Ecoweb – a concept comparison tool for eco-design

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Flamco is a company in the heating, ventilation, and air conditioning (HVAC) industry, known for their expansion vessels and air and dirt separators, among many other products. Motivated by their parent company as well as government regulation, Flamco wants to further improve their sustainability practices. More specifically, they want to be able to assess the sustainability of a concept early on in its development. The main research question for the assignment is:

> *How can the development parameters with the largest influence on product sustainability be presented in a useful way for use in product development?*

This main question consists of two parts: identifying the development parameters with the largest influence on sustainability and presenting them for use in product development. To answer this question, a tool named Ecoweb was developed. Ecoweb is an application with which design decisions can be compared based on their influence on life cycle analysis (LCA) performance and circularity. LCA performance is an important metric of sustainability, which is indirectly required to be at a certain level by Dutch construction law. The circular economy is an economy in which value of products is kept in shorter cycles of reusing products, parts, and materials rather than discarding the product immediately after use, with materials being recycled at best. In the near future, Flamco wants to develop products only with a circular design: a design suited for the circular economy. LCA performance and circularity together indicate the sustainability of a concept for Flamco.

The data of Ecoweb is based on research into the many guidelines, frameworks and standards regarding LCA and the circular economy, processed in a sensitivity analysis. This sensitivity analysis is a long list of design decisions, factors of which LCA and circularity consist, and their relations. The Ecoweb application makes this data usable and provides an overview. Using this tool, Flamco can obtain sustainability advice early in the development process, without having to perform an entire LCA for each concept, which is time consuming and requires a lot of data. The current version of Ecoweb (v0.2.1) visualizes the input and output factors, allowing the user to explore their relations. This can be seen in figure 1. Input factors are the design decisions and output factors are the various parts that LCA performance and circularity consist of, grouped in a parent-child tree structure. The data is visualized in a web of circles and lines, which the user can drag around, expand, and collapse. This web can be freely explored to gain an overview of the components of LCA performance and circularity, as well as what design decisions influence it. More importantly, Ecoweb allows the user to group desired input factors in the form of a concept, with which a score for LCA performance and circularity can be calculated. Ecoweb calculates this score by summing the total influence of each design decision on LCA performance and circularity, resulting in a quantitative score. This score, especially when compared to scores of other concepts, can be regarded as advice on which design decisions are better suited for the circular economy or increased LCA performance. This advice can be weighed in the decision to continue with a concept, as it makes sustainability quantifiable and comparable to other important factors such as cost price. Overall, Ecoweb is the start of a tool that provides advice for making the right sustainability decisions early in the development process of Flamco. The recommendation for further development of Ecoweb is to continue

in two directions: sensitivity analysis data improvement and further application development. Iteratively improving the underlying data of Ecoweb by feeding back development results after Ecoweb has provided advice reinforces the model. Furthermore, the application itself can be improved in terms of user interaction, making it easier for the user to learn and obtain advice in the field of sustainability.

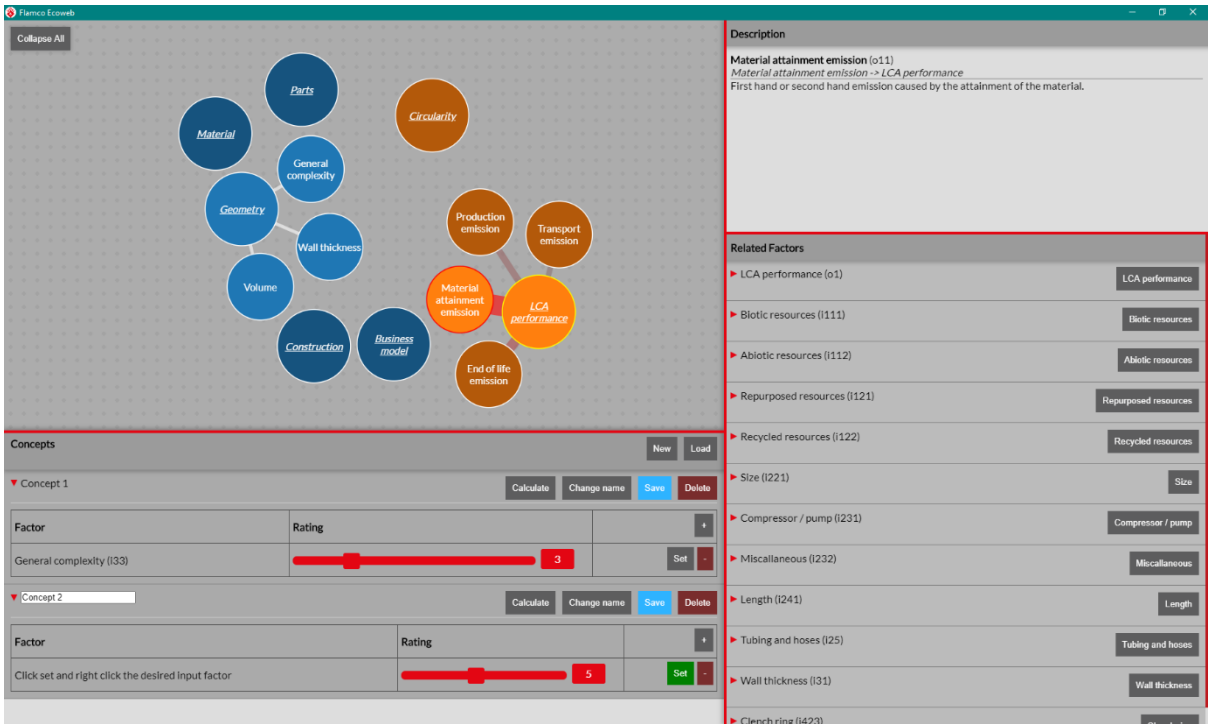

Figure 1: Ecoweb v0.2.1