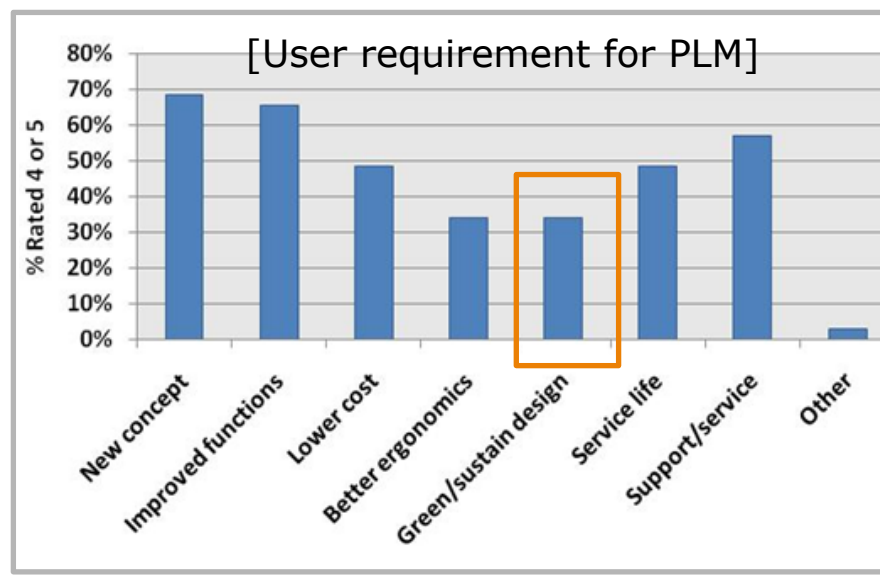


Software Support For Sustainable Product Development

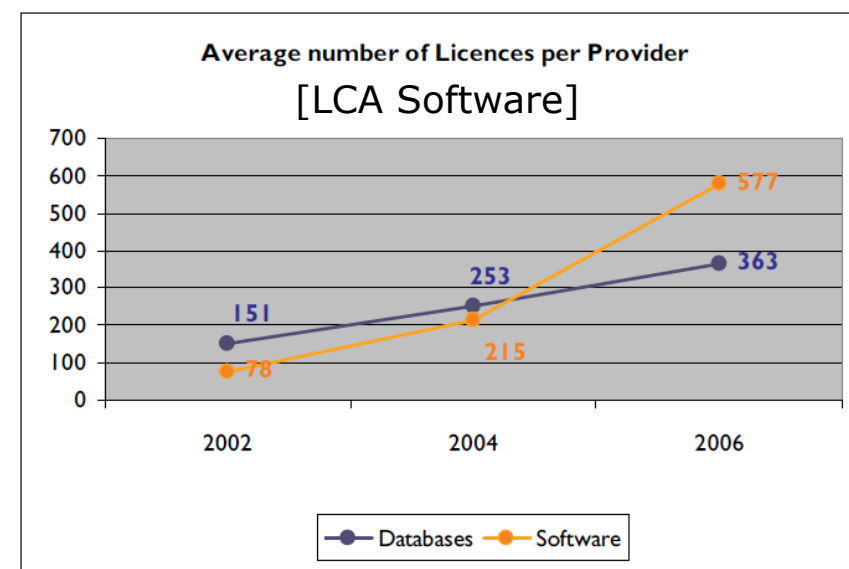
Funding Sources: Industrial Affiliates of LMAS

Motivation

- Weak Software Support for Environmental Sustainability
 - Interest increases among product developers.
 - LCA Software Sales 25M€/Yr (~2005)
 - LCA usage is not active in product development yet.



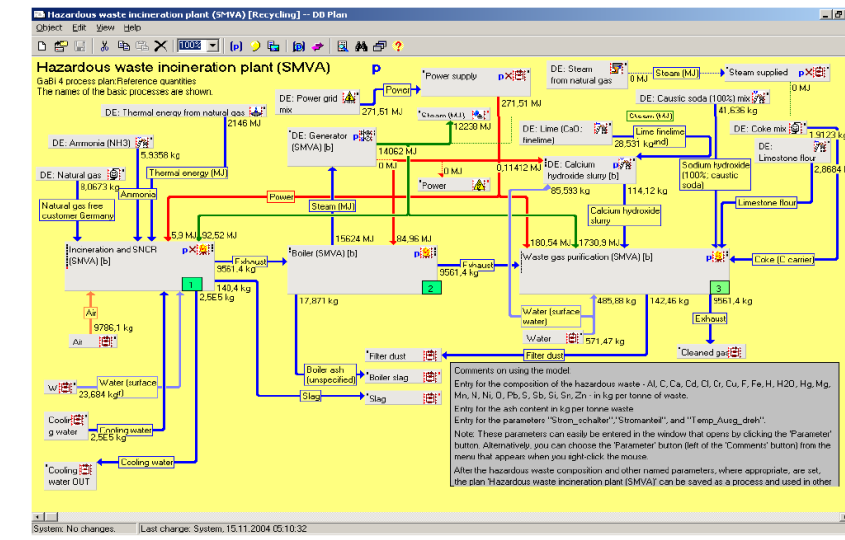
CIMData Poll 2009



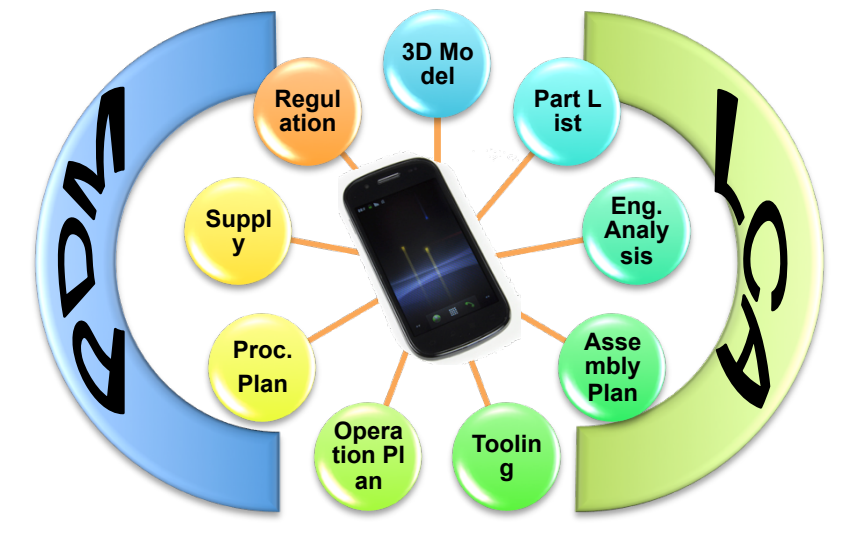
TNO-Report (2005)

Problem

- Challenges to applicability of LCA tools
 - Excessive data input requirement
 - Poor interface with conventional tools
 - Uncertainty resulting from averaged information



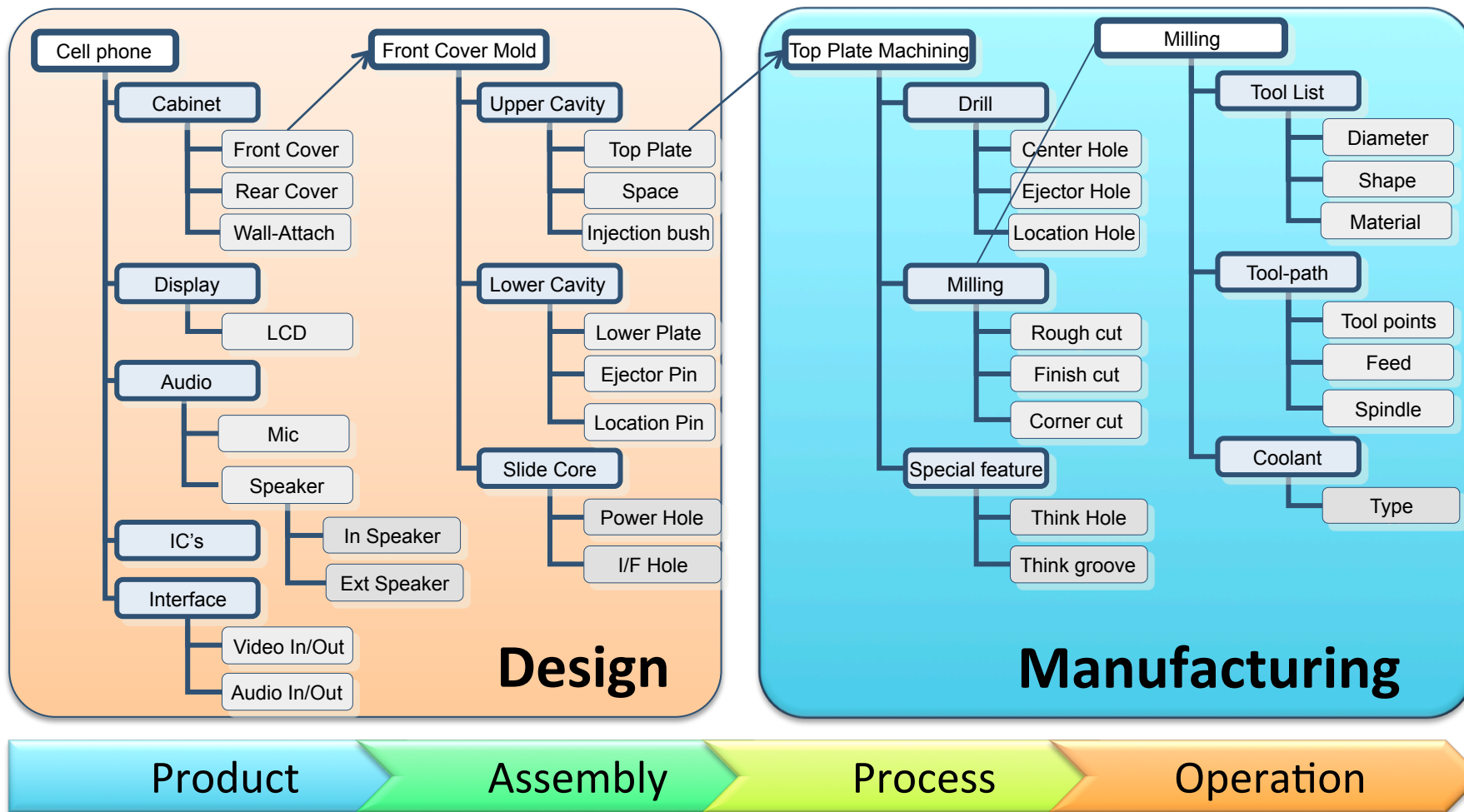
LCA Workbench [GaBi4]



Redundant Data Input

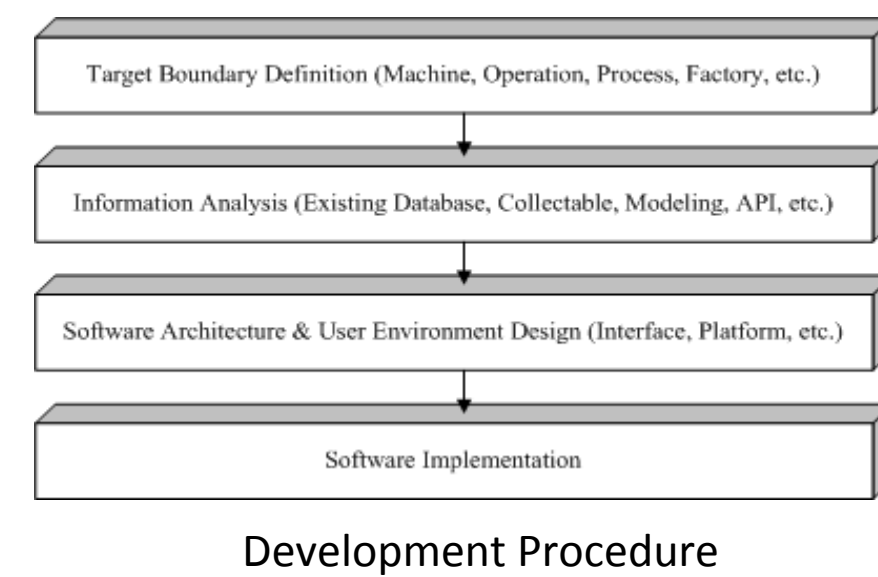
Product Development Hierarchy

- Product data has complex hierarchical structure.
- Each phase has different perspective in LCA.
- Environmental Impact = Sum(Lower level impact)

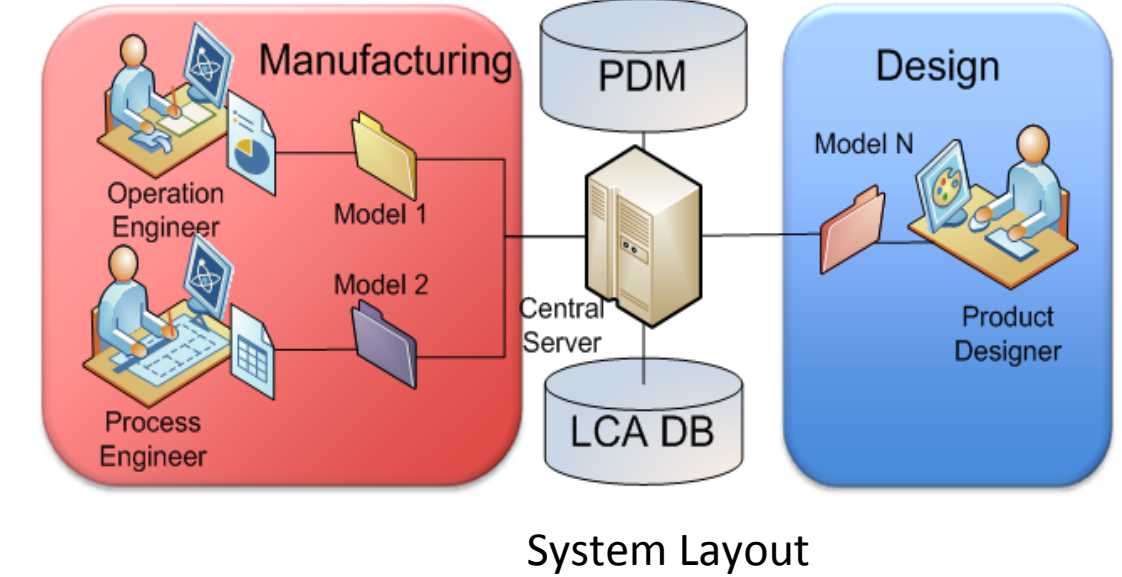


Implementation Strategy

- Strategy
 - Sharing information with product database
 - Integrating with existing development tools
 - Minimizing additional input parameter
 - Designing models for different working environments



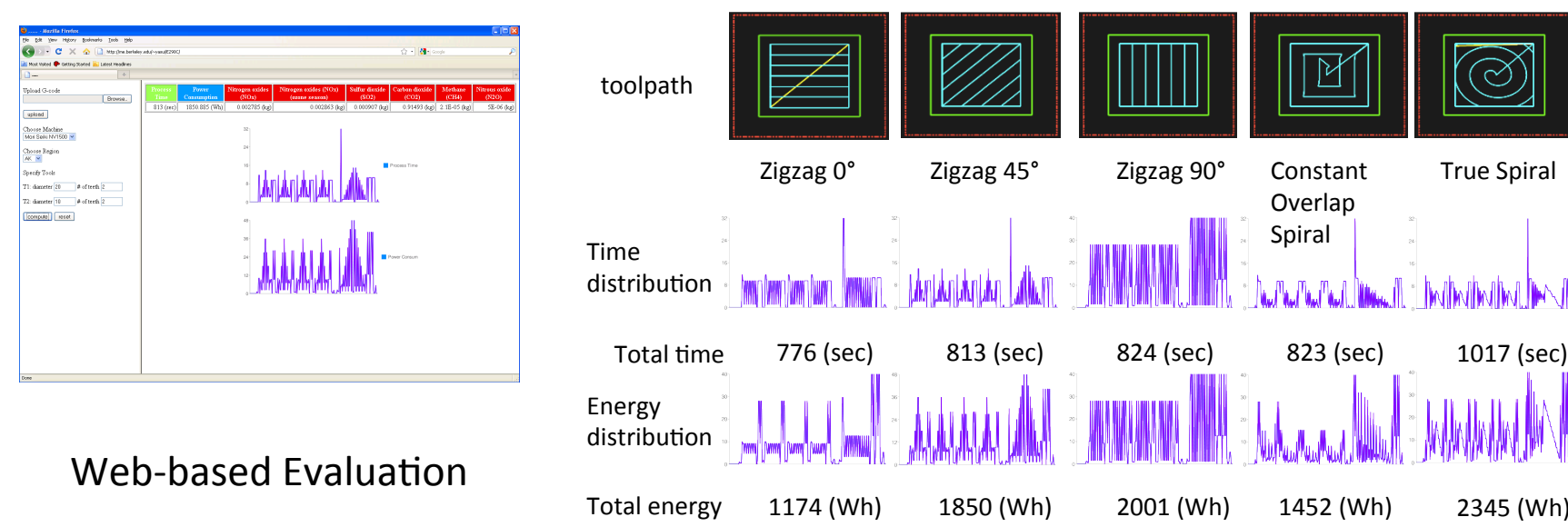
Development Procedure



System Layout

Operation Level Software

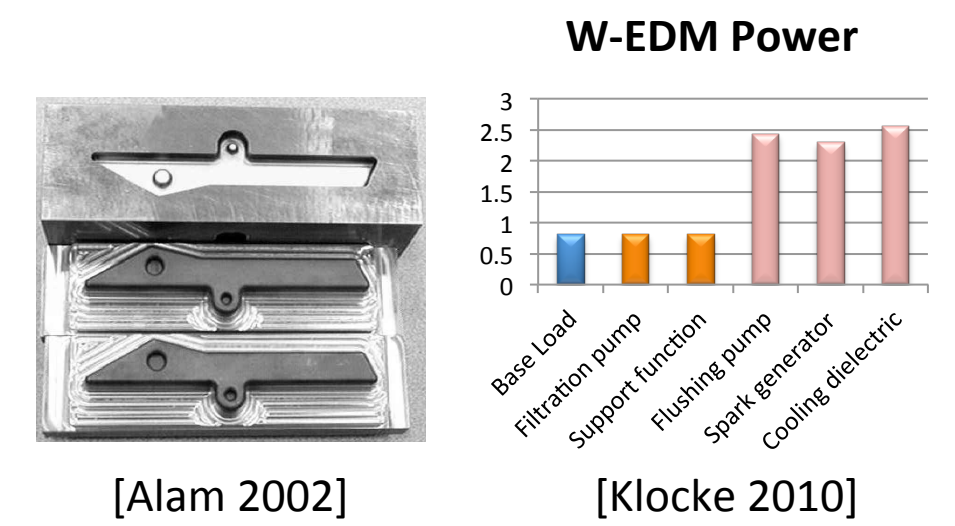
- Rectangular Pocket (100X100X40)
 - Rough cut ($\phi 20$) and Finish cut ($\phi 10$)
 - 5 tool-path schemes compared.
- Web-based S/W for evaluation
 - Performance variation is small, energy distribution is large.



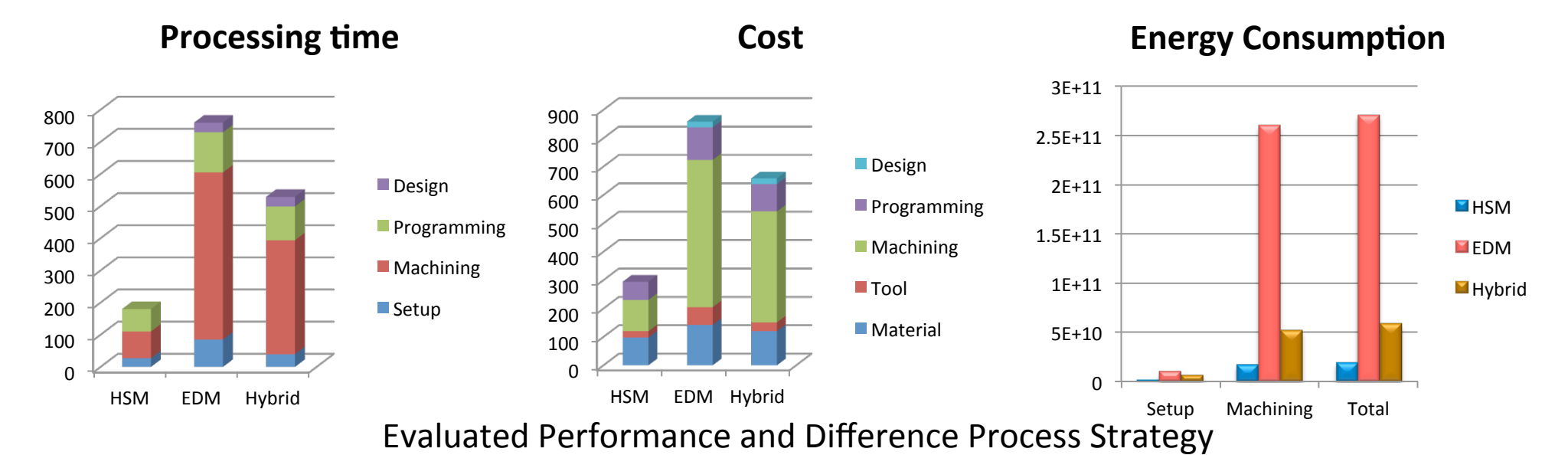
Web-based Evaluation

Process Level Software

- Pocket with slender boss
 - HSM, EDM, Hybrid (HSM+EDM)
 - $E_{EDM}/E_{HSM}=2.5$, Constant MRR
 - $(E_{idle}/E_{work})_{HSM}=0.40$
 - $(E_{idle}/E_{work})_{EDM}=0.25$



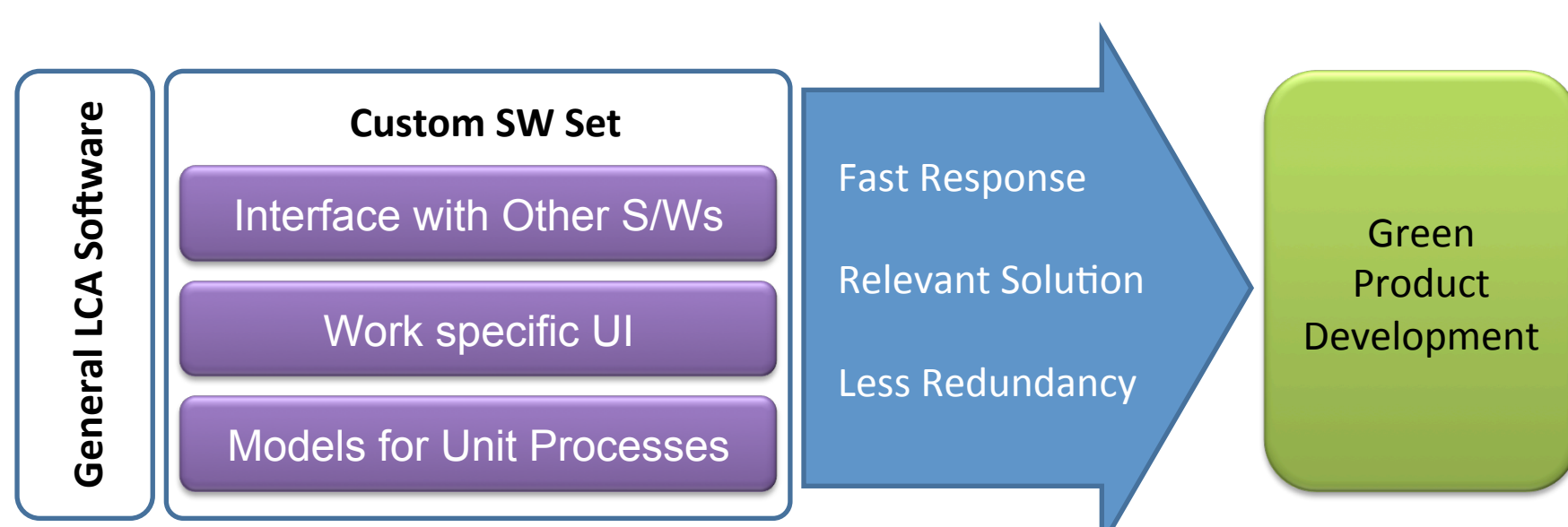
- Clear differentiation among different plans.



Evaluated Performance and Difference Process Strategy

Conclusion

- Software specific to working environment is needed.
 - Complementary to general LCA tools
 - Relevant to problem solving and product improving
 - Maximizing product data usability
- Custom API and universal data format are required.



Future Work

- PLC & Sustainability
 - Various products manufacturing methods
 - Data completion flow and communication methods
 - Relationship between product specification and sustainability
- Software support
 - Analysis of existing tools (GaBi4)
 - Custom tools availability (API, XML, etc.)