

Simulation of a representative disassembly process in the context of a greenhouse gas-neutral circular economy

Conceptual design, modeling, and evaluation within the framework of the CircEcon project

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Motivation

- Limited availability of natural resources and increasing demand for raw materials
- Political and regulatory frameworks promoting the circular economy (e.g., EU strategies and recycling targets)
- Environmental impacts of linear economic models, particularly increasing waste volumes and pollution
- Economic potential of the circular economy through reuse and high-quality recycling

Conceptual Design & Development

- System layout created using the software Visual Components
- Project boundary conditions were taken into account
- Findings from the manual disassembly of the vehicle door were incorporated



- Development of a safety concept for the disassembly system
- Virtual modeling of the disassembly process of a vehicle door
- Establishment of a basis for simulating future disassembly processes of various products
- Development of a validated concept for the real-world implementation of the system

Result & Next Steps

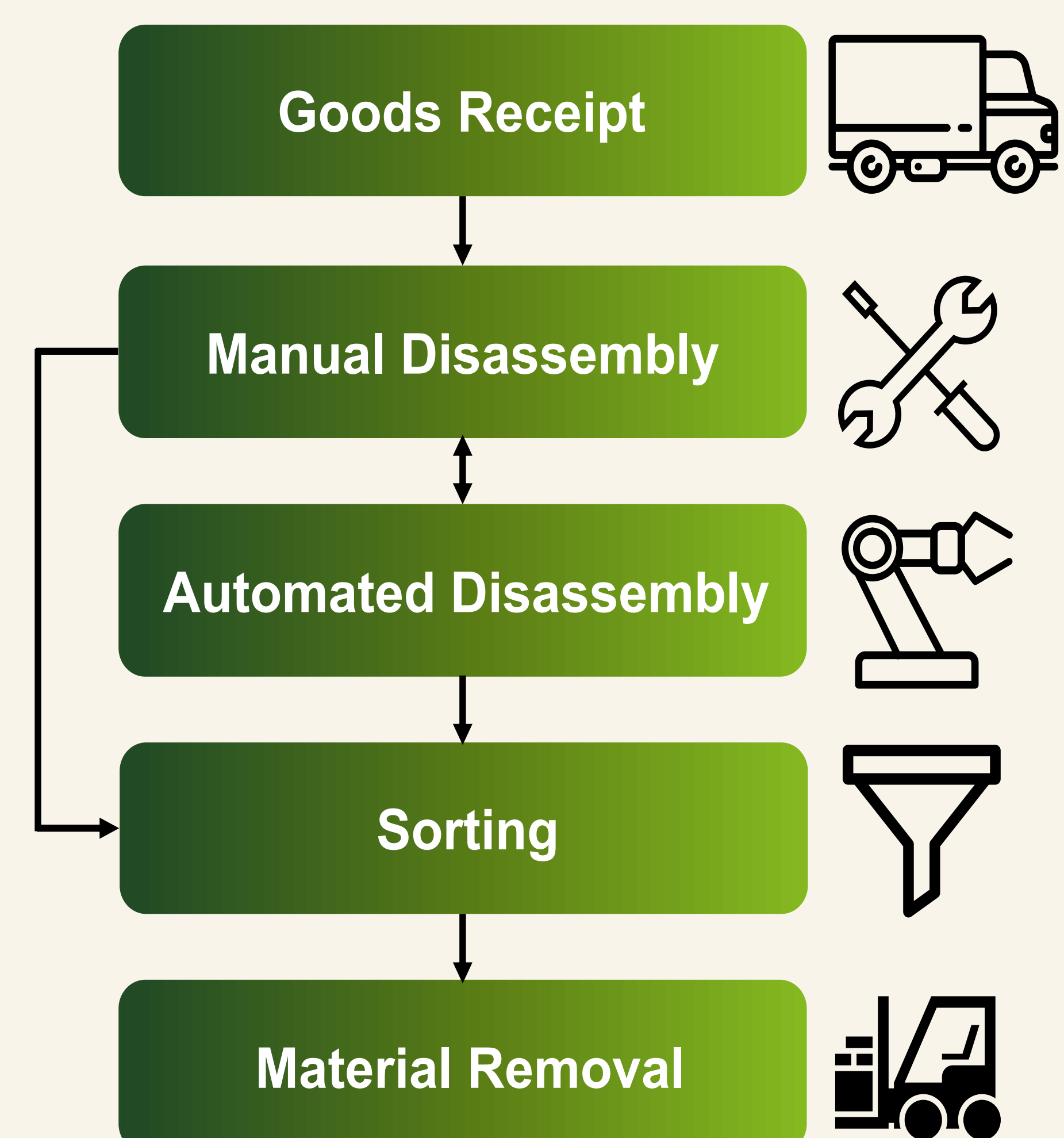
- Successful virtual modeling and simulation of the disassembly process of a vehicle door
- Automated disassembly of four components with material-specific separation and automated material removal
- Continuous representation of material flow within the simulation, providing a stable basis for real system planning
- Optimization of robot path planning for collision-free and time-efficient motion sequences
- Risk assessment to analyze potential bottlenecks in the material flow

Use Case

Due to its structural complexity and heterogeneous material composition, a vehicle door is particularly suitable as a demonstrator for the investigation and development of disassembly processes.



- Manual disassembly of the vehicle door to systematically record all components and fastening elements
- Conducting a material flow analysis to identify material types and quantities
- Categorization of materials according to their material properties and recycling potential
- Derivation of process flows for the structured and efficient implementation of disassembly



- Established a foundation for structured workflows for operators
- Clear definition of interfaces to downstream process areas
- Ensured a controlled transfer of materials to subsequent processing steps

