Abstract

Particularly for reasons of reputation and cost, companies are increasingly demanded to minimize their environmental impacts. Logistics processes have a strong impact on the environment and, thus, offer high potential to improve the environmental performance of a company. The environmental balance of logistics processes can be improved by the integration of environmental objectives in logistics planning. The supply chain design (SCD) offers the greatest potential for planning-based environmental improvements. Therefore, the former cost- and performance-oriented procedure in SCD must be enhanced by the integration of environmental criteria.

In this thesis, initially, requirements for the methodology in the SCD are derived by identifying SCD tasks, structuring them exemplarily and identifying their environmental impact. The analysis of these tasks results in the definition of seven requirements to specify the necessity of the enhancement of an exemplary SCD reference methodology.

By means of current scientific literature, 17 environment-related indicators are chosen and exemplarily implemented into the logistics performance indicator system of the VDI guideline 4400 being extended by a third target "low environmental damage". In order to accordingly allow the calculation of environmental indicators to the suitable effort on a long-term planning level such as the SCD, appropriate calculation formulae are developed and required input parameters for each means of transportation are defined based on current literature and relevant norms.

As the input parameters result from the two concept phases of the chosen SCD reference methodology, they are enhanced accordingly. This in particular concerns the phase of the detailed assessment, because it lacks of environment-related methods, although dynamic effects being relevant for this phase influence the environmental balance of logistics processes significantly. In order to assess environmental indicators by considering dynamics and to apply them as a control factor, the discrete-event simulation is enhanced by an intra-simulative environmental assessment. As this provides an environmental balance at simulation runtime, a concept of environment-based control rules is developed to integrate environmental decision criteria in the design of dynamic systems.

The SCD reference methodology enhanced by an environmental assessment is finally applied and evaluated in two use cases. The results show that the new methodology provides a suitable instrument to consider environmental objectives integrated to cost and performance objectives in the SCD. Thereby, companies are enabled to reduce environmental damages already at an early planning stage.