

Circular economy and value stream mapping to support PET bottle production and recycling

Background

The recycling industry plays a critical role in achieving the environmental goals of manufacturing firms. However, this industry faces many challenges relating to uncertainty in material input quantities, ratios and quality. This is often due to a missing information exchange between companies active at the beginning-of-life and the end-of-life of a product. The rise of Big Data and advanced data analytics present new possibilities for more efficient exploitation of process and product data in many industrial sectors, being particularly useful to prepare for challenges related to planning and design of operations. More advanced connectivity solutions could unlock higher levels of performance by looking at more systemic measures beyond a single machine, process, facility area and even beyond the factory gates. However, data models are not always suitable and existing data not fully exploited to address the goals of economic, social and environmental sustainability. We need better performance indicators based on the principles of eco-efficiency and circular economy (CE) to identify and evaluate different scenarios and support fact-based decision making for industrial sustainability.

Within Luxembourg, a lot of companies active in the PET-bottle supply-chain (e.g., preform producer, filling and recycling company) can be found in the closer surrounding area, which simplifies a cross-company analysis. Due to its small surface and its central location, Luxembourg perfectly suits to test and verify new models and procedures to identify and evaluate different CE scenarios and support fact-based decision making.

Aim and objectives

The industrial case for this project is based on PET bottle recycling in Luxembourg. The project aim is to improve the sustainability performance and circular resource flow of industrial systems through the use of CE indicators and information exchange. The objectives are three-fold:

- Evaluate the usability of different CE indicators by applying them to a real industrial case using Value Stream Mapping (VSM) as a basis for the material flow analysis;
- Identify whether there are data gaps or uncertainty to use/calculate the indicators for each process in the VSM, and deliver reliable and useful results for design and process improvements;
- Evaluate the usefulness of the CE indicators for potential users and what information would deliver the most value to them (e.g. different information needs/requirements for designers, manufacturers and recyclers who can act on the information provided by the indicators).

Tasks

- Review the scientific literature on circular economy and eco-efficiency principles relevant to the project;
- Develop circular scenarios using VSM to evaluate different industrial system configurations for PET bottles;
- Test a selection of CE indicators on industrial partners' production and recycling processes, especially focusing on data availability, data quality and data model shortcomings (in collaboration with companies from Luxembourg);
- Highlight the pros and cons of the CE indicators from different users' perspectives.

Requirements

MSc programmes: Production/Materials/Industrial Design Engineering, Product Development, Industrial Ecology.

We are looking for two students with a good understanding of industrial systems and life cycle thinking. They should have a strong interest in environmental sustainability. Additional merits include Circular Economy, Life Cycle Assessment and other environmental analysis courses.

Thesis work starting January 2022, 30 credits / 20 weeks.

To apply, contact the main supervisor with your CV and academic transcripts in English. Welcome!

Contact information

Main supervisor: **Clarissa González**, clarissa.gonzalez@chalmers.se

Co-supervisor: **Jeff Mangers**, University of Luxembourg, jeff.mangers@uni.lu

Examiner, co-supervisor: **Mélanie Despeisse**, melanie.despeisse@chalmers.se

Industrial partners: *Company details and contacts will be provided during the project, including global leader in packaging and recycling industry*