

Design for Environment: An Integrated Product Life Cycle Design Tool

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Short History of Environmental Management

- ◆ Process/End-of-pipe
 - ❖ Command and Control
- ◆ Pollution Prevention
 - ❖ Reduce, Reuse, Recycle
- ◆ Product Focus (i.e., DfE)
- ◆ Sustainable Production and Design(?)
 - ❖ Industrial ecology
 - ❖ Societal issues

What is DfE?

- ◆ A system approach to design that incorporates environmental, health and safety concerns over the full product life cycle.
- ◆ Bridges the gap between product development and environmental management
- ◆ Issues addressed by DfE:
 - ❖ Where to focus efforts on design improvement?
 - ❖ Does my product comply with company policy and targets?
 - ❖ Does my product meet regulatory standards?

Global View of DfE

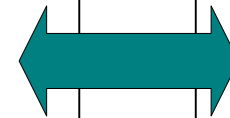
Strategy: what is driving a Company's position on products and the environment

Action Plan

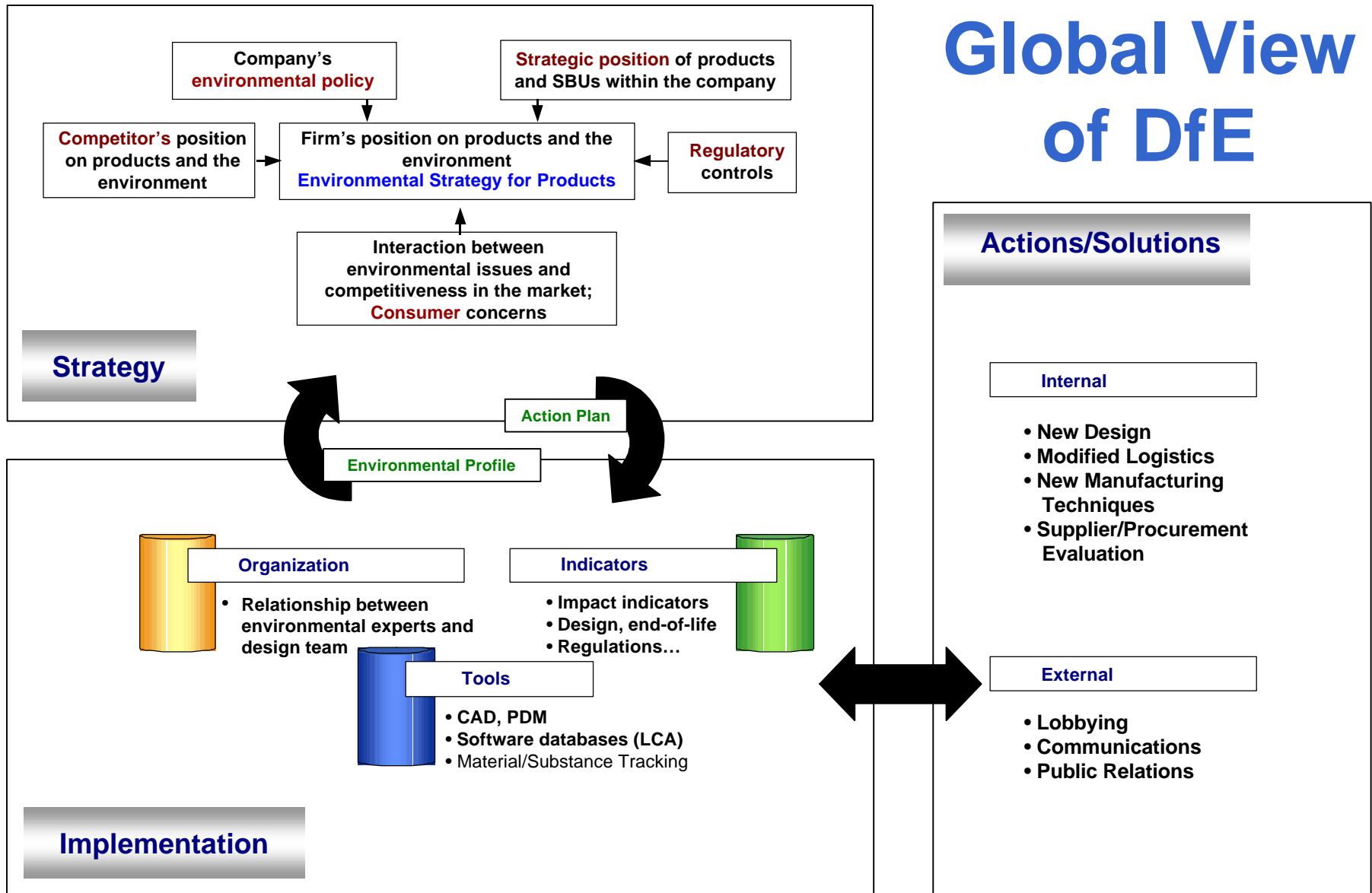
Environmental Profile

Implementation: use of organization, indicators, and tools

Actions/ Solutions: both internal and external

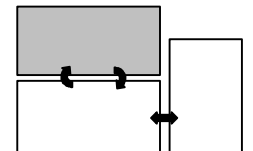


Global View of DfE



Strategy Aspect of DfE

- ◆ Current DfE approach is generally incremental or piecemeal
 - ❖ problem --> study --> solution (?) -->return
- ◆ Strategy tends to take a back seat to implementation, often ignoring long-term stewardship role of DfE
 - ❖ driven by regulations, restrictions
- ◆ Therefore, potentially-critical questions are not answered
 - ❖ How to determine the tools or indicators to use?
 - ❖ What product line should be the focus?



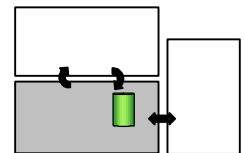
Current DfE Implementation

- ◆ Use of Indicators to drive design changes, e.g.
 - ❖ guidelines
 - ❖ restrictions
- ◆ Use of Tools
 - ❖ Life Cycle Assessment
 - ❖ Life Cycle Management
 - ❖ Total Cost Accounting
- ◆ Organizational changes to implement DfE
 - ❖ Environmental expert involved in design team

 These are not necessarily being used together

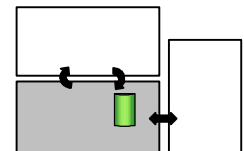
Guideline Approach

- ◆ Designed by companies to take into account:
 - ❖ Consumer demands
 - ❖ Market constraints
 - ❖ Regulatory constraints
- ◆ Short-term focus
 - ❖ Driven more by regulatory concerns than sustainability issues
- ◆ A largely qualitative approach
- ◆ Used by designers and EH&S staff



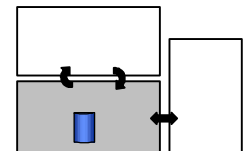
Guideline Approach

- ◆ Focuses on discrete characteristics
 - ❖ Waste Management
 - ❖ Use phase
 - ❖ Material consumption
- ◆ Focuses on 'current' environmental issues
 - ❖ heavy metal use
 - ❖ energy consumption
 - ❖ choice of plastic
- ◆ Few, if any, software tools available
 - ❖ Most guidelines are developed in-house



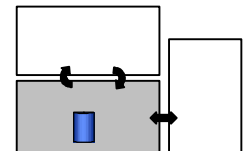
LCA Approach

- ◆ Issues addressed by LCA:
 - ❖ Should a specific material or process be restricted?
 - ❖ What end-of-life processes should be promoted?
 - ❖ Does a specific regulation make sense from an environmental point of view?
- ◆ Quantitative: detailing processes and materials
- ◆ Helps to highlight potential trade-offs:
 - ❖ Industrial stages (use phase vs. manufacturing)
 - ❖ Media (air vs. water, etc.)
- ◆ Plenty of software tools available



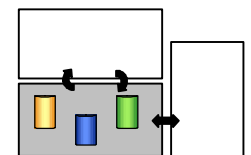
LCA Approach

- ◆ Used by R&D or LCA experts (not designers)
- ◆ Not pervasive in the US
- ◆ Cannot be easily used as a day-to-day DFE approach:
 - ❖ The complexity of LCA requires significant knowledge of the technique
 - ❖ Extensive data collection may be required
 - ❖ LCA provides only part of the information needed by DFE



Evolution of DFE (1/2)

- ◆ Ideally, Tools, Organization, and Indicators converge:
 - ❖ Providing a simplified LCA for designers
 - ❖ Integrating design constraints *and* environmental concerns
 - ❖ Allowing for single indices that give weights to different impacts
- ◆ DfE moves beyond reactive methods (checklists) to integrate more active and sustainable/systematic methods
- ◆ Comprehensive DfE should be integrated into the day-to-day design process, taking strategy into consideration

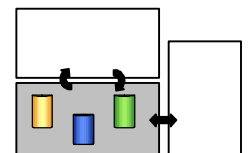
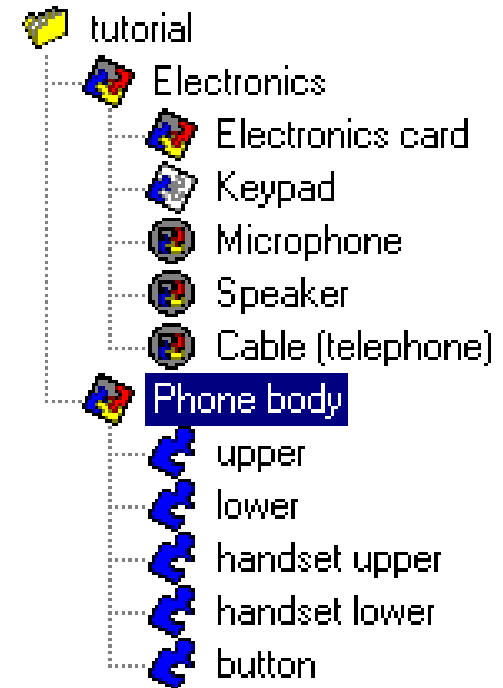


Evolution of DfE (2/2)

- ◆ Single-score methodologies are seen as useful for the comparison of different product designs
- ◆ Software tools seem the best suited to this new approach, considering various types of data required (life cycle, restrictions, etc.)
 - ❖ Example in electronics industry of a software tool used by Kodak, IBM, Mitsubishi, Alcatel:
Environmental Information and Management Explorer (EIME™)

EIME™

- ◆ Simplified LCA database
 - ❖ Database with data on components (e.g., speaker), materials (e.g., ABS) and processes
- ◆ Client-server approach integrates LCA and company guidelines
 - ❖ Environmental expert determines company's guidelines - weighting factors for impacts, materials of concern, warnings for the designer
 - ❖ Designer generates the design and calculates the impacts



EIME Designer

Project Edit Mode Window Help

Project: Tel tut

Brickman
Tutorial
Copy of Tutorial

New
Copy
Delete
Promote

lower

External Links:

upper
Screwing

lower

But ABS fine S
Condensibile

Molding by
injection Inf

ToDo Dialog

It is highly recommended to mark plastic parts for end of life recovery with a weight exceeding 150 g, as preconised by the ISO 11469 standard.

Nothing Done In Progress Done

OK

Module Name		
SMD (Surface Moun		
Coil (SMD for PWB)		
Bulb (tungsten halo		
Cable (optical fiber)		
Cable (high current)		
Cable (telephone)	ECO-177-	23 Cables
Battery (alkaline)	ECO-174-	21 Batteries
Battery (Li-ions)	ECO-173-	21 Batteries
Battery (NiMH) ** no data **	ECO-172-	21 Batteries

Components Links Materials Additives Coatings Processes

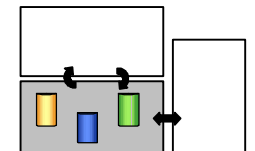
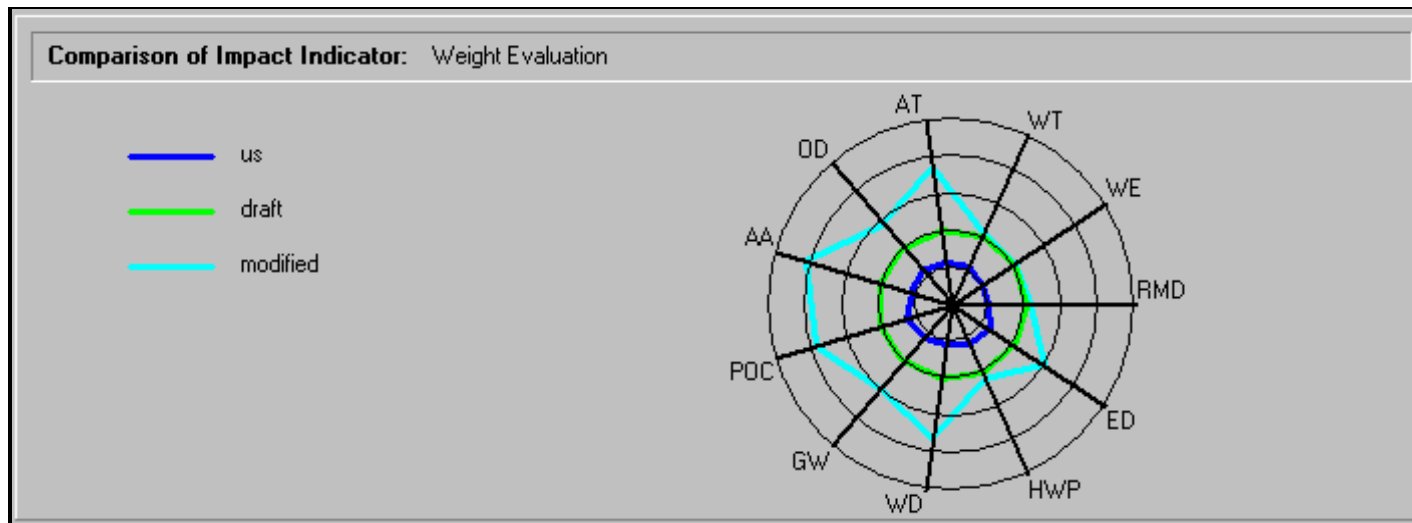
generic electronic
very small transfo
Tungsten haloge
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Help

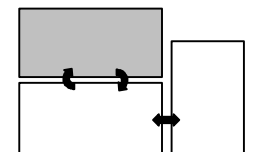
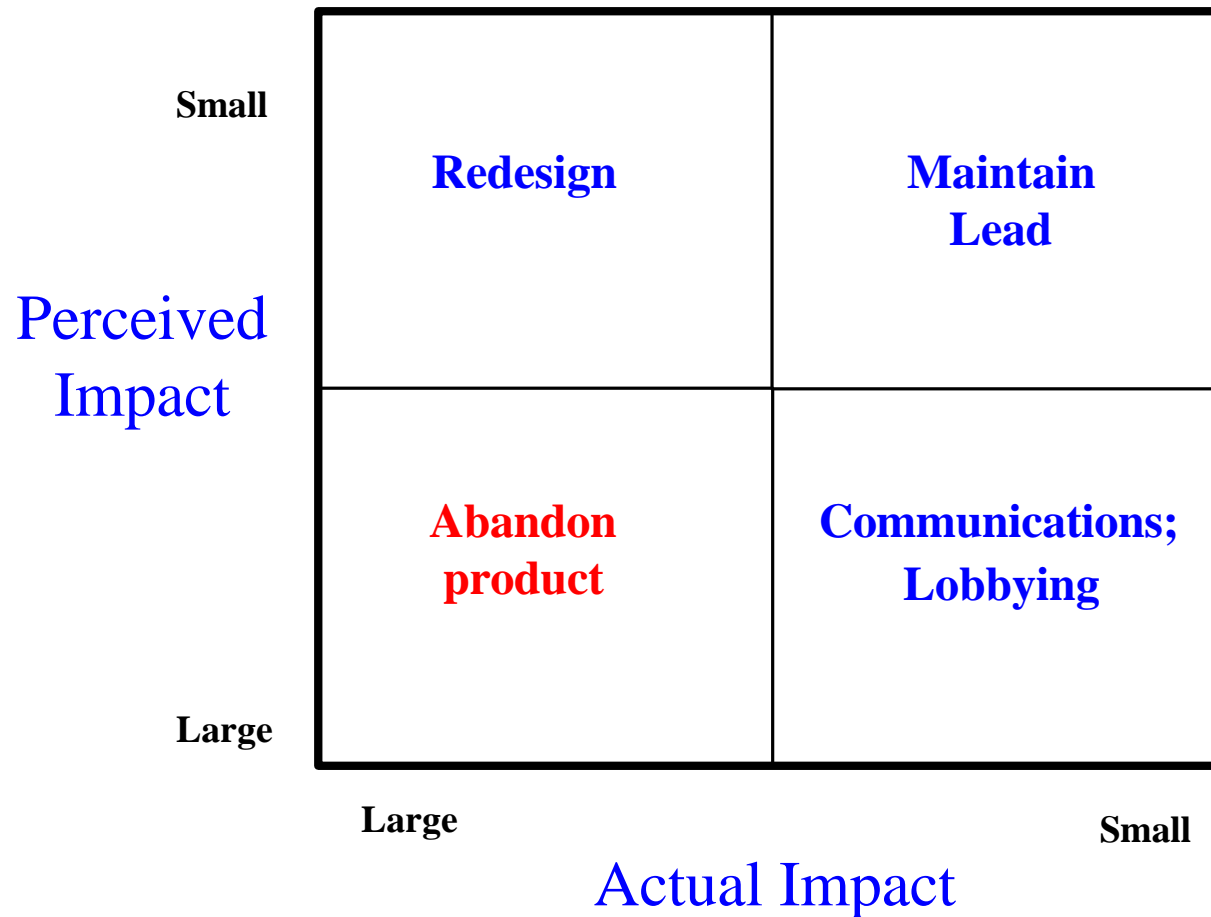
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EIME™

- ◆ Results provided for different impact and design categories
 - ❖ Greenhouse effect, air acidification, raw material depletion ...
 - ❖ Recycled content, recyclability, bill of materials, flags...
 - ❖ Ability to compare impacts of different product variations

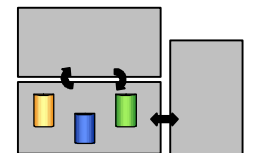


Approach to Strategy: Example



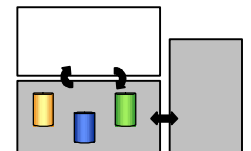
Case Study: HP Inkjet Printer Cartridges

- ◆ Addressed concern about future product regulations
 - ❖ worked with HP to determine what products to focus on
- ◆ Performed LCAs on a number of products
- ◆ Results provided some solutions:
 - ❖ changed logistics
 - ❖ modified design of existing products
 - ❖ influenced design of next generation of product



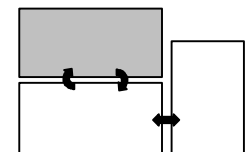
Case Study: France Telecom

- ◆ Wanted to evaluate the environmental performance of its suppliers
- ◆ Used EIME™ to build profiles of a number of products from suppliers
- ◆ Generated in-house guidelines for the evaluation of suppliers



Case Study: Legrand

- ◆ Environment seen as a market driver in electronics
 - ❖ competition from cheaper producers in Asia
- ◆ Goal is to develop a DfE strategy for the company
 - ❖ group level focus
- ◆ Discussions have focused on
 - ❖ organizational structure
 - ❖ tools to use
 - ❖ what products lines to focus on
- ◆ Long term partnership



Summary

- ◆ DfE should be an integrated approach
 - ❖ strategy and implementation
 - ❖ tools - organization - indicators
- ◆ One tool does not fit all
 - ❖ a mix of tools may be necessary
 - ❖ an accurate assessment of needs is important
- ◆ Strategy approach can focus on seizing opportunities rather than defusing 'threats'
- ◆ A longer term focus can lead to new markets or products