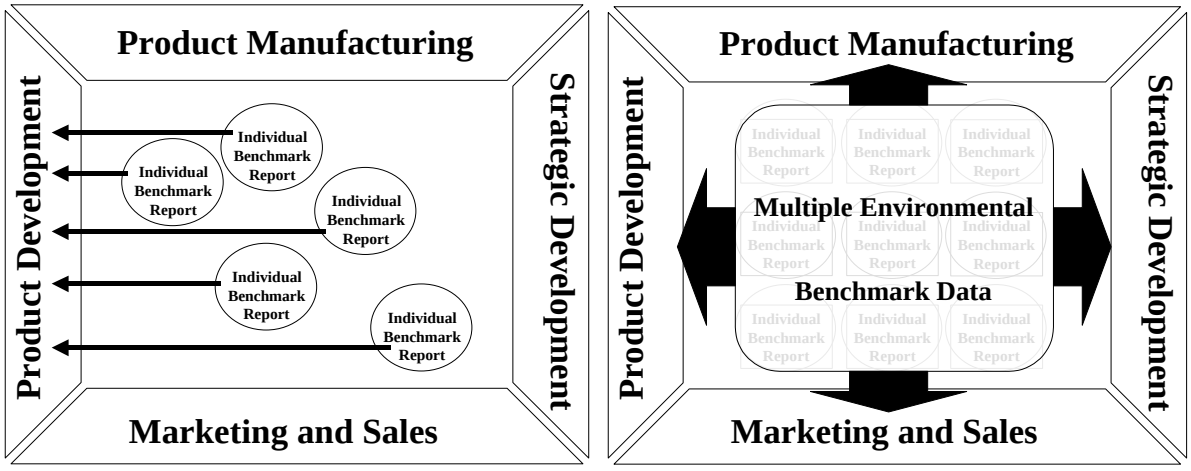

Figure 2. The use of (multiple) environmental benchmark data

In companies, departments like Product Manufacturing, Marketing and Sales, and Strategic Development need to be involved for planning, manufacturing and selling of improved products. Information gathered from multiple environmental benchmark studies are expected to facilitate this; this issue is currently being researched. It is expected however that using multiple environmental benchmark data automatically addresses aspects of the environmental value chain that have previously remained unaddressed. Structural over- or underperformance tells something about how a company performs rather than how a product performs, and such facts are less easily dismissed than incidental underperformance, as already indicated above. The utilization of multiple benchmark data as a step beyond standard environmental benchmarking procedures would thus constitute a methodological improvement. Though seemingly basic in approach, it is explored in the subsequent subparagraphs how concrete results can be obtained in the form of so far unavailable information necessary for incremental as well as substantial improvements in the environmental performance of products.

4. Case studies: Synthesis of benchmark studies

As discussed above, the large amount of available benchmark reports at Philips make it possible to obtain information about environmental issues, not only for individual products, but also per product category and in particular across product categories. Starting in the summer of 2001, projects on packaging and energy issues are on their way to synthesize the available data, and are briefly reported on in this paragraph. Although not yet part of an established procedure, it shows what type of additional information can be derived from synthesizing benchmark data. In the future, these approaches may be incorporated in the standard Environmental Benchmark procedure. In addition, it also proved useful to extend existing benchmark datasets with data from consumer test organisations in order to increase the number of observations and to obtain even more meaningful results.

4.1 Correlation between benchmark variables

One possibility of synthesizing benchmark data is to investigate how the performance on the various benchmark variables is correlated, in particular those variables on which distinct design efforts are focused but that are in practice related to each other. This way, interesting results have been obtained by calculating indexes for variables such as product volume and packaging volume, product weight and packaging volume, TV screen size and energy consumption et cetera. The large number of benchmarks then enables the derivation of what can be observed to be best practice for these indexes in a certain field. At the same time, it also enables the identification of results for individual products that show a significant underperformance – results that otherwise might have remained unnoticed. For example, from Figure 3 (displaying the performance of Philips products next to those of the competition in terms of product volume/packaging volume) it was learned that for 7 out of 9 product categories Philips products score better than the competition, suggesting room for relative improvement for the remaining categories.

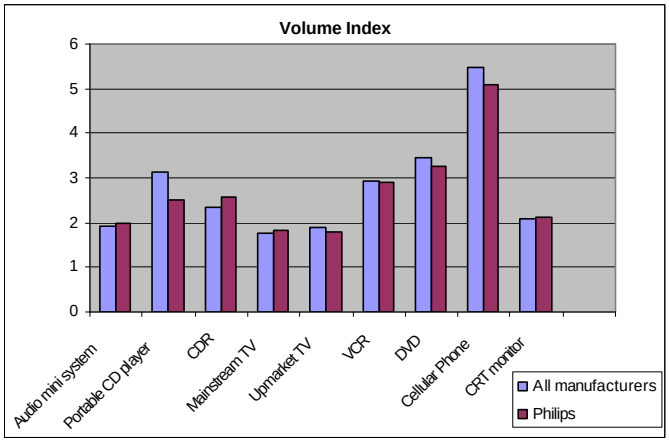

Figure 3. Correlation between product and packaging volume, based on multiple benchmarks

Also in absolute terms conclusions can be drawn. From a similar graph for product weight/packaging weight it became clear that Philips portable CD players performed significantly better on this ratio than the competition. At the same time it became clear that this ratio was quite unfavourable for Philips DVD players, for no apparent reason. Analysis results like these can be meaningful starting points for further generation of green options, in addition to those generated already by the established benchmark procedure as discussed in Chapter 2.

4.2 Trends

Another possibility is to trace trends related to particular benchmark issues, provided that sufficient benchmark data is available. For example, analysis has shown how power consumption data (in this case for audio sets) from various benchmarks over time have developed. Although those measurements appear to show a downward trend, it was also quite clear that there is a wide spread of measurements. Observations like these give rise to questions addressing correlations between functionality and energy consumption as well.

5. Conclusions

From initial projects in the exploitation of data from multiple environmental benchmark project it has become clear that:

- Available data can be structured in such a way that multiple benchmark reports can function as a basis for analyses that go beyond standard environmental benchmark follow-ups;
- Options for environmental product improvement can be generated that responsible departments were previously unaware of;
- The analysis of multiple environmental benchmark data provides a means for the detection of structural (environmental) under- or overperformance for manufacturing companies.

Furthermore, research project currently on the way are expected to show that:

- Facts derived from multiple environmental benchmark data analysis facilitate communication with higher management levels and with other departments involved in the planning, manufacturing and selling of products.
- This improved communication is a means to overcome problems in the environmental value chain that have previously remained either unaddressed or unsolved.

Acknowledgement

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