Life Cycle Engineering Methodology Applied to Material Selection, a Fender Case Study

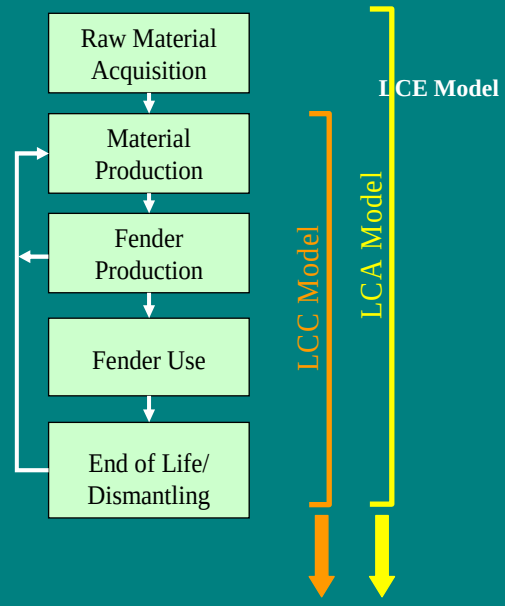
Pilot Project

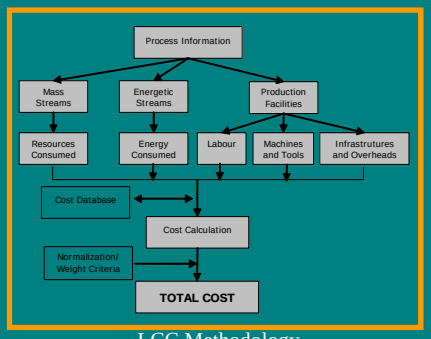
Mechanical Engineering Department
Instituto Superior Técnico, Lisbon, Portugal
I. Ribeiro, P.Peças, A. Silva, E. Henriques

Introduction

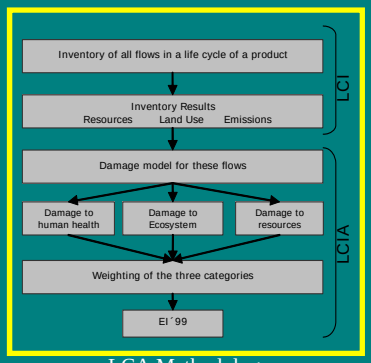
A Life Cycle Engineering (LCE) approach is proposed to support material selection for specific applications, integrating the performance of the material in technological, environmental and economical dimensions throughout the duration of the product. The proposed methodology compares a set of candidate materials and, through the aggregation of the three dimensions, identifies the "best material domains". These "best material domains" are presented in a ternary diagram, which allows a global comparison of the candidate materials and supports informed decisions as regards the selection of the "best material" according to different business scenarios and corporate strategies. The methodology was applied to a case study aiming the use of new metallic materials (high strength steels and aluminium alloys) for an automobile fender currently made of mild steel.

Case study: automobile (on the left) and fender (on the right)

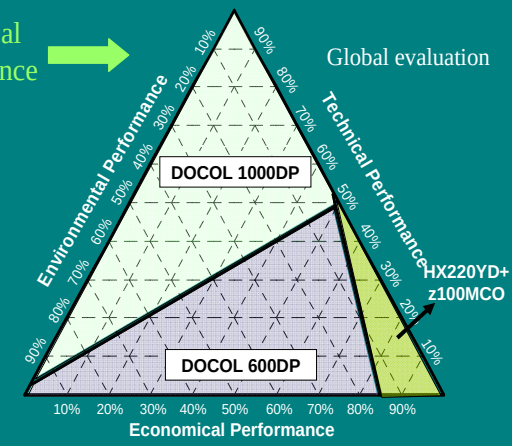


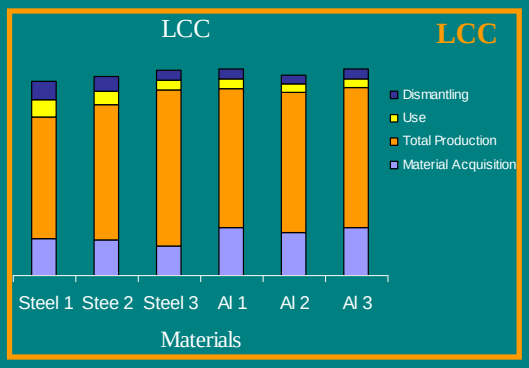


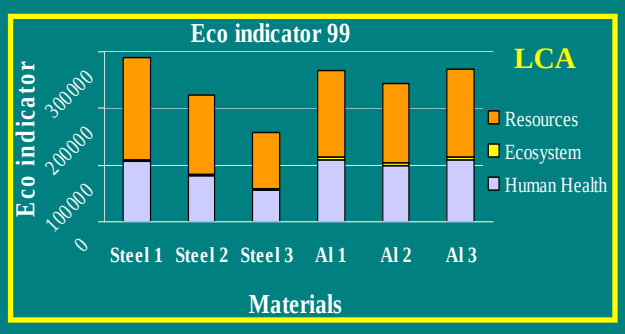
LCC Methodology



LCA Methodology







Conclusions

- The results revealed that the comparisons between fender materials based on economic, environmental and technical dimensions greatly depend on the importance weights attributed to the dimensions evaluated. The global evaluation developed in the study illustrated the possible material choices for different importance weights, which are attributed according to the pursuing strategy.
- As far as the "best material" for the application is highly dependent on these importance weights, it is crucial to decide cautiously the importance given to the technical, economical and environmental decision aspects.
- Another important issue is the importance of the data collected in an early stage of the analysis. As demonstrated in the sensitivity analysis, one single data value can modify the entire evaluation and can lead to different choices. Thus, it is important to obtain accurate information about the product life cycle in order to avoid unwise decisions.
- Finally it should be remarked that only metals were considered as alternatives. In fact, the screening of the set of candidate materials, highly dependent on the experience and knowledge of the design team, is a critical issue to achieve a good material for the application. Material selection methods like the one proposed by Ashby is a useful approach for the initial screening, feeding the methodology with a consistent set of candidate materials.

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