GreenDelta
sustainability consulting + software

Integrating life cycle assessment tools and information with product life cycle management / product data management

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GreenDelta / Dassault 3DS / pernexas

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DASSAULT SYSTEMES | IF WE ask the right questions we can change the world.

pernexas

Linking LCA and PDM / PLM

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Linking LCA and PDM / PLM

1 Goal and introduction

2 Linking Enovia with LCA

- **a) Case 1, from PDM to LCI**
- **b) Case 2, from PDM to LCA and from LCA to PDM**

3 Outlook, outreach

1 Goal and introduction

1 Goal and introduction: motivation

a) Product design stage is highly important for the environmental performance of products
(Bad aerodynamics, heavy car, rare metals required, …)

→ Knowledge about the environmental performance is important in the design process

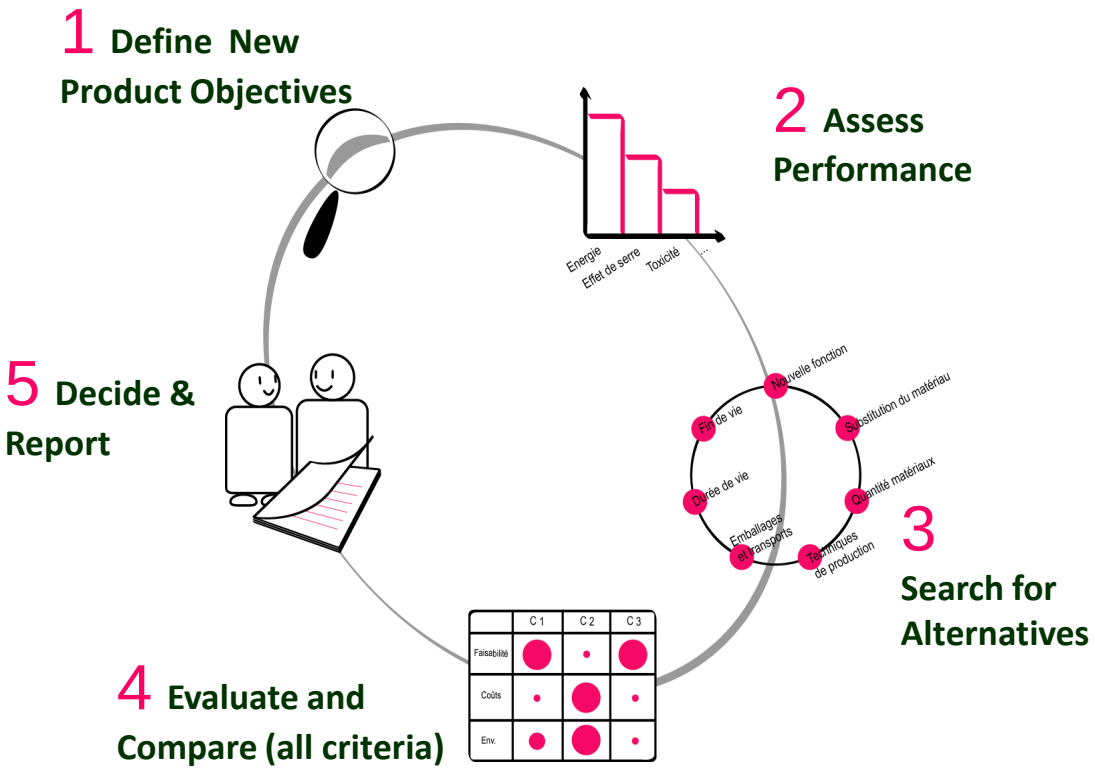
1 Goal and introduction: motivation

b) A lot of information is available in the design process, especially in modern, powerful PDM, PLM tools, that is very useful for Life Cycle Assessment and Sustainability Assessment

→ Make this available.

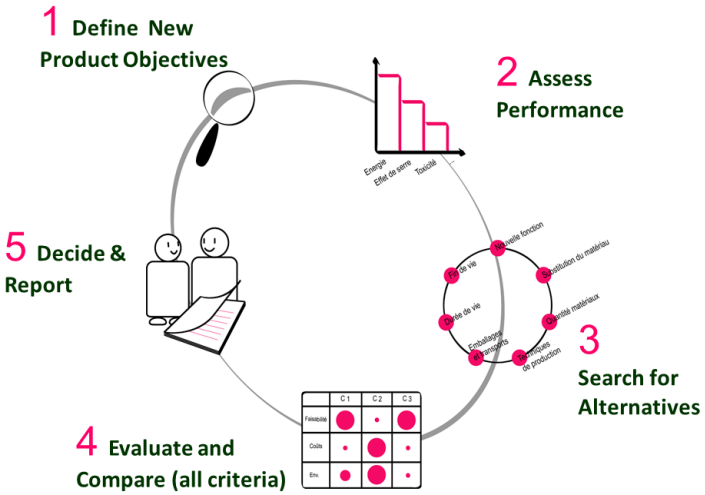
1 Goal and introduction: motivation

(this is nothing new: DfE, Design for environment, ISO 14062)



1 Goal and introduction: DfE

- The main process is DESIGN
- The target actors are **Designers** and **Product Managers**



1 Goal and introduction: DfE

→ Project commissioned by Dassault Systèmes, for GreenDelta and Pernexas, to investigate interfaces.

1 Goal and introduction: tools

CATIA

CAD

ENOVIA

PDM

DELMIA

Manufacturing

Product **L**ife cycle **M**anagement [PLM]

Life Cycle Assessment (LCA)

openLCA

SimaPro

Gabi

EIME

GreenDeLTa

Linking PLM with LCA, principles

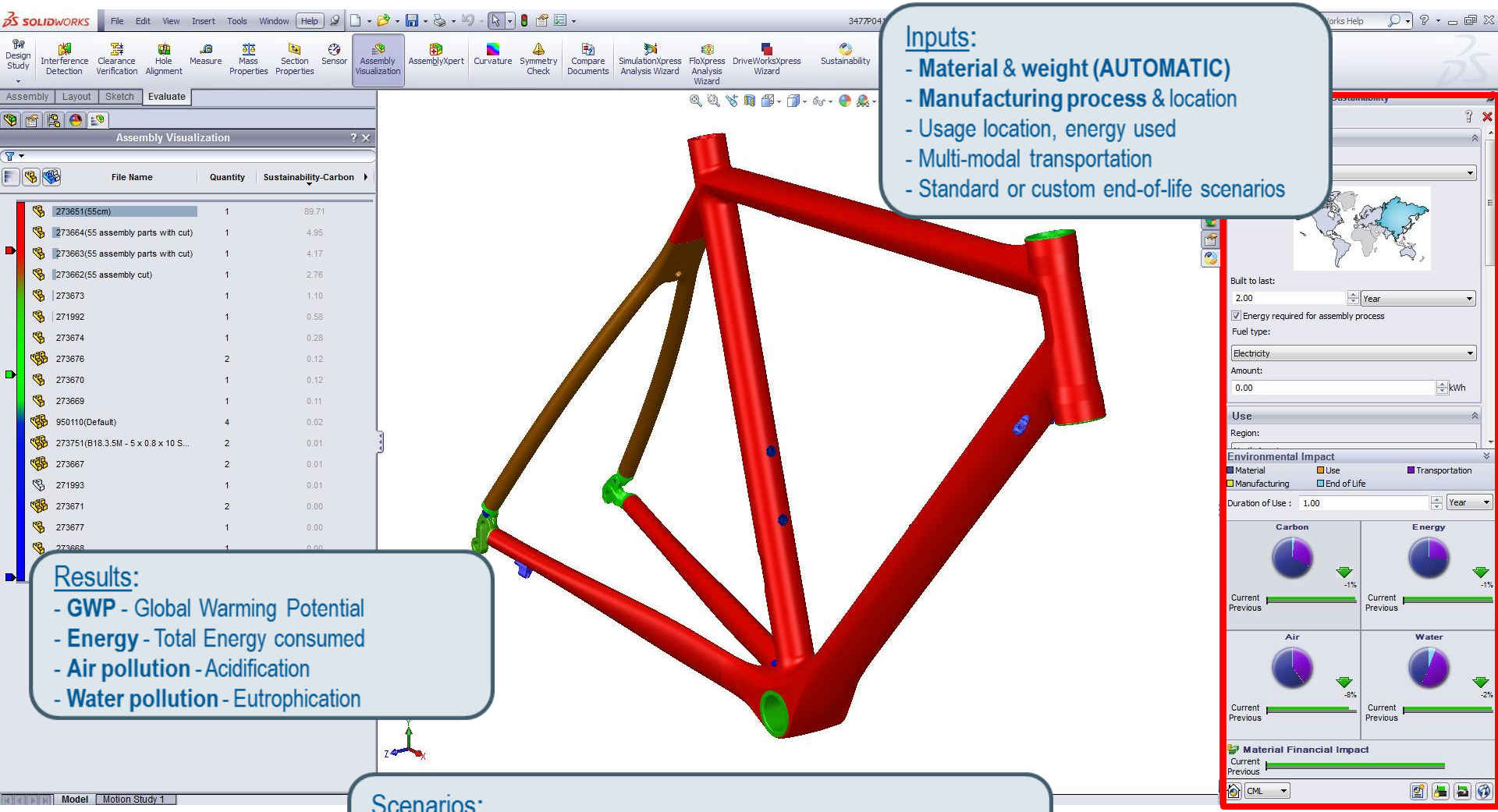
a) Interface

Work in progress…

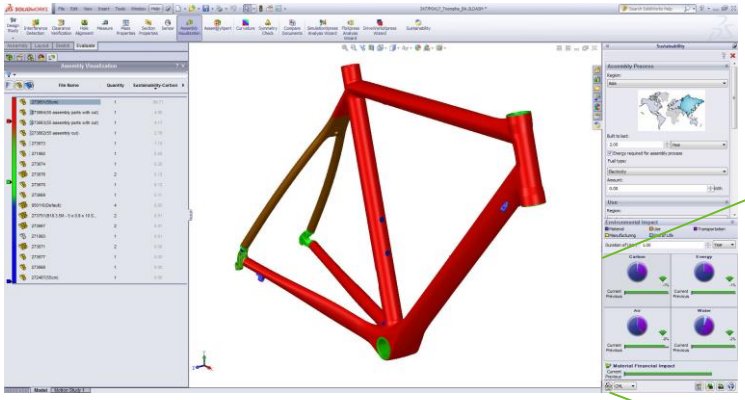
b) Integration

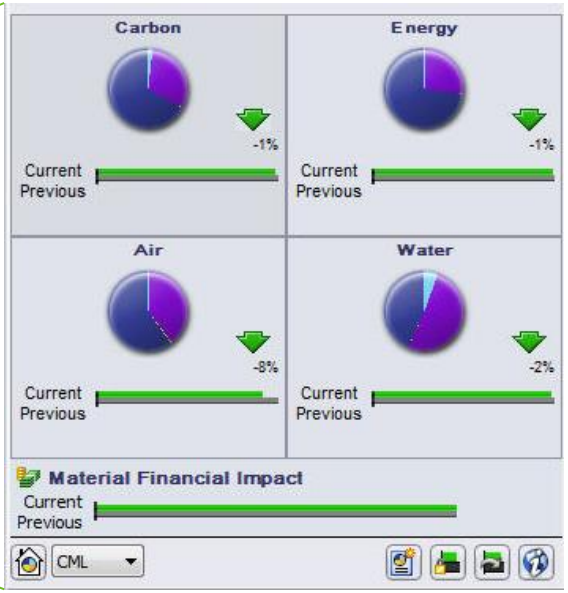
Existing !

LCA integrated in SolidWorks Sustainability



LCA integrated in SolidWorks Sustainability





→ Static, fixed calculation results

→ Fixed, rather simple impact assessment

→ Material based; changing transport, recycling, end-of life?

Second option: Interface to full LCA tool

Promises

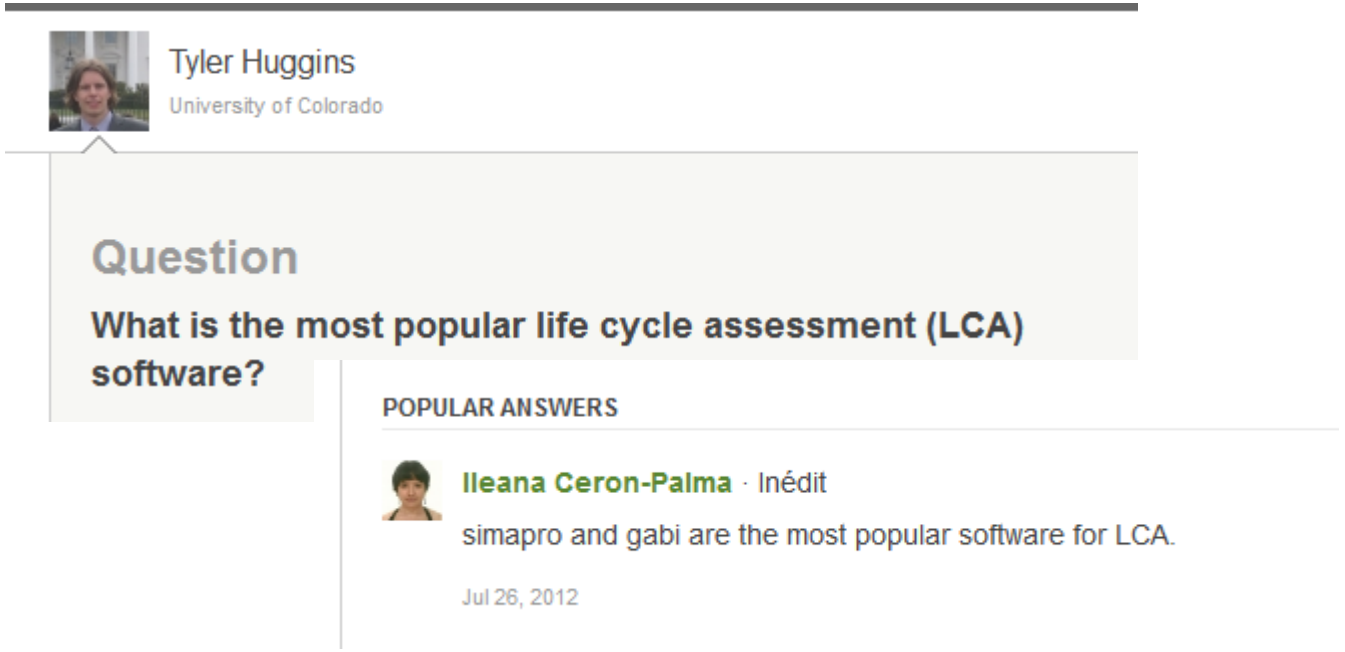
- more flexibility in impact categories and LCA models,
- consideration of more complex life cycle impacts
- easier managament (updates)
- also transfer from PLM to LCA

→ Project, with the following LCA tools

- GaBi (www.gabi-software.com)
- SimaPro (www.pre-sustainability.com/SimaPro)
- openLCA (www.openlca.org)
- Eime (www.bureauveritas.de/wps/wcm/connect/bv.../cps-servicesheet-eime)

→ Motivation for selecting these LCA tools

Why **GaBi** and **SimaPro**:



Why **openLCA**: the world's only free and open source, professional LCA software; GaBi and ecoinvent databases available

Why **EIME**: Strong in France, electronic sector

Screenshots from www.researchgate.net/post/What_is_the_most_popular_life_cycle_assessment_LCA_software

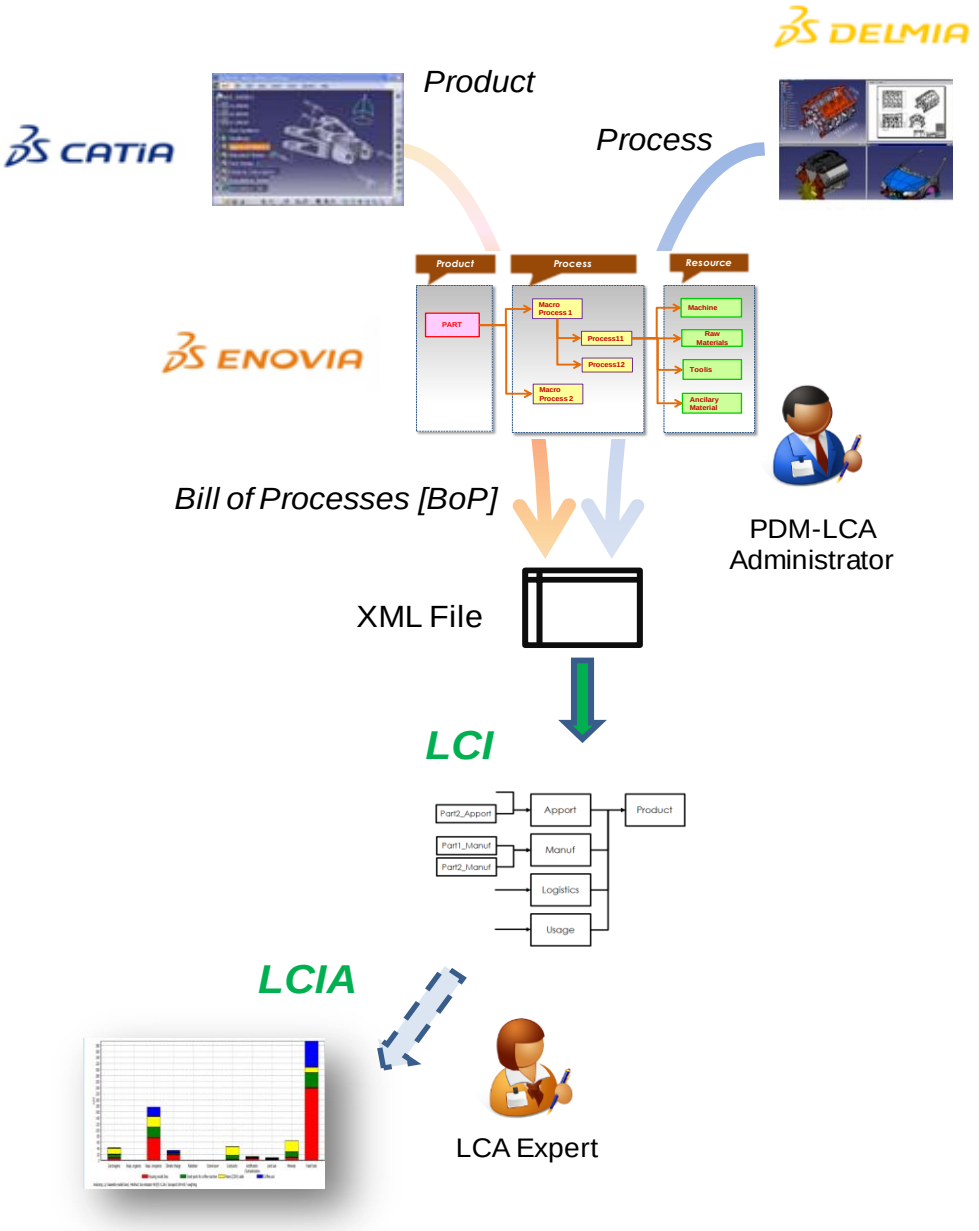
2 Linking Enovia with LCA

2 Linking Enovia with LCA

Case 1: Data transfer from PLM to LCA

- Product data
  - From PDM & CAD
- Process data
  - From Manufacturing
- Complementary data
  - Logistics
  - Usage
  - End of life

Case 1 ENOVIA export to EcoSpold1 / SimaPro7

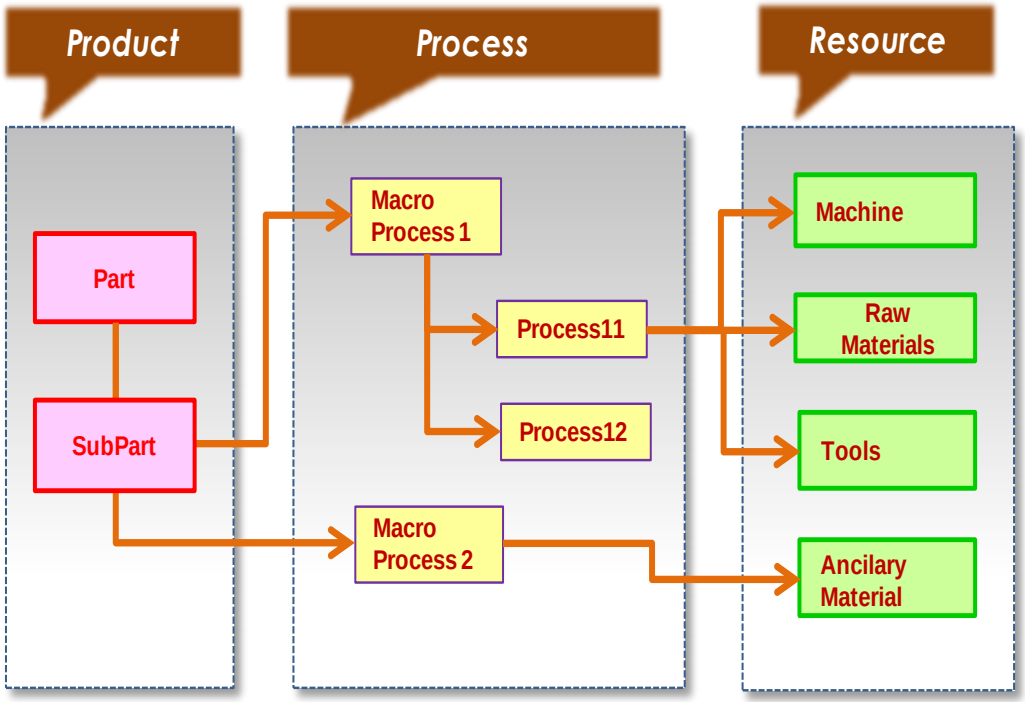


- Work: Mapping of the PPR & LCI data models with Ecospold1 XML
- Implementation: prototype based on
  - **ENOVIA v6r2012x**
  - **EcoSpoldV1 (XML file based)**
  - **SimaPro 7.2**
- Issue: Reconciliation of Materials & Processes databases…
  - mapping file of EcoSpold1

Case 1 ENOVIA export to EcoSpold1 / SimaPro7

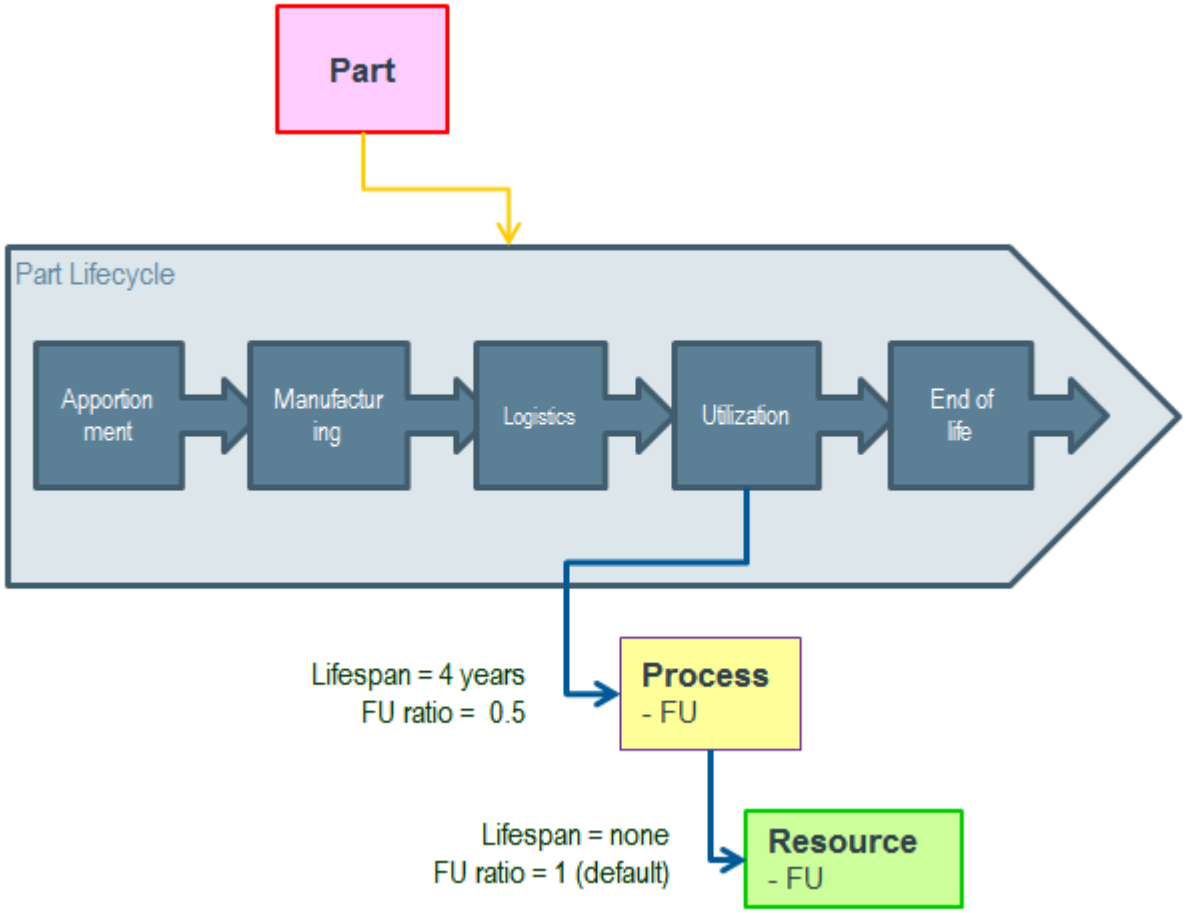
Product-Process-Resource [PPR] data model (for Manufacturing)

- **Part** associated to macro-processes for each Life Cycle Stage
- **Processes** break down to sub-processes
- Processes consume **Resources**
  - that are characterized by their environmental impacts: raw material, energy consumption, waste production



Case 1 ENOVIA export to EcoSpold1 / SimaPro7

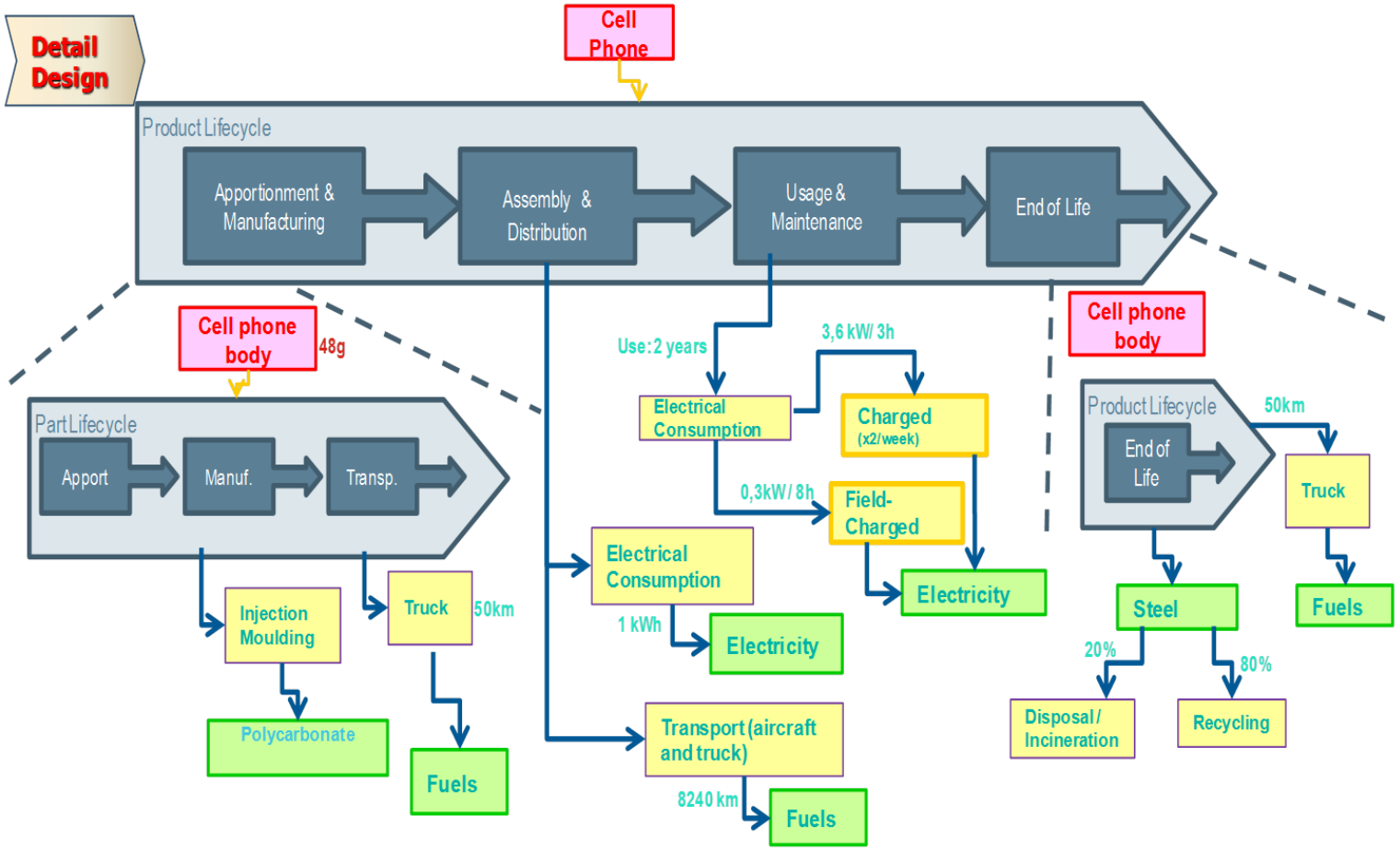
Extended PPR…



- Addition of **Life cycle** for Parts
- Addition of the Life cycle **Stages** as properties for the Part-process relationship
- Authorize 0 to N sublevels for Process description
- Addition of the **Functional Unit** for Processes & Resources
- Addition of the **Functional Unit Ratio** between Part-Process & Process-Resource

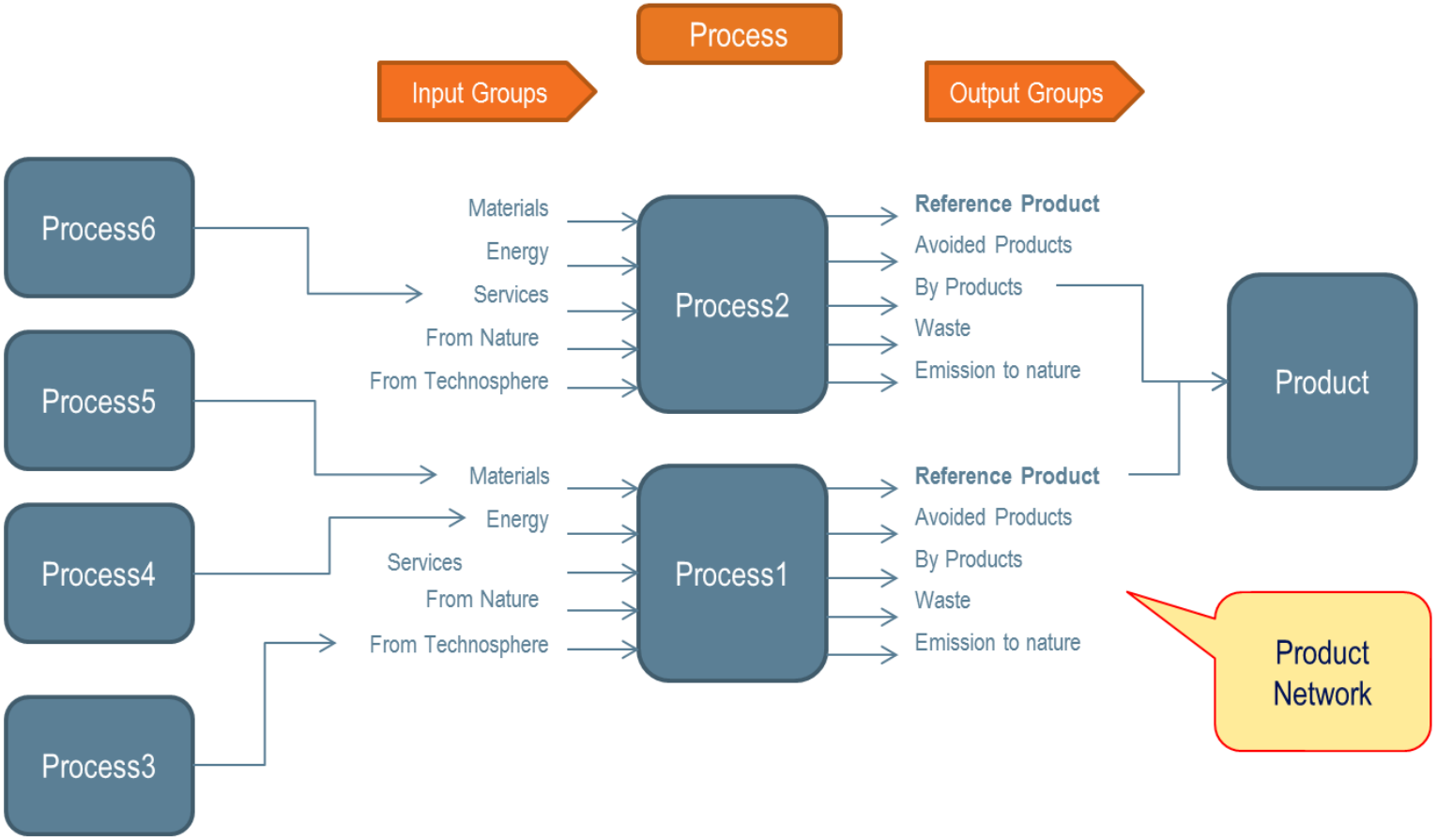
Case 1 ENOVIA export to EcoSpold1 / SimaPro7

Example :"Cell Phone Body" Bill of Processes [BoP]



Case 1 ENOVIA export to EcoSpold1 / SimaPro7

Ecospold1 : product network



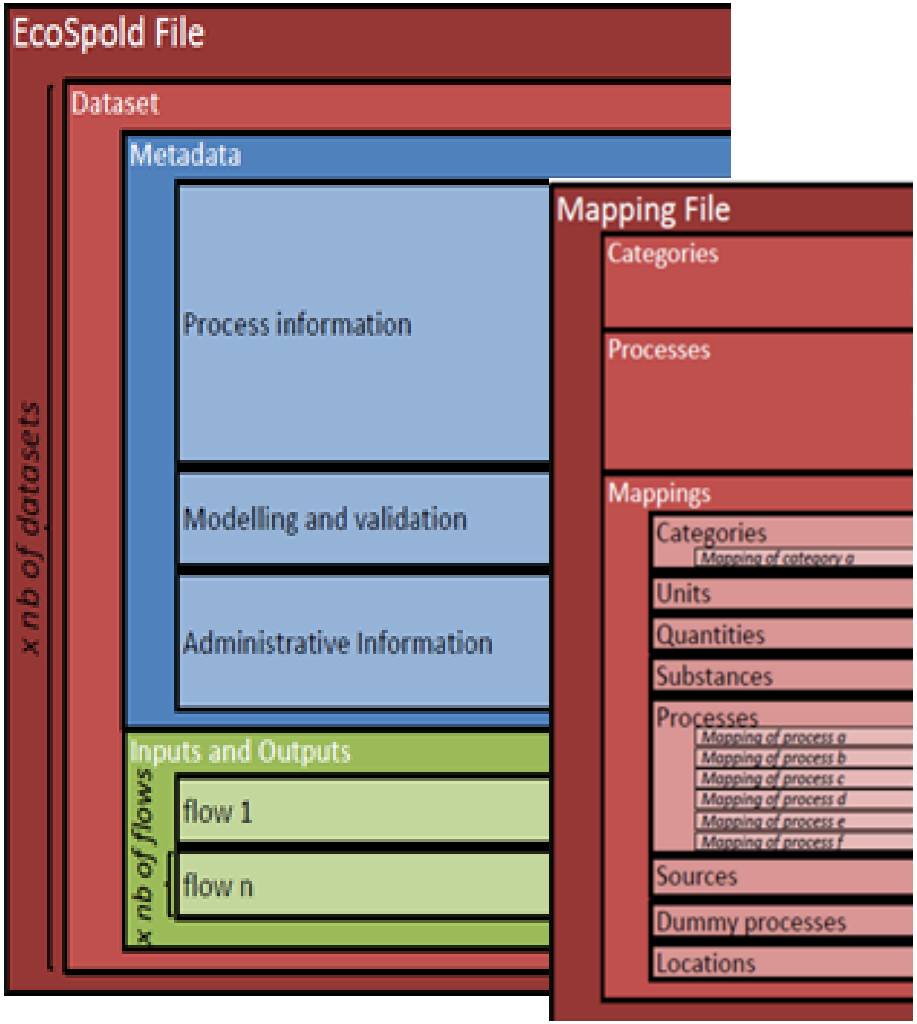
Case 1 ENOVIA export to EcoSpold1 / SimaPro7

Ecospold file

- List of datasets (Processes)
- Metadata
- Inputs & outputs

Mapping file

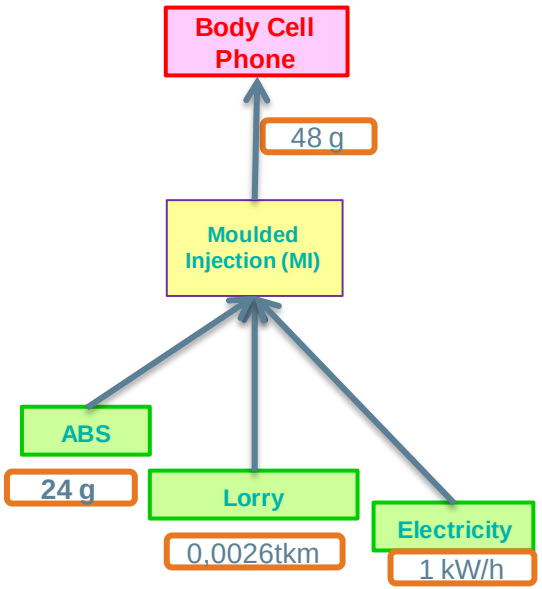
- Declarations of Categories & Processes
- Mapping for all objects, in particular Materials & Processes databases (ENOVIA to SimaPro)



Case 1 ENOVIA export to EcoSpold1 / SimaPro7

Mapping ENOVIA – EcoSpold1 – SimaPro7

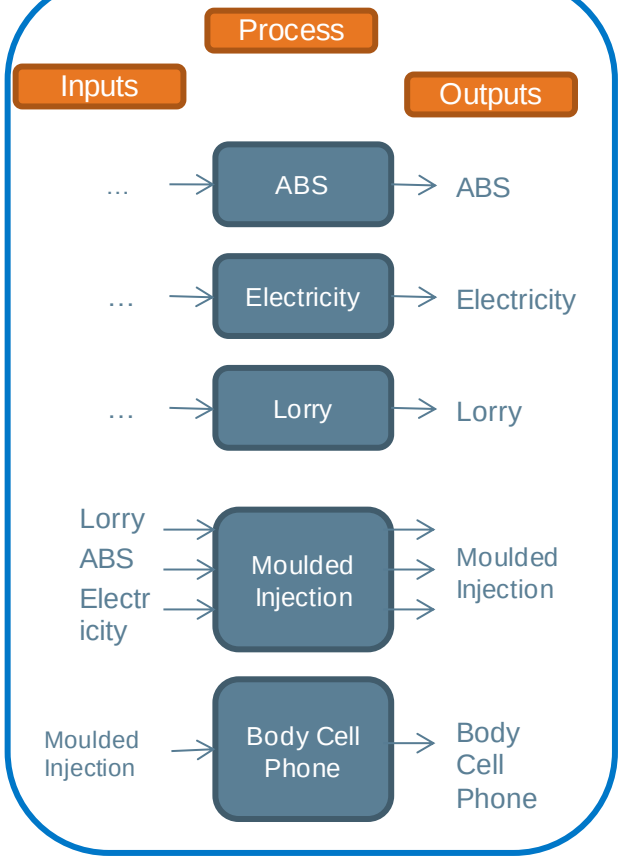
ENOVIA PPR



Ecospold (XML Structure)

Dataset ("resource"): ABS (24g)
category="**Plastics**"
subCategory="**Rubbers**"
Outputs: ABS
Dataset ("resource"): Lorry (0,0026tkm)
category="**Transport**"
subCategory="**Road**"
OutPuts: Lorry
Dataset ("resource"): Electricity Front Body Cell Phone (1kW/h)
category="**Energy**"
subCategory="**Electricity country mix**"
Outputs: Electricity Front Body Cell Phone
Dataset ("process"): Moulded Injection
Category: Body Cell Phone
Subcategory: Moulded Injection
Inputs: ABS , Lorry, Energy
Outputs: Moulded Injection
Dataset ("Part"): Body Cell Phone
Category: Body Cell Phone
Subcategory: Body Cell Phone
Inputs: Moulded Injection
Outputs: Body Cell Phone

Simapro



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Case 1 ENOVIA export to EcoSpold1 / SimaPro7

Results and Prospects

Transferring Product Definition from PDM to LCA is feasible!

- EBOM structure to LCI product network is automatic
- Functional Unit taken into account
- Mapping Materials & processes is still manual

Ecospold1 Mapping File **current bottleneck**:

- Declarations of processes, categories
- Mapping of processes

Limitations

- Ecospold1 “Modeling and Validation” not managed
- PPR modeling not tested on a full product for validation

Case 2 ENOVIA - LCA direct interface

Test implementation with openLCA

- Source code available for openLCA
- No security issues
- (openLCA developed by GreenDelta)
- More generic „eLCA connector“ developed to ease connection to other LCA tools

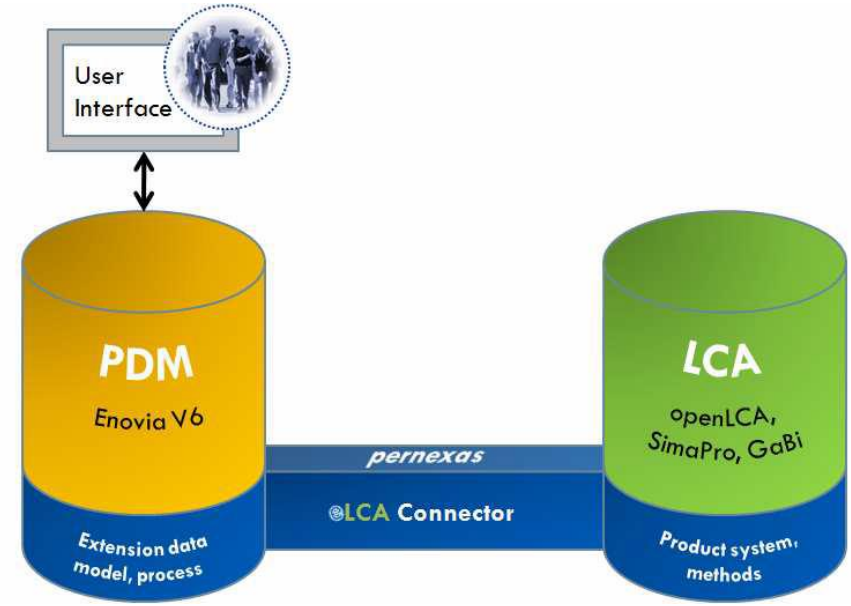
Case 2 ENOVIA - openLCA interface

Principles of the interface

- Connecting ENOVIA Parts to their corresponding LCA modules in openLCA
- Run LCIA engine then send the LCA results back to ENOVIA for the Part under study
- Implementation: ENOVIA v6r2012x, openLCA 1.2.8
- ENOVIA using OpenLCA Java API for “on demand” calculation of LCA indicators

Case 2 ENOVIA - openLCA interface

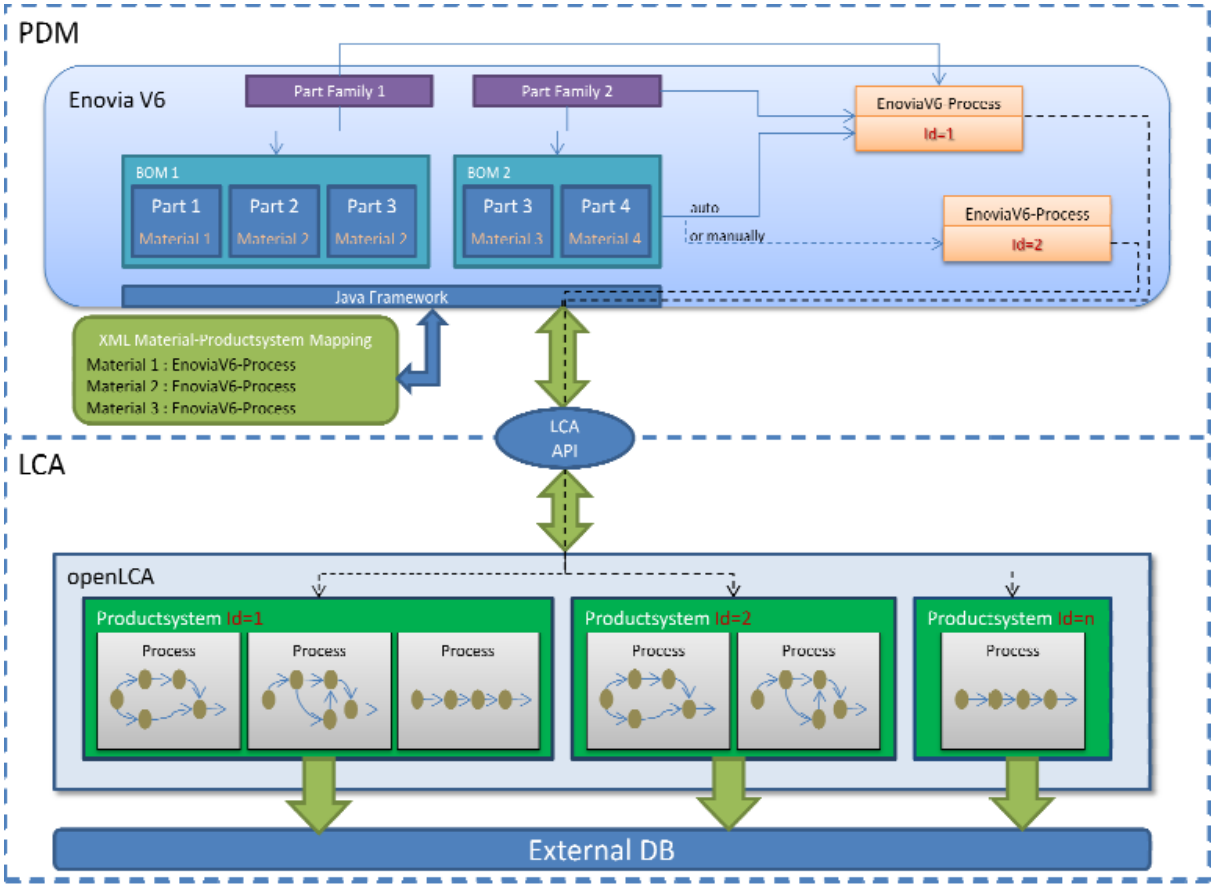
Principles of the interface



- **Pros**
  - Automatic and real time
  - Mass LCIA calculation for Parts
  - open source LCA (cost)
- **Cons**
  - Specific connector adaptations for other LCA tools required

Case 2 ENOVIA - openLCA interface

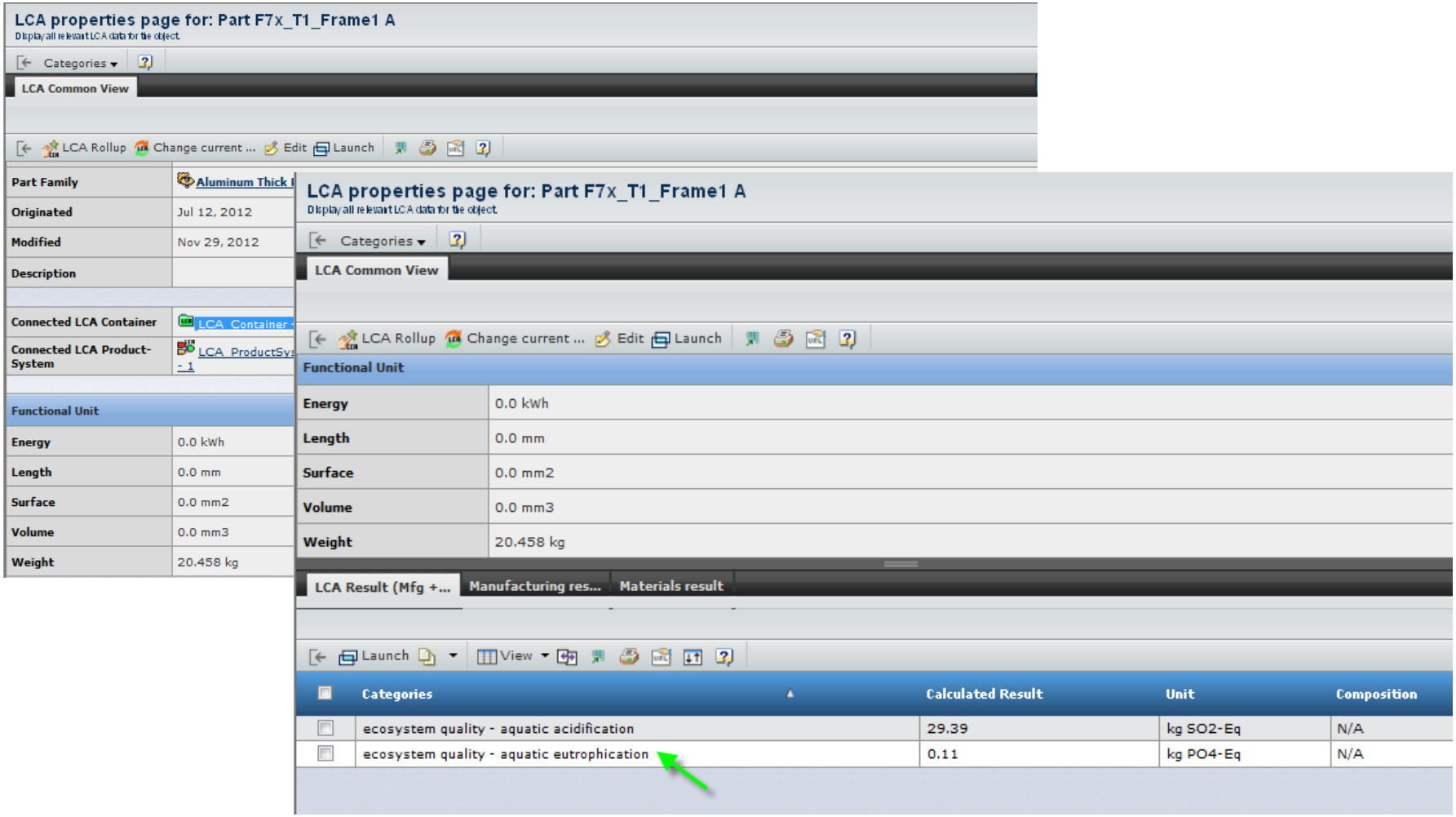
PDM-LCA Interface concepts



- Parts are assigned to a **Part Family**
- LCA datasets correspond to **LCA Product-System**
- Part Family is assigned to one or several **LCA Container** with a default LCA PS
- Parts inherit the default LCA Product-System for LCIA calculation

Case 2 ENOVIA - openLCA interface

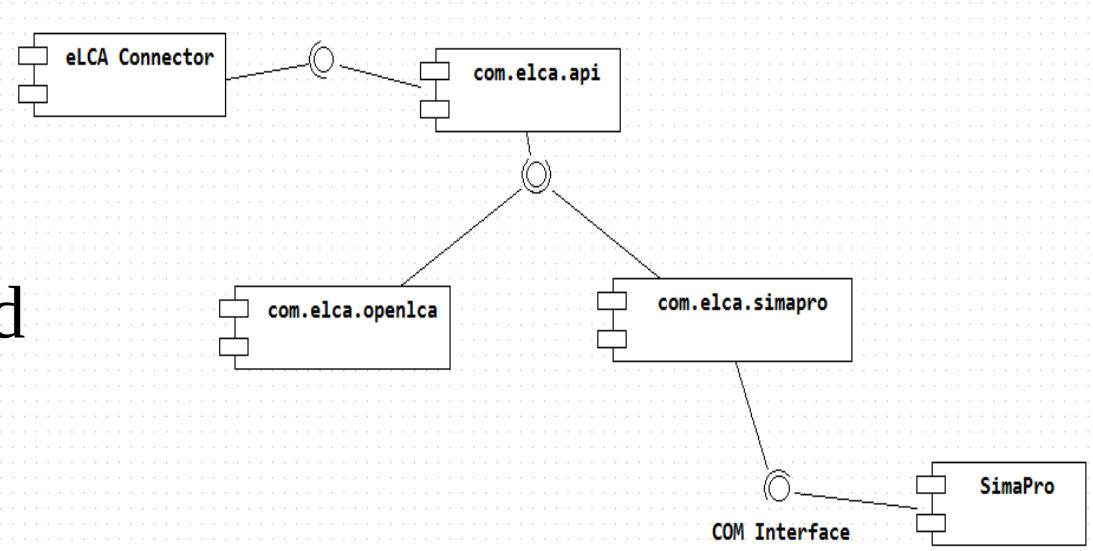
Implementation and LCIA results in ENOVIA

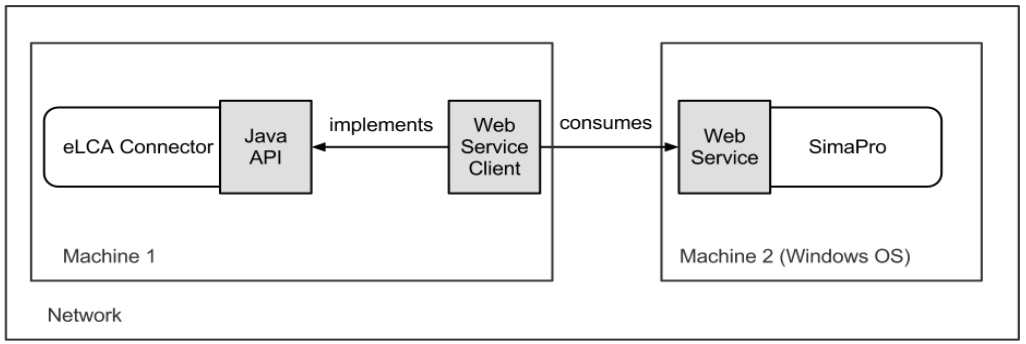


Case 2 ENOVIA - Perspectives with other LCA tools

SimaPro7: COM interface available

- GreenDelta has already implemented the e-DEA web tool for SimaPro = good candidate !





Case 2 ENOVIA - Perspectives with other LCA tools

GaBi: no public API or service to access from other tools; only import/export of files using private (GBX) or standard format (ILCD, Ecospold)

EIME v5: only online LCA tool, no public API or service to access from other tools; only import/export of files in a specific format!

Case 2 ENOVIA LCA dynamic exchange

Results and Prospects

Dynamic, real-time exchange between Enovia and LCA tools is feasible

- for openLCA, already now
- for other tools, possible, with implementation effort (SimaPro)
- a functioning “eLCA” connector has been implemented to make a connection with other LCA tools easier → we are open for collaboration

3 Outlook, outreach

3 Outlook and outreach

- Data exchange between LCA and PDM/PLM makes a lot of sense:
  - Efficient Design for Environment
  - Efficient use of high quality data in LCA
- The presentation showed a straighforward approach to export data from Enovia as a complex PDM/PLM system into an LCA software, via an LCA data format and appropriate mapping files.

3 Outlook and outreach

- Further, the presentation showed an implementation that allows real-time data exchange between Enovia and openLCA, linking professional LCA modeling with Enovia.
- openLCA as open source solution is fully flexible and transparent and minimises security issues
- A connector software has been created to allow also other LCA tools to connect; this seems promising for SimaPro

3 Outlook and outreach

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→ contacts welcome!

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Thank you..

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