



The enablement of Eco-design through the integration of LCA and PLM

ESA Clean Space Day – October 9th 2024



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The world is how we shape it

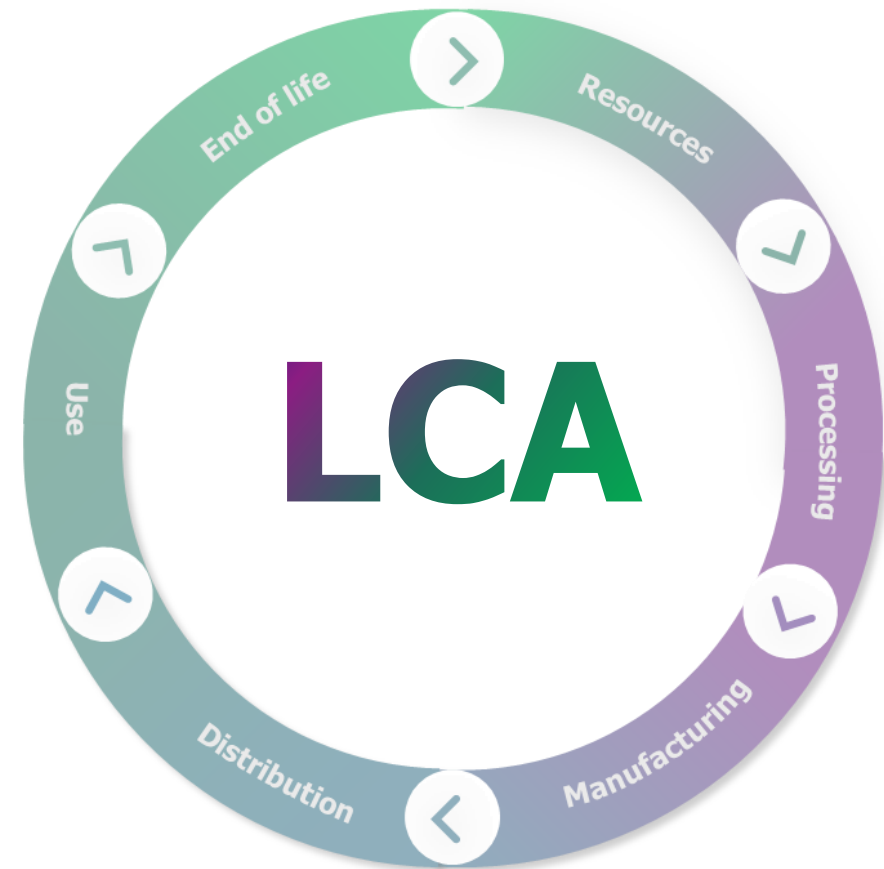
Product Lifecycle Management

PLM is both a business strategy and toolset that helps manage the entire product life cycle, including sustainable practices.



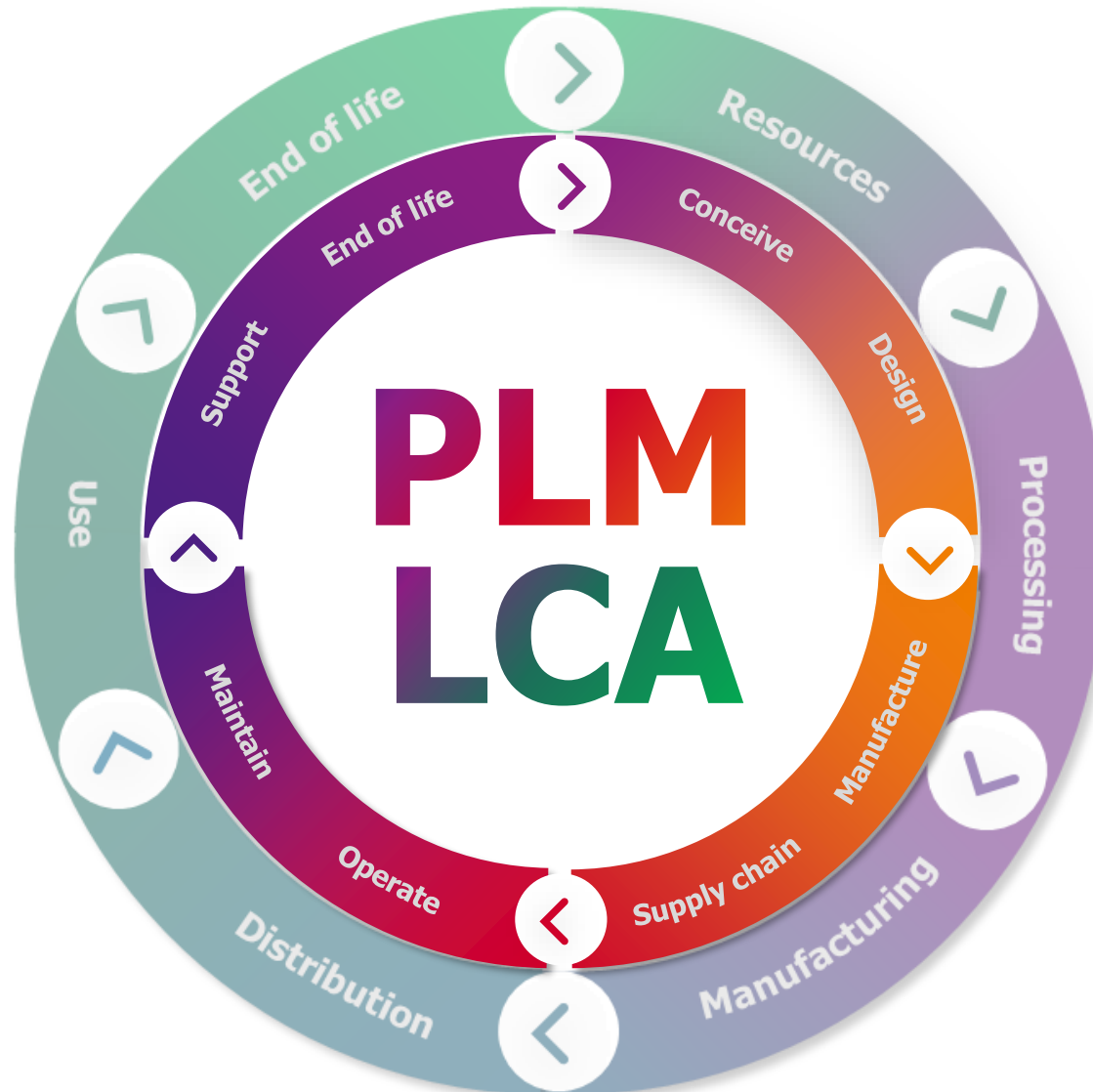
Sustainability supported by PLM

Lifecycle Analysis (LCA) for Designers



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Sustainability supported by PLM



Eliminate data silos and standardise datasets

Evolve LCA data in combination with your product data across each Mission Phase

Traceability and version control of LCI data

Empower Eco-design for Engineers

Eco-Design

Eco-design focuses on minimising the environmental impact of products throughout their lifecycle. This includes considering substances of concern, reusability and recyclability, reducing environmental footprint and more

Drivers



Legislation e.g. ESPR, REACH, EU Space Law

ESA and Supply Chain Expectations

Cost and Time Reduction

Challenges



Data

External Supply Chain (Tier 2 and below)

Capability and Mindset

Current Landscape

ESA Concurrent Design Facility

Standalone tools

- Bespoke spreadsheets
- Custom applications with high license costs
- Restrictions on data formats and application links

Data collection

- Primes have different questionnaires for data collection
- Readiness to share data (IP)
- Data availability / reliability
- Multiple data sources and formats

Gold standard:

- Simple to use
- Require as little inputs as possible
- Low level of LCA expertise
- Integrate with existing tool and data sets

How does PLM support Eco-Design?



Product Architecture

- ▶ Part name and level
- ▶ Physical links between Parts
- ▶ Product configuration

Part Characteristics

- ▶ Material
- ▶ Weight
- ▶ Manufacturing Process



Impact Factors

- ▶ Impact Categories
- ▶ Weighting
- ▶ Single score

One source of truth, aggregated data in a single format makes data more available and reliable

All activity within **one application** or connected to one dataset

Accessible with little to no change to process required from designers

Built to manage **different product configurations**

The background image shows a large Ariane 5 rocket on the left, with 'ariane services' and 'esa' logos visible. To the right, an Air Inter aircraft is partially visible. The scene is set against a blue sky with clouds. A vertical gradient bar on the left transitions from orange at the top to purple at the bottom.

Case Study: EcoDesign in PLM

Eco-Design For Engineers

Designer Centric

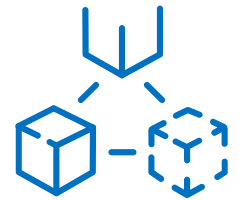
- ▶ Simple UI
- ▶ Graphical Feedback
- ▶ Abstracted Complexity



Our Approach

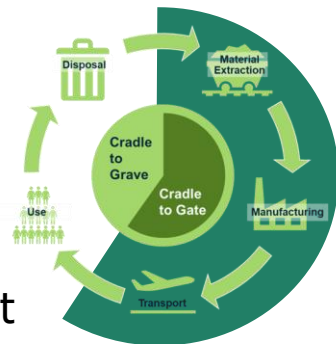
Data Principles

- Retain all levels of data
- Data traceability
- Aggregate data from all sources
- LCA for product configurations

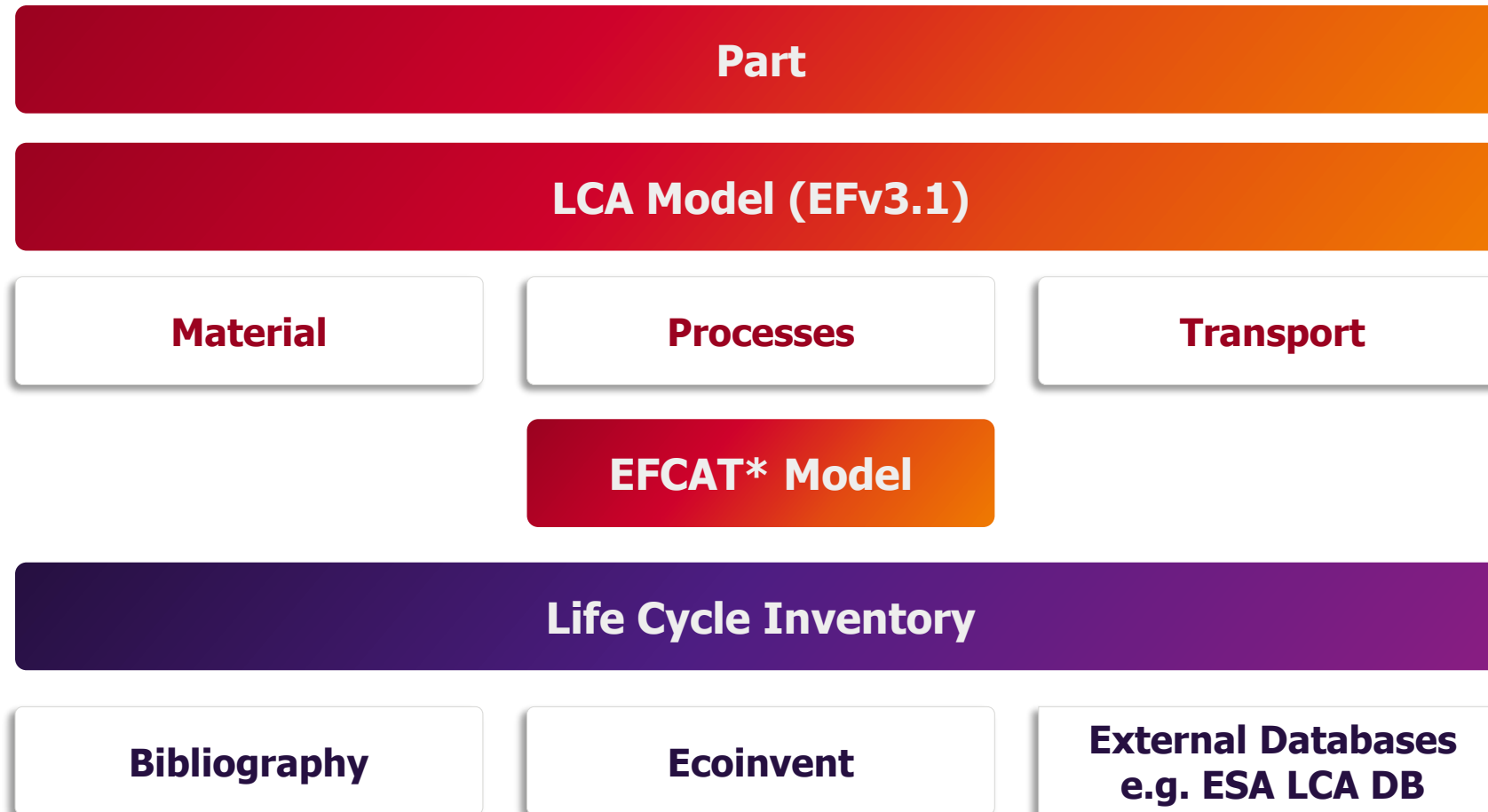


Life Cycle Analysis

- ▶ Cradle-to-Gate
- ▶ Single Score
- ▶ Midpoint Assessment



Case Study: EcoDesign in PLM



* EFCAT = Environmental Footprint and Cost Analysis Tool

Case Study: EcoDesign in PLM

CUK-EL-003

Part

Part Number: CUK-EL-003, State: Preliminary, Revision: A

Name: Drone Heliquad Battery, Unit: EA

Type: Component, Make / Buy: Make, Control Type: Make

Long Description: Drone Heliquad Battery

Weight (Kg): 0.5285, Cost (€):

Height (mm): 30, Length (mm): 50

Thickness (mm): 3, Width (mm): 40

Material: Aluminium (Avg. EU)

No Of Folds: 3, Geom. Complexity: Moderate

Component

Created By: Innovator Admin, Created On: 9/11/2024, Modified By: Matthew Sullivan, Modified On: 10/3/2024

Major Rev: A, Release Date: 10/3/2024, Effective Date: 10/3/2024, Generation: 12, State: Preliminary

Life Cycle Analysis Sustainability Scores

Overall: 0.0035043

Extraction: 0.000569 (16.2%), Transport: 0.002885 (82.3%), Manufacturing: 0.000049 (1.4%)

Sustainability Overview

Version History | Stage Breakdown

Legend:

- Water Use (m³)
- Photochemical Oxidant (kg)
- Particulate Matter (Disease Incidence)
- Ozone Depletion (kg)
- Energy Resources: Non-Renewable (MJ)
- Material Resources: Metals/Minerals (kg)
- Land Use Index
- Ionising Radiation (kBq)
- Human Toxicity: Carcinogenic (CTUh)
- Human Toxicity: Non-Carcinogenic (CTUh)
- Eutrophication: Terrestrial (kg)
- Eutrophication: Marine (kg)
- Eutrophication: Freshwater (kg)
- Ecotoxicity: Freshwater (CTUe)

Summary Table:

Acidification	Climate Change	Ecotoxicity: Freshwater	Energy Resources: Non-Renewable	Eutrophication: Freshwater
0.1033	31.22	120.9	447.0	0.002885
mg	kg	CTUe	MJ	%

[Show More](#)

Transports

Transport	Geography	Distance
Container Ship	GLO	120
Freight Lorry (EU...)	Europe (RER)	300

Page: 1 of 1 | 2 Results

CUK-EL-001

Component Report for CUK-EL-001

Overall Score

Transport, Manufacturing, Extraction

Extraction Score

Titanium, Chromium Steel 18/8, Aluminium (Avg. EU)

Overall Score	Avg. Component Score	Score change since last version
8.9297e-3	5.3669e-4	1.7859e-3

LCA Categories

Acidification (mol) : 0.4812	Climate Change (kg) : 92.9142
Ecotoxicity Freshwater (CTUe) : 223.2937	Energy Resources: Non-Renewable (MJ) : 1269.8041

[Click for more](#)

Component Grid

Part Name	Overall	Extraction	Manufacturing	Transport
CUK-EL-003	0.003504	0.000569	4.9370e-5	0.002885
CUK-EL-005	0.000348	0.000147	4.0230e-5	0.000160
CUK-EL-006	0.005009	0.000197	2.7109e-6	0.004810
CUK-EL-007	5.0243e-5	4.9626e-5	5.5259e-7	6.4264e-8
CUK-EL-009	1.7800e-5	1.7525e-5	2.2820e-7	4.7414e-8

What's Next?

Our goal is to enable a **designer-centric** Eco-Design process through the **integration of Life Cycle Analysis and Product Lifecycle Management**

Data Availability and Transparency

Workflow integration

Real-time feedback

We are looking for **partners** to develop use cases based on your workflows and develop **best-practices for implementing Eco-Design**

Features

- Substance tracking
- Connector for any LCA database (xml, ecoSpold2...)
- LCA management interface
- Data quality reporting

Q&A