

## Proposal for Research Master Internship

### Evaluation of environmental benefits of Smart Product-Service-Systems

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**Keywords:** Environmental assessment, Product-Service-Systems (PSS), Industry 4.0, Life Cycle Assessment.

**Industrial Collaboration:** elm Leblanc, Bosch Group

**Location:** Mines Saint-Etienne, FAYOL-GEO

**Description** AT the heart of industry 4.0, Industrials are developing integrated offers of “Smart Product-Service Systems”. The objective of this research work is to contribute proposing a method to evaluate the quantitative environmental benefits of implementing a Smart Product-Service System (PSS) offering, from a multi-actor perspective, in the specific application field of Heating Systems. On the one hand, this evaluation could consider environmental aspects such as resource consumption, energy and water consumption, the environmental protection standards, toxic and greenhouse gas emission, and waste generation. On the other hand, it could consider aspects of circular economy including the upgradability of the Smart PSS offering (multiple usage cycles) and end of life for the heating systems.

This Master is developed in collaboration with the elm Leblanc company (Bosch Group), manufacturer of heating systems. Thus, based on existing approaches of environmental assessment (Certainly with a focus on Life Cycle Assessment approaches), the main goal is to propose an easy-to-implement method to evaluate a Smart PSS offering focusing in the specific field of the residential heating industry.

The Master is developed within a collaborative research team, including a PhD Student working on PSS design.

The master goals include:

- State of the art of life-cycle oriented methods and approaches to evaluate quantitatively the environmental impacts, with two complementary focuses: (i) methods proposed for traditional PSS and Smart PSS offerings; (ii) methods proposed for Heating systems and offers.
- In relation with the industrial context, analyze of the 2 life cycles of (i) traditional heating systems and (ii) smart PSS for heating systems from the environmental point of view: identification of the flow with environmental impacts; prioritization of the more important factors for environmental assessment; Proposal of a model for heating systems life cycle model.
- In collaboration with the team, define the frontiers of the system to be assessed. Then, analyze the data necessary for the environmental assessment and identify limits in data accessibility, potential hypothesis required as well as pertinent granularity level for the model.
- Referring to the industrial case study elm Leblanc, propose the conceptual definition of a rather simple environmental assessment method, which could evaluate, at design time, the key environmental factors identified. The simplicity is required for a possible industrial application. The objective of the method is to compare environmentally alternative PSS solutions proposed during the design process.
- On a limited case study, make a first step towards implementation of this method (we think life cycle assessment approaches should be the more pertinent). This includes to configure a consistent set of indicators required for the approach and to apply a Life Cycle Assessment tool on first experimentations with the data of the case study.

**Student Profile:** Involved in a Master Program with research orientation, from an Engineering School or University, with some first competencies in one or several of these fields:

- Basics on industrial systems: System Design, Industrial Engineering, Decision-making methods for product design
- Methods : Environmental assessment, Eco Design (EcoConception), Life cycle assessment
- Tools : SIMAPRO, GABI, Open LCA

French skills would also be a positive point, however this is not a constraint.

#### Candidature

- To be sent by electronic mail to Xavier Boucher ([boucher@emse.fr](mailto:boucher@emse.fr)) and Jonathan Villot ([villot@emse.fr](mailto:villot@emse.fr))
- Curriculum Vitae / Evaluations of Bachelor of Master Cursus / Motivation letter