

## PhD in Industrial Engineering / System Design:

### Design of integrate Product-Service-Systems, with configuration of value creation networks and economic models – Application to individual or collective heating systems

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**Doctoral School :** Ecole Doctorale SIS, Ecole des Mines de Saint Etienne et Université Jean Monnet.  
**Fundings :** By the company ELM Leblanc (BOSC Group, <https://www.elmleblanc.fr/>)

**Key words:** Integrated Design, System Design, Decision Making, Economic model simulation and evaluation, Value network modelling, Product Service Systems (PSS).

#### Context and objectives

ELM Leblanc, member of Bosch group, is a major international actor in the field of design and manufacturing of heating systems for individual or collective usage. As part of its innovation strategy, ELM Leblanc is currently designing new generation of heating systems integrating ‘connected objects’ (IoT), able to provide better regulation functionalities for a lower energy consumption.

The overall objective of the thesis is to develop an integrated design method, applied to Product-Service-Systems. This method will include the capacity to design and configure efficient value network based on partnerships to deliver services offers which will be associated to the technical heating systems themselves. The design method will provide decision-making approach for economic risk management for the various stakeholders of the value network. The research work will develop design tools integrated within the overall method:

- Modelling tools, to support the design various alternative scenarios of value creation linked to the design of the product-Service-System (heating system with connected objects) ;
- Design method and tool to anticipate the value expectations of the various actors, and the potential difficulties linked to value sharing;
- Design method and tool to simulate and balance alternative economic models for the multi-actor value network under design, and to confront it to the potential ecological impact (lower energy consumption).

The different aspects should contribute to manage the deployment risks associated to the technological innovations.

To develop this approach, two complementary scientific domains and methods are expected to be utilized:

- Qualitative modelling approach to support system design. Typically, the ‘conceptual modelling’ methodologies (Karagianis et al., 2016) can used to formalize and implement a modelling language specifically dedicated to the representation of value networks during the design process (Boucher et al., 2016).
- Quantitative methods of ‘Simulation under uncertainty’(Chalal et. al. 2015, Buxton at al., 2003). Such methods could model the uncertainty induced by the behaviors of users (and other actors in the value network) in order to anticipate the impacts of these behavioral parameters both on the economic balances for the various actors of the value network and on the ecological impacts. The objective is here to simulate both the economic and ecological performance of value network, in order to support the integrated design process.

## Candidat profile

Diploma from an engineering University/School, with a Master of Science in one of this key field : Mechanical engineering, Industrial engineering, Manufacturing systems design, System design.

Skills on some of the following topics:

- Integrated design of systems
- Modelling and design of production systems (or value chains)
- Decision-making / Decision Support Systems
- Uncertainty modelling and evaluation
- Performance evaluation applied to value chains or production systems (notably economic performance)
- Simulation of industrial systems

## Candidature

The candidature will include

- Curriculum Vitae
- Motivation letter
- Student Transcripts for the last years of studies
- Recommendation letters

Please send the candidature in electronic version to Pr. Xavier Boucher, [boucher@emse.fr](mailto:boucher@emse.fr)

## References

Boucher X., Medini K., Fill H.G., “Product-Service-System Modelling Method”, Book Chapter, in Domain-Specific Conceptual Modelling: Concepts, Methods and Tools, Edts Dimitris Karagiannis, Heinrich C. Mayr, John Mylopoulos, Springer Edition, 2016, ISBN 978-3-319-39416-9.

Buxton, D., Farr, R. and Maccarthy, B., 2003. The Aero Engine value chain under future business environments: using agent-based simulation to understand dynamic behaviour. In Proceedings of MITIP. pp. 11–12.

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Idrissi N., Boucher X., Medini K. Generic conceptual model to support PSS design processes. Proceedings of IPSS 2017, 9th CIRP IPSS Conference : Circular Perspectives on Product/Service-Systems., 19-21 June 2017, Copenhagen, Denmark.

Karagianis D. Mayr H.C. Mylopoulos J., 2016. Domain-specific Conceptual Modeling – Concepts, Methods and Tools, Springer, 2016.

Medini K., Boucher X., Value chain configuration for PSS delivery – evidence from an innovative sector for sludge treatment, CIRP Journal of Manufacturing Science and Technology (2016), Vol 12, pp. 14-24, DOI information: 10.1016/j.cirpj.2015.10.003

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