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Activity-based Sustainability Assessment of Highly Automated Manufacturing

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Sustainability of technology is a multifaceted endeavor and a main requirement from industry is to make it a profitable business case with clearly defined targets. To achieve that, a new assessment framework and applicable method [1] is presented which has been developed closely with industry. It uses a top-down decision-making process known from financial target setting for each cost center and the well-known life-cycle perspective according to ISO 14040 [2] in Sustainability Assessment. Thereby it is possible to allocate absolute environmental thresholds of functionalities (e.g. "transportation") down to smallest production units by using activity-based target setting in a consistent way to lowers risks in the planning phase of products and production.

Success factors (SF), specifications and parameters are describing the manufacturability and therefore the revenue potential of products. By combining those with production and technology data, like cycle time, energy efficiency and material consumption as well as with expert opinion it is possible to determine an allocation method that predicts the so-called life-cycle targets (lct) for each cost center in manufacturing. A linkage to life cycle databases is established as well in order to predict environmental impact of the activities holistically (even divided into process, infrastructure and overhead). This approach allows to identify hotspots and can avoid sub-optimization within the different production levels as well as between different environmental impact categories.
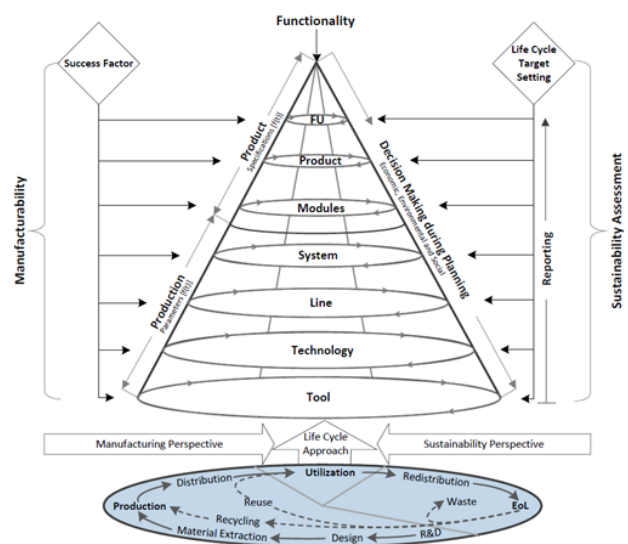

Figure 1 Sustainability Cone: Conceptual framework of merging life cycle perspective, product and production to derive life cycle targets (lct) thus optimizing product and production in an early planning phase [1]

This framework has been applied to a product life cycle of a standard passenger car, with emphasis on highly automated manufacturing. Lct's for production cells and widely used technologies in highly automated car manufacturing will be presented followed by a discussion of how to use them in the decision making internally and externally in reporting schemes

[1]   J.-M. Rödger, N. Bey, and L. Alting, "The Sustainability Cone – A holistic framework to integrate sustainability thinking into manufacturing," *CIRP Ann. - Manuf. Technol.*, vol. submitted, 2016.
[2]   ISO 14040, "Environmental management - Life Cycle assessment - Principles and framework," Geneva, 2006.