Master Thesis Proposal – Robotic disassembly cell for circular economy

1. Global information

Title of the research project	**Robotic disassembly cell for circular economy : Robotic and automatic process proposal**
Laboratory name	I2M – Institut de Mécanique et ingénierie Bordeaux
Information about the future supervisor in the laboratory	Pr. N.PERRY, Dr. R.CHAVANNE
City and country where the project will be performed	Bordeaux
KIMP tracks concerned	DM
Constraints (language, nationality or more specific…)	Laboratory with restricted area
Period of the Master Project	February to End of August

2. Scientific and Problem definition

Scientific issue (the scientific problem written as a question): **?**

How integrates Industry 4.0 technology into Circular Economy process to improve functional components and module recovery

Keywords (a selection of 3 maximum):

Circular economy, Industry 4.0 technologies, Decision making

Description of the problem and the context:

The intensification of circular economy needs to take technologies from industry 4.0 (digitalization, robots and cobots, AI, augmented operator, digital chain …) applied to End of Life of products.

Circular economy can be seen as recycling, but we want to promote higher value recovery thanks to components or module recovery. Theses elements have still residual functionalities (or value: economic, environmental, resource..) at the End of Life of the product.

As illustrated bellow, we are developing a multi-technology human-robot automatic cell to test and define some potential disassembly lines to face products such as electric motors, power converters, big electric wastes (WEEE), and later battery, H2 PAC or other products related to the Extended Responsibilities of Producers (sports and leisure, gardening …). The platform development involves 6 French laboratories and industrial partners and start at the end of 2022.

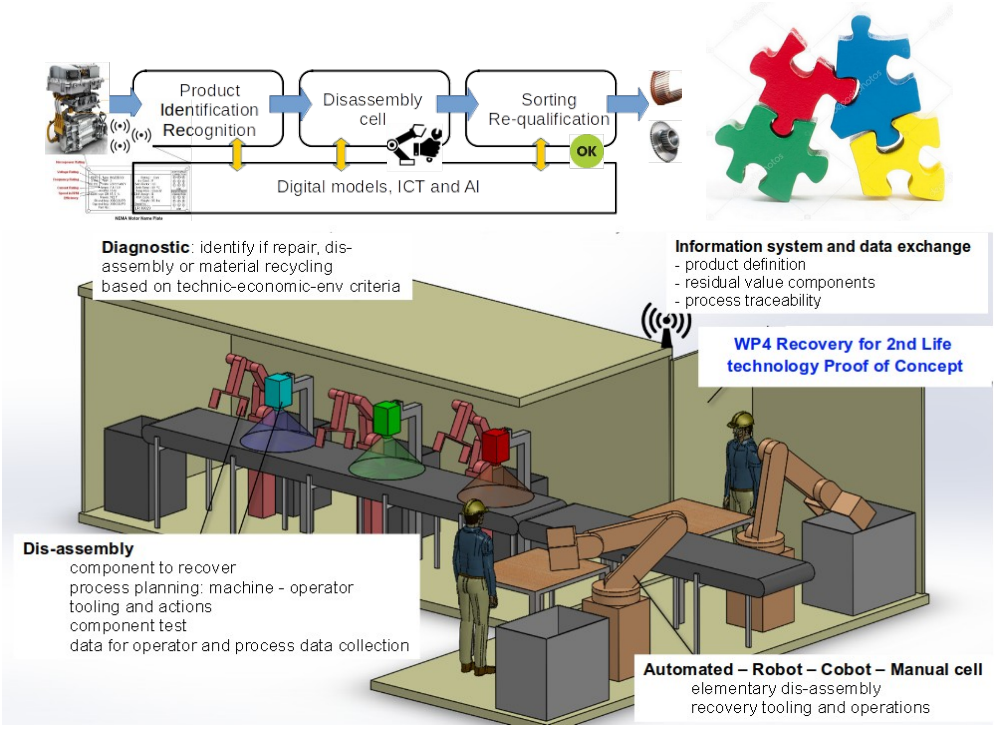

Figure 1: functional description of the SDC2 Project (Smart Disassembly Cell for Circularity of WEEE, e-Motors & Power-converter)

Many challenges must be studied in this work. The master will be done in collaboration with PHD students and Engineers. Here are some example of key aspects to work on, not all of them will be studied by the master student, it will depend on the progress of the platform development.

- Identification of components and assembly solutions, based on a library of component (mechanical, electrical) and assembly solutions. Several digitalisation options should be used to face the challenge of corrosion, hurts and all the real life effects on products. This is typically the main input of the digital chain needed to support all the activities. This digital chain must be designed as an IS architecture with open option for future inputs and data (new type of products, new technologies, new data ..)
- Disassembly and sorting systems must be developed, tested, and adapted to a large panel of product. This should be develop with the product handling system, and combine with options of fully automatised, multi robots, human and cobots operations.
- Component value quantification must be proposed, based on models and data related to economic and costs, environment and CO2, resource and criticality, scarcity… This evaluation should focus on the most valuable component to recover on a product.
- An automatic disassembly process plan will be developed (knowledge based or full AI ?) . It will propose the different process operation (mixing human, robots or cobots operators) and the handling and tooling of the product disassembly. It will also give the good information to the operator with augmented reality solutions.
- Digital certification of the disassembly process in order to avoid product recovery certification thanks to physical tests ; virtual qualification could ease the component guarantee.

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This Master thesis will be involved in one or two of this different topics, but with the objective of a global integration, and the applicability to different type of product (same family but different size, and different family).

This subject is included in a bigger project, the exact activities will depend on the state of the ongoing work done in the project.

Detailed work to do

The work carried out will focus on the implementation of robotic / cobotic technical solutions for the robotized cell. Several actions will be carried out in connection with :

- handling of parts and products to be disassembled and their tooling
- disassembly operations and definition/integration of tools and end-effectors on robots/cobots or in manual use
- synchronization of multi-resource operations (several robots or automatic systems / operators with cobots)
- information input by workstation or operation to support actions and gestures (using augmented reality or product information displays)
- in-process information gathering to prepare traceability and qualification of disassembled parts and systems

<u>References (3 references + 1 reference from CIRP community):</u>

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J. Martinez Leal, S. Pompidou, C. Charbuillet, N. Perry (2021) Design for and from Recycling: A Circular Ecodesign Approach to Improve Circular Economy, Sustainability 12(23), p.9861

<u>Salary and terms:</u>

French Internship minimum salary (around 600€/month)[1]

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<u>More references :</u>

[1] https://www.legalplace.fr/guides/remuneration-stage/

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Ref from Research. Team

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