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System Dynamics Modelling to Assess Economic Profitability of Reverse Supply Chain Related Business Models.

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The research field considering reverse supply chains has increasingly gained importance in both academia and industrial practice. Since resource scarcity of critical raw materials like technology metals has become a huge challenge for producing companies, the resulting question is how innovative business models can enable both the proactive take-back of products and its components and the subsequent recovery. Latter one includes various options like direct reuse, remanufacturing and recycling which are of high importance to secure material availability and to improve the value chain sustainability. Hereby, the economic assessment of each business model alternative need to be conducted in order to select the most profitable one depending on the actual business case.

In our research work, we firstly define applicable business model alternatives which are the basis for the manufacturer to offer new services to its customers on the one hand and to manage a goal-oriented return, recovery and resell of used products and components on the other hand. This is conducted with the help of the morphology methodology in order to understand the characteristics and attributes of reverse supply chains and to meaningfully structure business model types aiming at an increased customer satisfaction. To specify the determining characteristics, a theoretical framework like e.g. Business Model Canvas is chosen. In addition, we also present a target system which is deduced to assess the economic profitability of each reverse supply chain related business model. Considering this, we analyse existing process reference models to define the relevant components of an appropriate target system. Subsequently, we identify a relevant set of dynamic factors which have a significant influence on reverse supply chains and the related business models.

Based on the preceding partial results, we study the interactions between key performance indicators, business model characteristics and influential factors. With the help of causal loop diagrams according to the system dynamics methodology, we firstly detect the interactions in a complex reverse supply chain system in order to transfer the identified structure into a mathematical model. Latter one is developed to understand the economic behaviour of reverse supply chain related business models for specific parameter constellations and to find optimization measures. Altogether, the simulation model serves as an instrument for a lifecycle overarching assessment of business model alternatives combining the value proposition towards the customers as well as the corresponding value chain design. By including the identified influential factors in form of varying input factors and the defined target system including measuring parameters, the simulation model demonstrates both cost and benefit indicators. Finally, it enables manufacturers to organize their reverse supply chain activities appropriate to the current market situation and to decide for example whether a product will be refurbished interminably or whether it will be recycled.