Environmental Product Lifecycle Management – Customizing the Enterprise Specific Manufacturing Processes

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The most recent EU Directives lay down new conditions toward the environmental responsibility of producers and their products. The requirements to the products' lifecycles rise continuously. Methods and tools for Life Cycle Assessment (LCA) of products become more and more important for the industry. Highly sophisticated tools, offering a wide range of environmental data and functionalities are already available. However, due to the high scientific level of these tools, the applications are very complex. They result often in a lack of integration in the daily practice. This paper describes the "Environmental Product Lifecycle Management" approach which integrates the LCA in standard software systems like the mySAP Business Suite. This will be realized by extending the SAP module Compliance for Products (CfP) of TechniData AG. Nowadays the CfP manager provides many solutions concerning the material declaration (e.g. check of the fulfilment of certain material lists), RoHS Compliance and many other material based questions. The product structure within the CfP Manager will be extended by the processes of the product life cycle; material production, manufacturing, use and disposal. The main focus of this paper lies on the manufacturing phase of the product and in particular on the customization of the enterprise manufacturing processes. In this context, customization means to preset all environmental process information, needed for an LCA. The aim is to enable the calculation of the environmental impact when manufacturing a specific product within an LCA Compliance tool. After the customization, the user has to enter the product specific information only. In the background the tool combines the manufacturing specific information and the product specific information and calculates the energy and material flows that are defined in advance.

Keywords: Product Lifecycle Management, Manufacturing, Life Cycle Assessment, SAP

Transfer-Unit 55

Ökobilanzierung in SAP

Benjamin Kuhrke

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Background

PTW

Institute for Productionmanagement,
Technology and Machine Tools
Technical University Darmstadt

Research Department:
Environmentally sound
products and processes

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Transfer-Unit 55
Optimised Processes, Methods and Instruments for the Development of Environmentally- Friendly Products

C1 C2 C3 C4 C5

HILTI KÄRCHER MOTOROLA HEIDELBERG TECHNIDATA

Overview

- motivation and approach
- status quo of the e-business solution
- underlying concept of the Lifecycle Assessment within the e-business solution
- example to point out the concept with the focus on the manufacturing processes

Motivation and Approach of the Project

Motivation

Industry Challenges

Requirements from product related environmental protection:

- legislation
- customer requirements
- environmental policy

Problems

- isolated application
- time consuming
- difficulties in interpreting the results

Scientific Solutions

Life Cycle Assessment

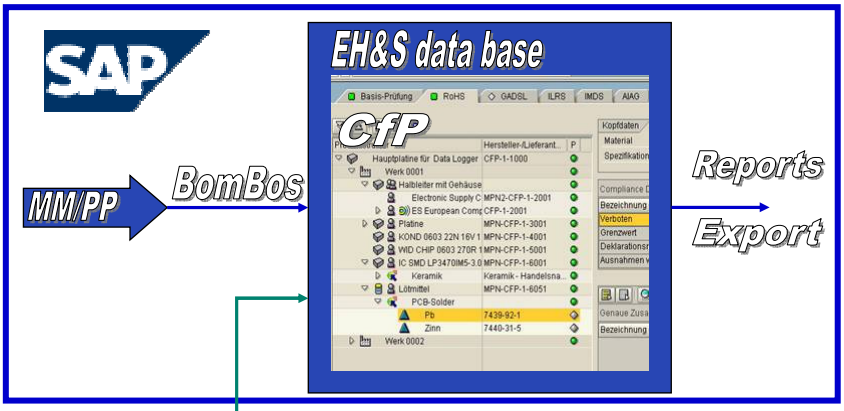
- methods
- instruments
- software solutions

Approach

use of environmental information which is already kept in the enterprises

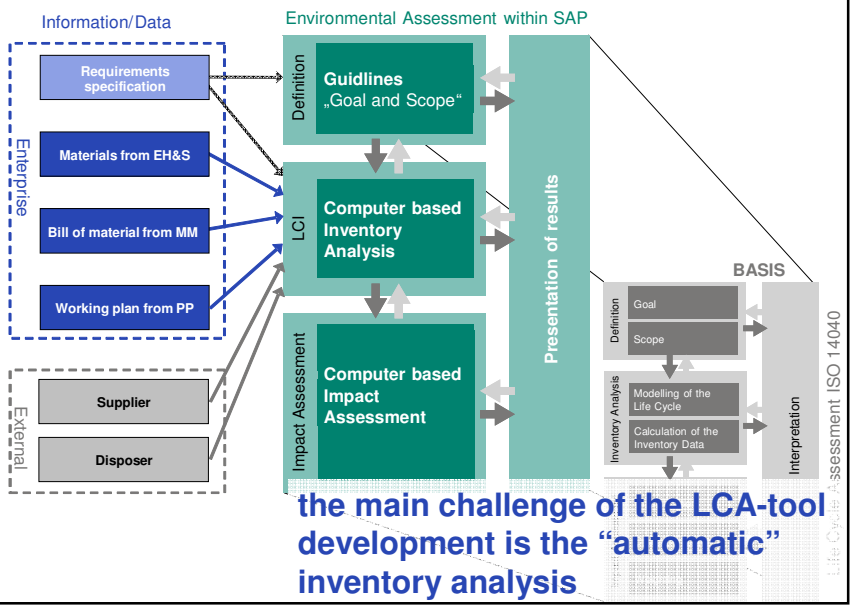
Life Cycle Assessment with SAP CfP – ***„Compliance for Products“***

Compliance for Products – CfP



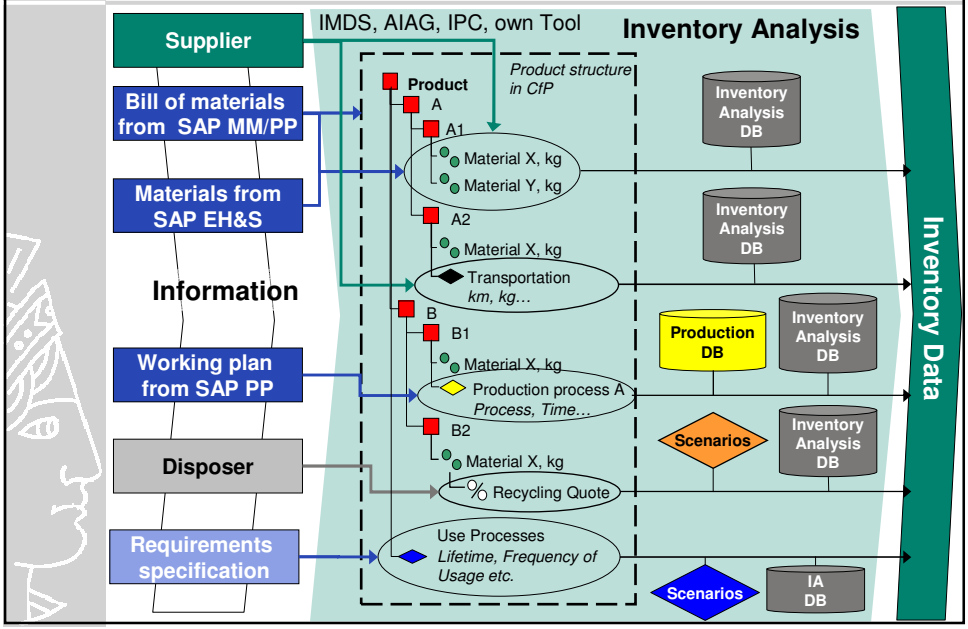
- AIAG
- IMDS
- Jeita - Compliance Connect Sheet
- IEC and IPC are planned
- Data Collection Tool - Technidata

General Concept



the main challenge of the LCA-tool development is the “automatic” inventory analysis

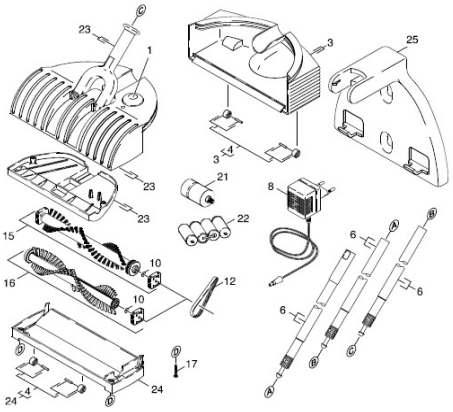
Concept for the Computer based Life Cycle Inventory Analysis



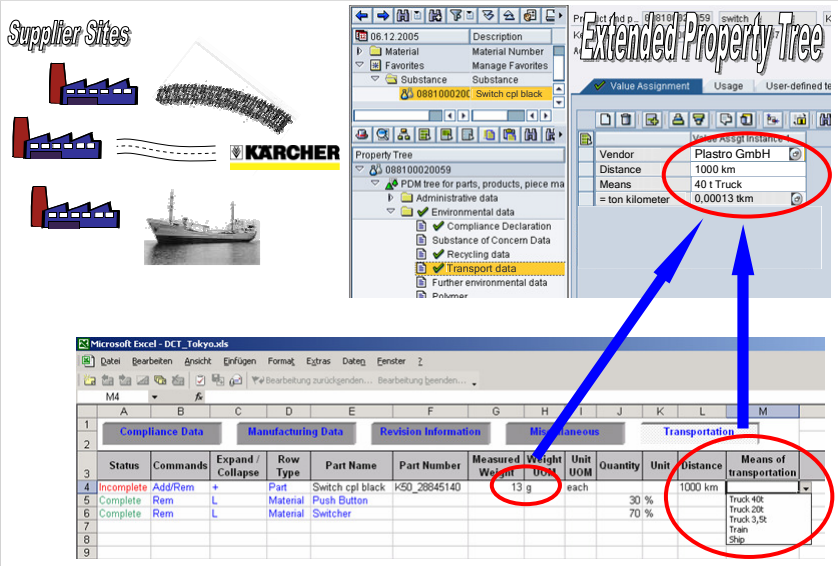
Example: Electric Brush from Kärcher

KÄRCHER

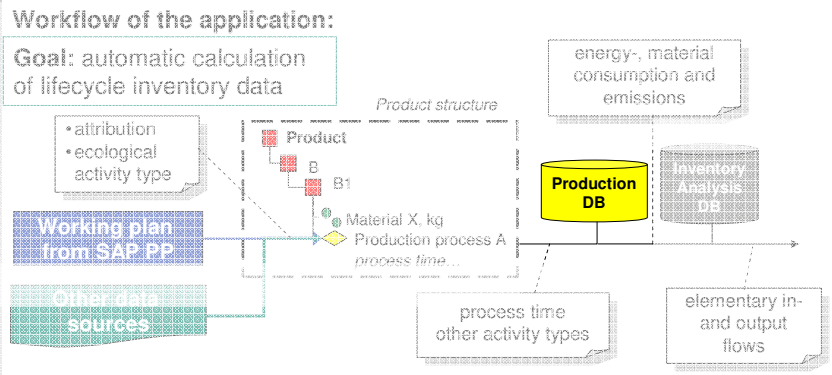
- battery operated (NiCd-Accumulator)
- input power 1,6 W
- operating time 20 minutes



Gathering and Processing of the Transport Data



Customizing the Manufacturing Processes



Goal: Modeling environmental process parameter to enable the automatic Lifecycle Inventory of the Production Processes

Analyzing the production processes → **Modeling the product specific material and energy flows** → **Estimation of the pre-process chains**

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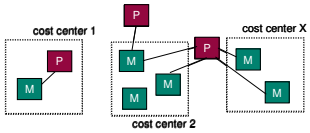
Customizing the Manufacturing Processes
Analyzing the production processes

Selection of relevant production processes

- added value -> no transport
- environmental impact



defining of process boundaries
cost center

defining the system boundary

defining the structure of the process
(Process machine and periphery systems)

e.g. process time

defining the ecological activity types

to get product specific energy- and material flows

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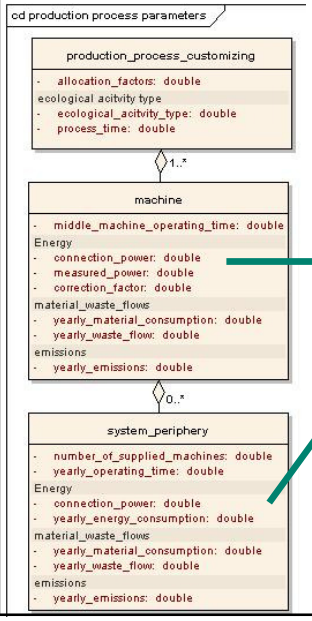
Customizing the Manufacturing Processes
Modeling the product specific material and energy flows



energy demand:

ecological activity type = process time

$$E_{process} = P_{workplace} \cdot t_{process}$$

$$P_{workplace} = P_{machine} + P_{periphery/machine}$$

$$P_{machine} = f_{correction} \cdot P_{connection}$$

$f_{correction}$ with measurement or expert survey

$$P_{system_j/machine} = \frac{P_{system_j} \cdot T_{system/year}}{\sum_{i=1}^{N} T_i}$$

$P_{system/machine}$= pro rata Power of one system
T_i= machine operating time

$$P_{periphery/machine} = \sum_{j=1}^{M} P_{system_j/machine}$$

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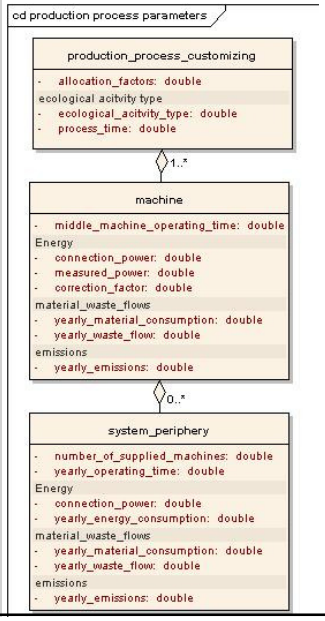
Customizing the Manufacturing Processes

Modeling the product specific material and energy flows



operational supplies and waste flows:

ecological activity types = process time, others

$$C_p(t) = CPV_p \cdot t_{process}$$

$$W_p(t) = WPV_p \cdot t_{process}$$

time depending consumption and waste parameter value

1. Consumption per time is equivalent

$$CPV_p = \frac{C_{p/year}}{\sum_{i=1}^{N} T_i}$$

2. Relation of consumption per time is known

$$CPV_p = \frac{C_{p/year}}{x_{i-1} \cdot \sum_{i=1}^{N} \left(\frac{t}{x_{i-1}} \cdot T_i\right)}$$

same procedure for **waste** and **emissions** parameters

3. yearly consumption per machine is known

$$CPV_{p,i} = \frac{C_{p,i/year}}{T_{machine}}$$

$C_{p,i/year}$ = consumption per machine

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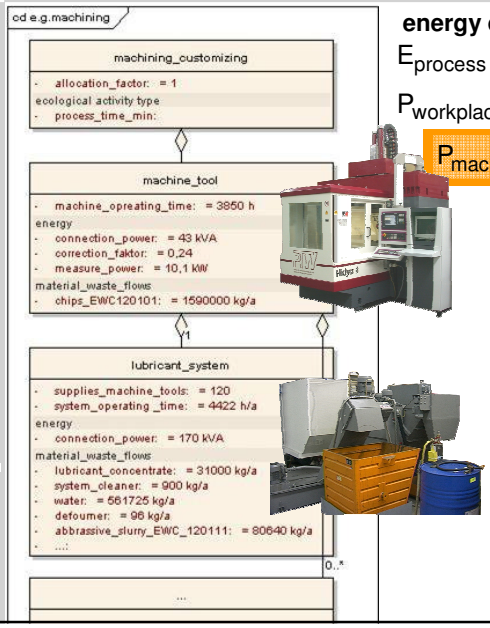
Customizing the Manufacturing Processes

e.g. machining process



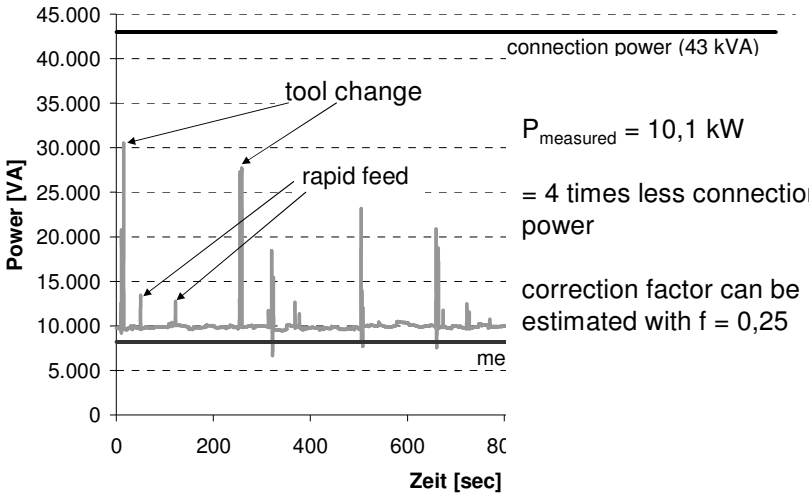
energy demand:

$$E_{process} = P_{workplace} \cdot t_{process}$$

$$P_{workplace} = P_{machine} + P_{periphery}$$

$$P_{machine} = f_{correction} \cdot P_{connection}$$

Energy measurement

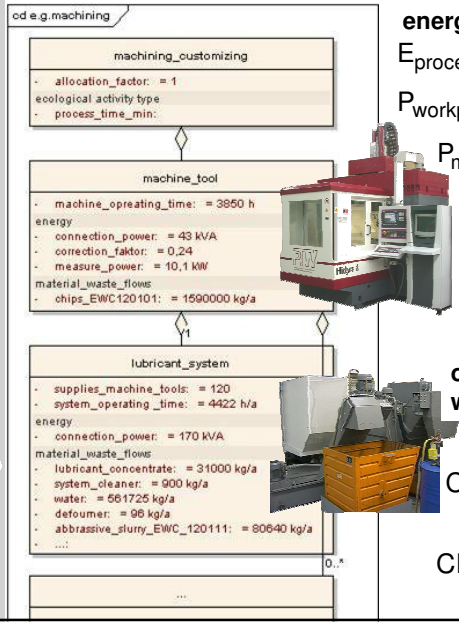


$P_{measured}$ = 10,1 kW

= 4 times less connection power

correction factor can be estimated with f = 0,25

Customizing the Manufacturing Processes
e.g. machining process



energy demand:

$$E_{process} = P_{workplace} \cdot t_{process}$$

$$P_{workplace} = P_{machine} + P_{periphery}$$

$$P_{machine} = f_{correction} \cdot P_{connection}$$

$$P_{machine} = 10{,}32\,kW$$

$$P_{periphery} = \frac{171{,}8\,kW \cdot 4422\,h/a}{3840h/a \cdot 120}$$

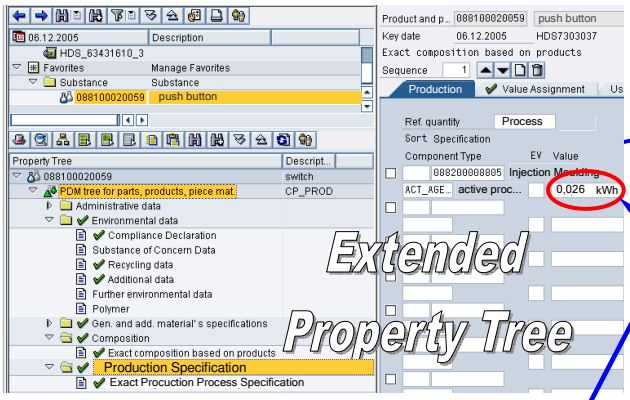
$$P_{workplace} = 10{,}32\,kW + 1{,}64\,kW$$

operational supplies and waste flows:

$$CPV_{lubricant} = \frac{31000\,kg/a}{(3840 \cdot 60)\,min/a \cdot 120}$$

$$CPV_{lubricant} = 1{,}12 \cdot 10^{-3}\ kg/min$$

Manufacturing – Accu Brush



Example:

worst case

89 kW

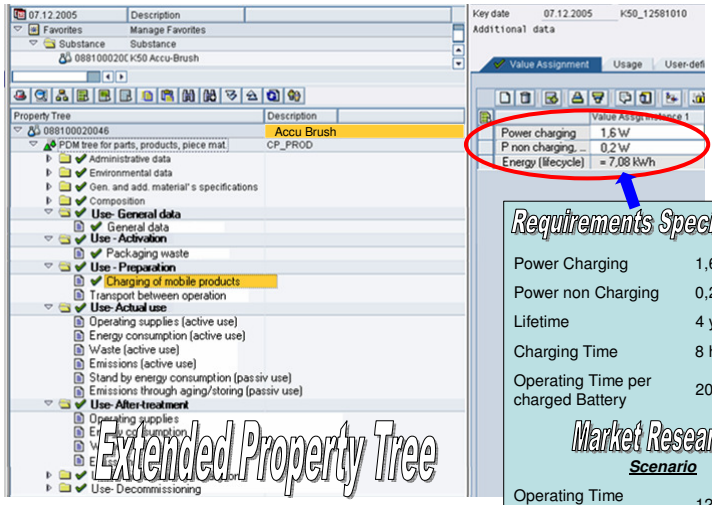
* 0,03 H / 100

0,026 kWh

Working Plan

Calculation Structure	Ressource	Quantity	Entity	Working Place
push button	K50_28845140_1	100	piece	
push button injection		0,03	hour	injection moulding

Use Phase



Requirements Specification

Power Charging	1,6 W
Power non Charging	0,2 W
Lifetime	4 years
Charging Time	8 hours
Operating Time per charged Battery	20 min.

Market Research

Scenario

Operating Time per Lifetime	12 hours
Charging Time per Lifetime	4 years

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Electric and Electronical Waste Treatment Scenarios

Category	Volume [l]	Weight [kg]	Example	Recycling	Disposal
Smallest Appliances	< 1	< 0,5	Mobile Phone, Watch	20 %	80 %
Small Appliances	1…15	0,5….3	Telephone, Coffee Machine	50 %	50 %
Medium Appliances	>15…75	>3…15	Vacuum Cleaner, Microwave	75 %	25 %
Large Appliances	> 75	> 15	TV, Air Conditioner	98 %	2 %

Volume = 1,5 l 50 % Disposal

Weight = 1,98 kg

Combustion

50 % Recycling

Shredder

Disposer Disclosure Recycling rates KÄRCHER	
Ferrous Metals	95%
Non Ferrous Metals	95%
Thermoplasts PP, PS, ABS	35 %
Residual	0 %

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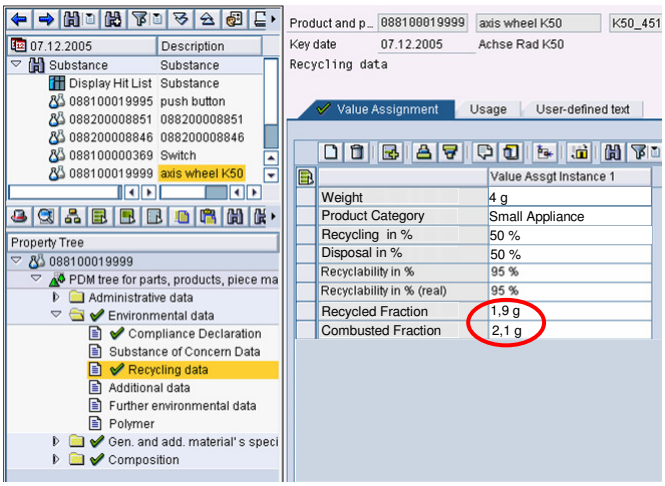
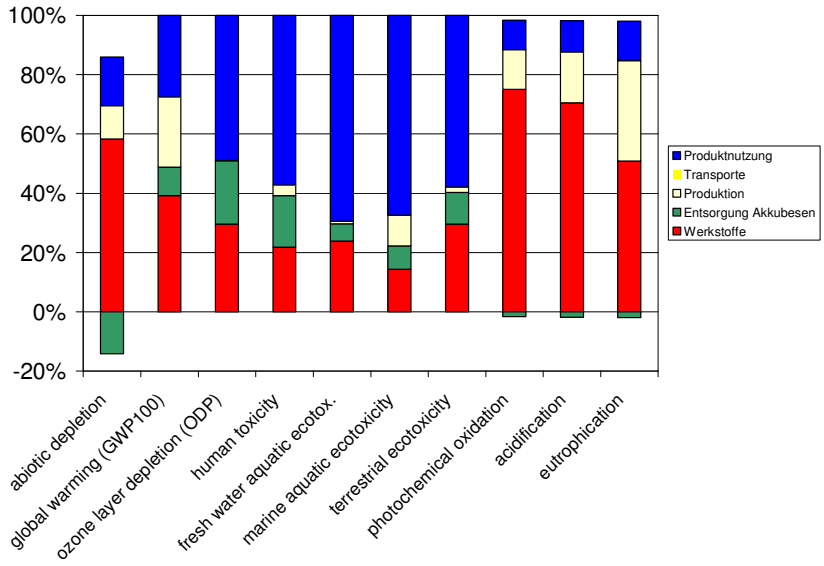
Electric and Electronical Waste Treatment Example: Axis of the Wheel



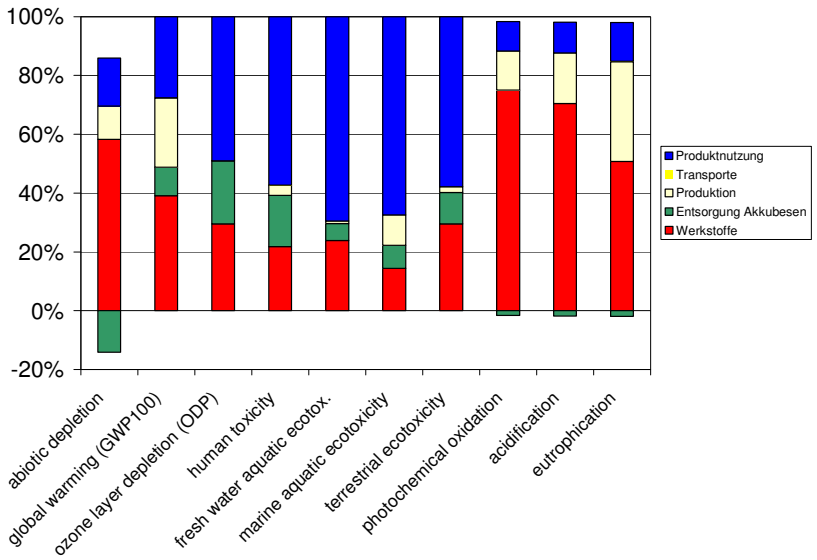
Zusammenfassung der berücksichtigten Werte

- 100 % Material mit Idemat
- Lediglich 700 g Injection Moulding
- Alle Transporte von den Zulieferen
- Alle Nutzungsprozesse
- Entsorgung mit vorhandener Datenbasis

Ergebnisse – nur eigene Produktion



Ergebnisse – alle Produktionsprozesse



3 Abschlussfragen

- Ist die Abbildung der Produktionsprozesse ausreichend?
- Welche Daten muss oder kann ich mindestens von meinen Zulieferern bekommen?
- Bestehen Alternativen zu dem Datenaustausch mit den Zulieferern?