The EPIC-ICT Method: Life Cycle Impact Indicators for ICT Products

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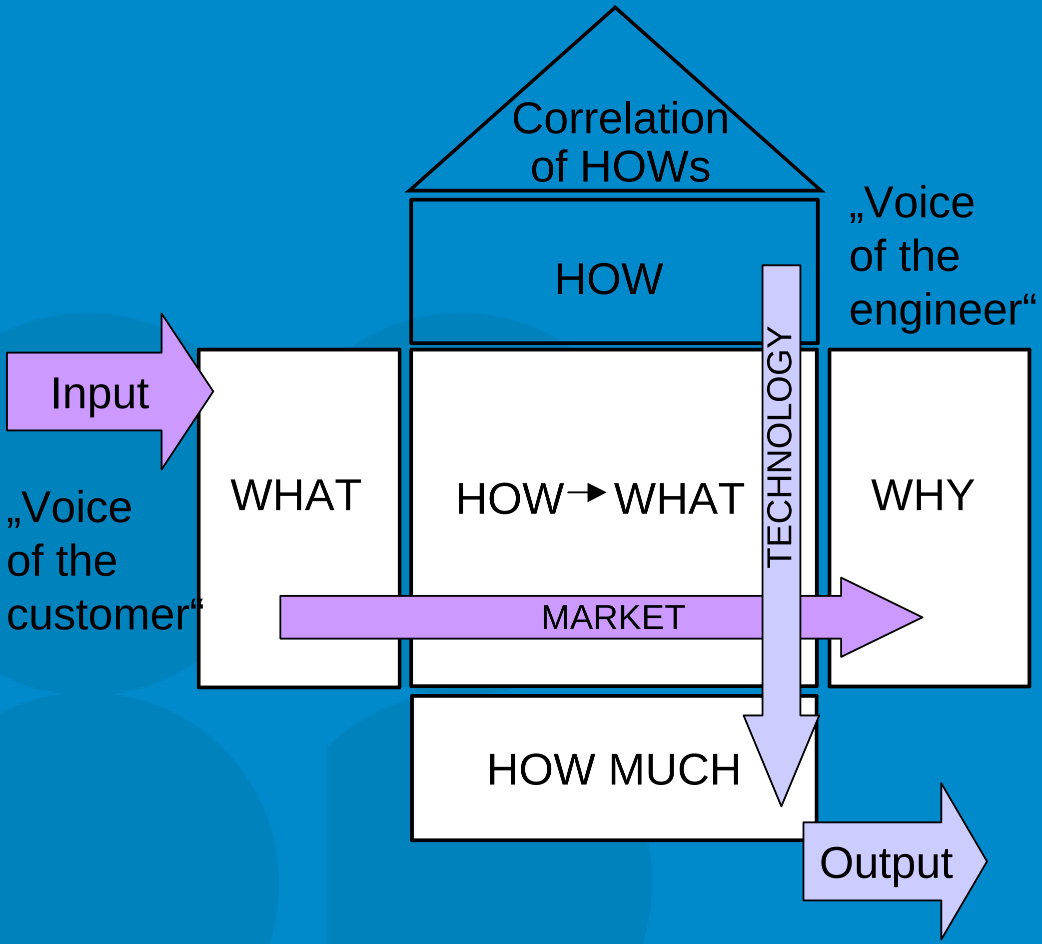
Introduction

- **Typically Life Cycle Assessment (LCA) is used to determine the environmental impact of a product**
- **LCA are very specific, very time consuming and very costly**
- **A few key product properties determine the life cycle impact of a product**
- **Goal of EPIC-ICT is to develop a method to determine life cycle impact indictors for ICT products**
- **EPIC-ICT Method developed makes use of:**
  - QFD (Quality Function Deployment)
  - Full LCA
  - Generic Modules

QFD House of Quality



4 Stages of QFD:

- Quality Plan Product
- Quality Plan Design
- Quality Plan Process
- Quality Plan Production

General QFD methodology used in academia and industry

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Customer Demands

- **Focus on customer demands towards computer FUNCTIONALITY**
- **These customer demands are:**
  – Internet access
  – E-mail
  – Office tasks / productivity applications
  – Multimedia
  – Gaming
  – VoIP
- **Other customer demands (cost, quality, noise, upgradability) have not (yet) been included**

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Technical Functions

- **Technical functions were translated as „MAIN COMPUTER ASSEMBLIES“**
- **These assemblies are:**
  - Motherboard:
  - Central processing unit (CPU)
  - Hard Disk Drive (HDD)
  - Random access memory (RAM)
  - Graphics card
  - Sound card
  - Drives: CD, DVD or Floppy
  - Ports
  - Chassis
  - Power Supply Unit (PSU)
  - Cooling system
- **Other product categories (washing machine, light bulb) have different main assemblies – method is the same**

QFD House Demands & Assemblies

- **Goal of this QFD house:**
  - Determine type of computer to be assessed (e.g. Office, gamer, multimedia)
  - Apples can be compared with apples
- **Assemblies can be further be broken down into possible versions**
  - Onboard graphic card vs. two graphic cards
  - CRT vs. LCD

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QFD House Demands & Assemblies

Office PC

Customer Demands / Requirements		Motherboard		Central processing unit (CPU)		Hard Disk Drive (HDD)		Random Access Memory (RAM)		Graphics card		
	Customer Importance	**SFF; highly integrated**	Perf. MB; numerous ports	**Low voltage CPU**	**High performance CPU**	**Small HDD**	**Large HDD/HDD array**	**1 module**	**4 modules**	**onboard Graphics**	**Graphics Card**	**SLI Graphics cards**
Internet access	9	9	0	9	1	9	0	9	0	9	1	0
E-mail	9	9	0	9	0	9	0	9	0	9	1	0
Office tasks / productivity applications	9	9	0	9	1	9	1	9	1	9	1	0
Multimedia	1	3	3	3	3	0	9	0	9	1	9	0
Gaming	0	0	9	0	9	0	3	0	9	0	3	9
VoIP	3	1	3	3	3	3	1	3	1	9	1	0
Importance (absolute)		*249*	*12*	*255*	*30*	*252*	*21*	*252*	*21*	*271*	*39*	*0*
Importance (relative)		*8%*	*0%*	*8%*	*1%*	*8%*	*1%*	*8%*	*1%*	*8%*	*1%*	*0%*

Customer Demands / Requirements	Sound card		Drives: CD, DVD or Floppy			Communication Ports		Chassis			Power Supply Unit (PSU)		Cooling System	
	onboard Sound	**Sound card**	**Optical Drives**	**Rec./-writable Opt. Drive**	Floppy	**USB**	**Ethernet**	**SFF chassis**	**Large space tower**	**Stylish case**	**Silent PSU**	**High Wattage PSU**	**Efficient Cooling System**	**Silent Cooling System**
Internet access	3	0	0	0	0	1	9	9	0	1	9	0	1	9
E-mail	0	0	1	1	0	1	9	9	0	1	9	0	0	9
Office tasks / productivity applications	3	0	9	9	0	1	1	9	0	1	9	0	1	9
Multimedia	0	9	9	9	0	9	9	3	1	9	9	1	3	9
Gaming	1	9	9	9	0	9	3	0	9	3	0	9	9	1
VoIP	9	1	0	0	0	9	9	9	0	1	9	0	3	9
Importance (absolute)	*81*	*12*	*99*	*99*	*0*	*63*	*207*	*273*	*1*	*39*	*279*	*1*	*30*	*279*
Importance (relative)	*2%*	*0%*	*3%*	*3%*	*0%*	*2%*	*6%*	*8%*	*0%*	*1%*	*9%*	*0%*	*1%*	*9%*

Bold Product (category) specific fields
Italic Methodologically fixed / automatically calculated
fixed!
to be filled in by marketing (manufacturer)

Assembly Impacts & Ranking

- **Assemblies have to be ranked in term of their environmental impact over the life cycle**
  - Use phase and EoL are included on the same level as main assemblies
- **This needs to be done with a full LCA**
- **This LCA needs to be done ONLY for each (sub-) category of products (not for every product by every producer)**
- **LCA of PC from Task 1.1 can be such an example**
- **This will demonstrate which assemblies have the highest impact and the highest potential for improvement**
- **Dependencies within assemblies need to be regarded**

Components Impact and Ranking

- **Assemblies are made of components**
  - E.g. Motherboard: PWB, actives, passives, connectors, ...
- **Environmental assessments of components can be done using Generic Modules (GM)**
  - Generic Modules have to be made only for a limited amount of components
  - Generic modules are based on a limited set of physical metrics (e.g. Number of layers, size of PWB)
  - Generic Modules are parametric models – changing the parameter(s) adapts the GM to the specific case
- **This will demonstrate which components have the highest impact and the highest potential for improvement**
- **The physical metrics of the high impact components can be taken as indicators**

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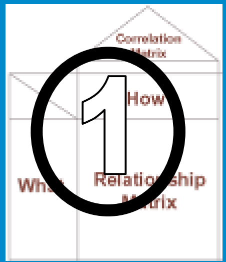
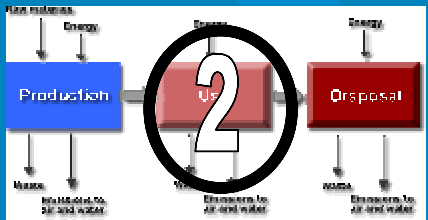
Life Cycle Impact Indicators

- **The physical metrics of the high impact components (of the high impact assemblies) are taken as indicators**
- **Before using these indicators the likelihood to change issues needs to be taken into account:**
  - Can issue be changed technically and practically?
  - By how much?
- **Major dependencies within indicators needs to be taken into account:**
  - If indicator A (e.g. size PWB) changes, how does indicator B (e.g. number of ICs) change?
- **The number of indicators for a certain product category is expected to be maximum 12**

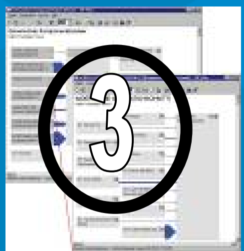
Overview of Method: Developing Life Cycle Impact Indicators



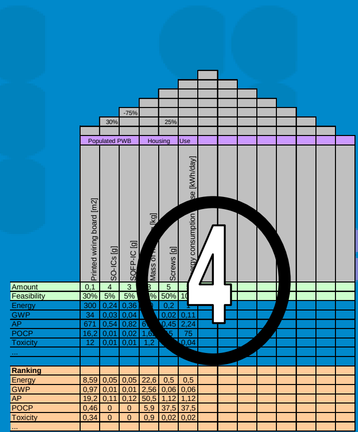
QFD
What: PC functionality
How: Main assemblies
Define product (-category)



LCA
One per product (sub-) category
Ranking of most important assemblies



Generic Modules
Main components of assemblies
Ranking of most important components
Physical parameters = indicators



Indicator Test
Likelihood to change?
Dependencies with other indicators
Reliable physical indicators

Conclusions

- **Using QFD with customer demands and assemblies the type of computer can be determined**
- **Using one LCA per product category a ranking of the most important assemblies can be made**
- **Using Generic Modules a ranking of the most important components can be made**
- **The physical metrics of the high impact components (of the high impact assemblies) can be taken as indicators**
- **The ranking and the indicators will also demonstrate the improvement potential for the designer**

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