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Stochastic Multi Attribute Analysis for Life Cycle Impact Assessment

Comparative Life Cycle Assessments (LCA) are decision driven analyses that evaluate multiple products or technologies with the goal of selecting the path of least environmental burden. Normalization and weighting are stages within the LCA process that standardize alternatives (comparative products, technologies, etc.) within impact categories for unbiased comparison and assign influence to each impact category relative to the overall assessment. However, these stages are subjective to the analyst or software they're using, and can result in contradictory tradeoffs among alternatives or values biased towards the analyst's perspective. Current valuation approaches rely on external normalization references that are often incomplete, incompatible, and outdated, and point-estimate weighting techniques that can be biased by analysts' subjectivity and provide an overly narrow view of complex environmental problems.

Researchers at ASU have developed software using stochastic multi attribute analysis (SMAA) to normalize alternatives and weigh impact categories. SMAA-LCA avoids subjectivity by testing all possible schemas without favoring one over another, and uses an objective outranking algorithm to clearly distinguish between negligible and significant differences. Weights can be fully inclusive, but the software also allows analysts to adjust impact category importance with a sliding bar menu for modifying weight distributions. SMAA-LCA can be applied to any comparative LCA because it internally assesses differences rather than using a standardized baseline from external references. SMAA-LCA reduces data requirements and facilitates sensitivity, scenario, and multiple stakeholder analyses, providing a much more robust evaluation of tradeoffs that lead to the developmental pathway of least environmental burden.

Potential Applications

- Comparative LCAs
- New Product Development
- Sustainability Studies

Benefits and Advantages

- Accurate – Objective outranking normalization algorithm clearly distinguishes between negligible and significant differences among alternatives.
- Practical
  - Adjustable weight distributions for impact categories.
  - No need for additional external references.
- Robust – Stochastic weighting provides decisive developmental pathways that are unbiased to user perspective.
- Versatile – Can be applied to any comparative LCA.

For more information about the inventor(s) and their research, please see

Valentina Prado-Lopez's directory webpage

Dr. Thomas Seager's directory webpage