Session 6: Sustainability and Circular Economy

Chair: Renzo Akkerman

Gizem Mullaoglu (Eindhoven University of Technology) - An Incentivization Selection Model to Promote Circularity in Repair Operations

Circularity plays a crucial role in the sustainable development goals of United Nations, to be achieved by 2030, including issues related to health, responsible consumption, and production amongst others. Circularity offers significant economic benefits in addition to its environmentally-conscious perspective without jeopardizing growth and prosperity. Repair operations play an important role in circularity between manufacturer and supplier. However, generally because of the challenges in the implementation and financial considerations, the repair operations sometimes would lead to a dead end. Therefore, to achieve circularity in repair operations, establishing different methods would be beneficial for both manufacturer and supplier. To accomplish a higher sustainable performance in repair operations, we propose an optimization model for a manufacturer to select a combination of incentivization methods such as price premiums, investments, and public recognition for its suppliers. Our study also focuses on the optimal determination of price premiums and investment for a single supplier which maximizes a utility function. Our utility function includes environmental, financial, and learning aspects to incorporate the important elements in the decision making. We aim to shed light on the incentivization method issues from the circularity perspective and provide beneficial insights and fruitful results for the opportunities in repair operations.

Patricia Rogetzer (University of Twente) - Analysis of a circular solution for complex waste streams

A newly built start-up company focuses on recycling waste on an industrial scale. They have their unique recipes to produce useful raw materials that can be used further in different processes. Out of slag, fuel and support material they create valuable resources and with that support the transformation towards a circular economy. The process is characterized by unknown compositions of input materials, fluctuating yield rates and the formation of co- and by-products. Our research provides the management team with analytical insights on land, machinery, and material requirements of building a factory. In order to assist them in terms of resource requirements for building the factory, a Mixed-Integer Linear Programming (MILP) model is developed, solved, and analyzed. The model provides the company with optimal waste amounts to produce, suggestions which waste to focus on and what storage to invest in as well as an advice how many machines are required for the process. We furthermore develop a decision support tool that can be used to guide cost decisions for the company.

Gijsbert Korevaar (Delft University of Technology) - Circular business model experimentation: An agent-based approach to validation of various business models for circular industries

In 2021, the World Bank published a report under the title ‘Circular Economy in Industrial Parks’. This report relies heavily on the research field of industrial symbiosis, an engineering and design toolbox that links to the core of business making in terms of resource efficiency, energy performance, and environmental impacts. The circularity of a single industrial operation is often difficult to define because of the embeddedness of single operations in a larger value chain of actors and consumers that goes beyond the responsibilities of the individual plant management. The larger system perspective of industrial symbiosis and circular economy places the engineering aspects besides non-engineering issues and offers a structural insight into the allocation and problem decomposition of those various issues. In my presentation, I will explain how modelling approaches can be used to simulate the network stability of both circular industrial parks and industrial symbiotic systems. I will show how to come to a taxonomy of socio-technical design methods that enables the designer and decision maker to formulate proper system boundaries, to find alternatives in supply chain management, waste management and process design, and to assess those findings in a balanced way. The presentation will focus on three research lines of 1) circular business model experimentation, 2) potential mapping of industrial exchange, and 3) modelling the behaviour of network actors.