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A methodological approach for implementing screening LCA into the early phases of product development



LCM 2023 THE 11TH INTERNATIONAL CONFERENCE ON LIFE CYCLE MANAGEMENT 6-7-8 september, 2023, Lille, France



Overview

- 1. Motivation
- 2. Reference system, requirements and methodology
- 3. Hotspot identification & design variable analysis
- 4. Model generation, data linking & precision monitoring
- 5. Example usecase









Motivation



Problem

- Current data quality and quantity availability in product design insufficient for sustainable designs
- Critical phases: Concept phase and design phase
- Low apparent data available for early LCA

Solution

- Most designs not actual completely new designs
- More than 67% of design tasks could be classified customized or variant designs*
- Use of existing data for screening LCA possible

-> Methodological approach for implementation into the development process needed!

*according to VDMA





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Reference system, requirements and methodology



Permanent Magnet Motor

Product development for

- New sustainable electric motor
- Robotic applications (dynamic speeds)
- Conventional permanent magnet design
- Basis: Reference machine from partner
 SIEMENS SIMOTICS 1FK7 Line

Methodology for integration of screening LCA











Hotspot identification & design variable analysis



Hotspot identification & design variable analysis

- No distribution or EoL analysis
- Main phases: Raw Materials + Use Phase
- Dynamc applications: inertia losses!
- Actual work can't be reduced! -> Eliminated from LCA

Derivation of relevant design variables









Model generation, data linking & precision monitoring



Output of design variables from models

- Siemens Simcenter 3D/ NX
 - CAD Models
 - FEA Models
 - CAM Models
- Matlab Simulink

Input into screening LCA models

- iPoint Umberto
- iPoint Product Sustainability
- Through existing API and NX Open

Precision Monitoring

- Feedback of LCA Data into Simcenter 3D/ NX
- Semi automatic updates







Example use case - Model



Simplified shaft and hub model

- Use phase szenario: **HU** high use and **LU** low use
- One Interface with 4 options
 - **P** Pressfit
 - **G** Glued
 - W Welded
 - **S** Screwed
- 3 Material Options:
 - **ST-H** Steel high alloyed
 - ST-L low alloyed
 - **A** Aluminium A
- Geometric scaling through mech. properties









Example use case - Automation







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Example use case – Results





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Conclusion

1. Leverage of Existing Data:

– Utilization of available data for the majority of product developments possible, allowing for efficient preliminary Life Cycle Assessment (LCA).

2. Systematic Four-Step Integration:

 Implementation of a structured approach to seamlessly incorporate screening LCA into the product development phase.

3. Comprehensive Demonstrator:

 Creation of a demonstrator that harmoniously integrates Computer-Aided Design (CAD), Finite Element Analysis (FEA), Computer-Aided Manufacturing (CAM), and LCA software to showcase the benefits of this approach.

4. Efficiency in Sustainable Design:

- Integration of screening LCA results to minimize the need for excessive engineering resources, thereby facilitating the creation of sustainable product designs.









Supported by:



Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

Research project: LiKE

Thank you for your attention! Paul Hoffeins







