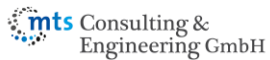## The Circular Manufacturing Ecosystem (CME)

To enable the CME, an ontology will first be developed to capture the requirements of factory owners, considering not only technical but also social, environmental, and economic aspects. The supply of second-hand and new production resources will be managed in an online marketplace. In the second step, an artificial intelligence (AI) algorithm matches the requirements with the available resources. The assembly line proposed by the AI is modeled using a digital shadow for the purchase decision and the planning of the new line. A plug-and-produce middleware is developed for the assembly and commissioning process, enabling the integration of second-hand equipment into the line. Finally, a digital twin will be provided for the new line to speed up commissioning and manage the plant in operation. The project is accompanied by a regular ethical and ecological evaluation of the technologies used and the development of the novel Circularity-as-a-Service business model.

Consortium

TUM · TU Graz · DIN · mts Consulting & Engineering GmbH · YAGHMA · Continental · netcompany intrasoft · ECI MECHATRONICS · surplex · IMT Atlantique Bretagne-Pays de la Loire École Mines-Télécom · COMAU · LMS Laboratory for Manufacturing Systems & Automation
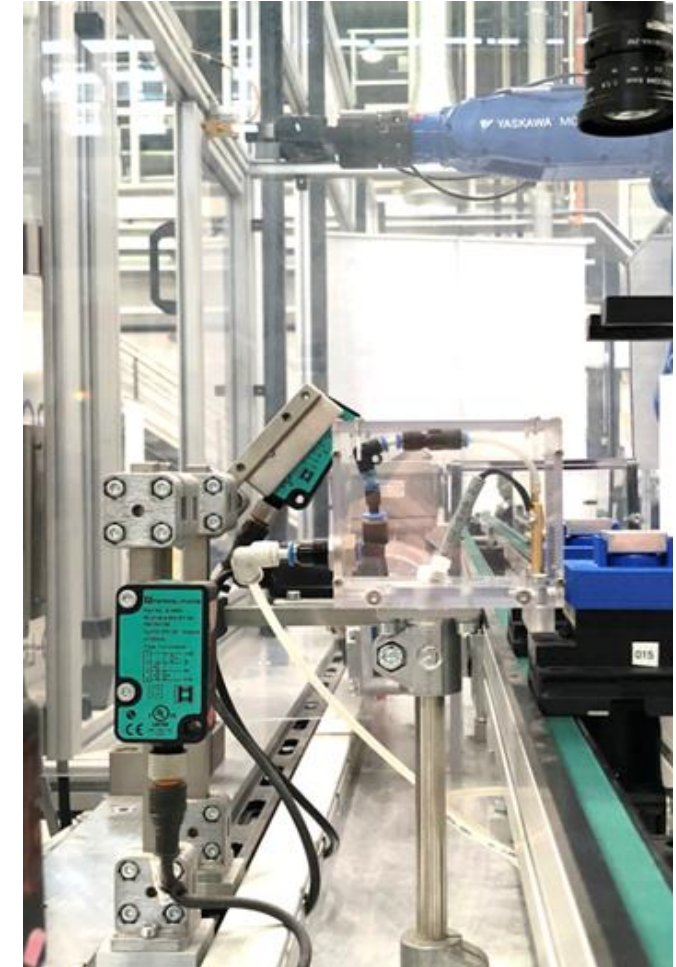
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ALICIA

Assembly Lines in Circulation – smart digital tools for the sustainable, human-centric, and resilient use of production resources

Circularity for Production Resources

The project ALICIA aims to develop a Circular Manufacturing Ecosystem (CME) for production lines, which will be demonstrated in two industrial use cases. By using second-hand production equipment, the material and energy requirements of new production lines are to be reduced by 70 to 80 %, and a reuse of up to 100 % of the equipment is to be achieved.

Initial Situation

Currently, production resources do not reach the end of their life cycle and are prematurely taken out of service, resulting in resource wastage. Reusing these resources is a promising way to reduce waste and promote the evolution of the circular economy. Additionally, the reuse can mitigate disruptions in global supply chains, such as those caused by the COVID-19 pandemic. However, the reuse of used production equipment is hindered by several challenges. First, the lack of compatibility between generations of equipment and manufacturers is a barrier that must be overcome. Furthermore, the difficult estimation of the remaining lifetime of the used equipment and the lack of availability of a Europe-wide marketplace for used equipment impedes the reuse. The project will address these challenges to pave the way towards the CME and resource reuse.
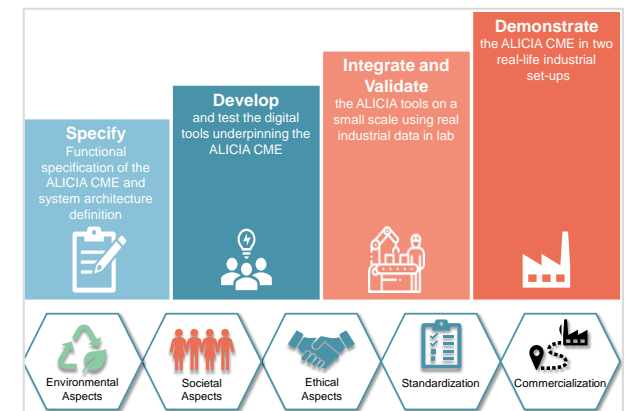
Objectives and Methodology

- Build a novel standardized framework for capturing factory owner and factory staff requirements related to production lines to pave the way for seamless data/business process exchange between various stakeholders in the value chain (suppliers of second-hand assets, machine builders, system integrators, providers of remanufacturing or recycling services)

- Develop a **set of integrated digital tools** (AI-matchmaking engine, Digital Shadow, and Plug & Produce middleware) to provide factory owners, their engineers, and technicians with a one-stop-shop service for planning, constructing, ramping up, and running second-hand production lines in a sustainable way

- **Integrate all ALICIA digital tools** developed in the first two objectives into a **small-scale system** and test it in a controlled environment ("small scale CME") by connecting it to the existing Market 4.0 online marketplace and a secondhand production resource database, and running tests on real data

- **Conduct real-life demonstrations** of the ALICIA CME in two industrial environments at the use case partners Continental and Comau

- Analyze **framework conditions** and prepare **commercial uptake** post-project
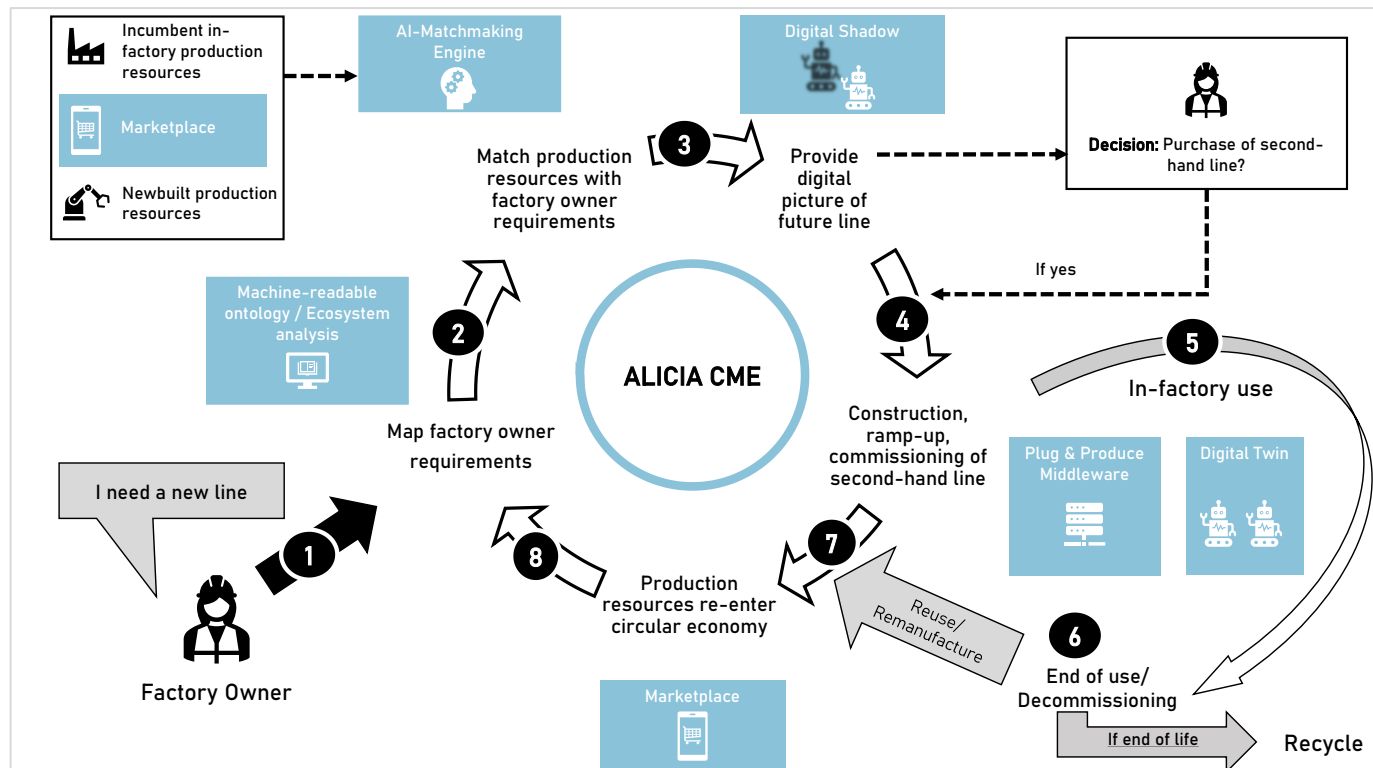
Concept of the ALICIA Circular Manufacturing Ecosystem (CME)

Methodology of the project