COMMUNAUTÉS DE RECHERCHE ACADÉMIQUE Rhône-Alpes

INDUSTRIALISATION ET SCIENCES DE GOUVERNEMENT

Internet website: http://www.arc8-industrialisation.rhonealpes.fr/

PhD Title: Generate, follow, capitalise knowledge transformation occurring between product designers and environmental experts activities

1. **ARC 8 topic concerned:** design and innovation of products and sustainable services
2. **PhD supervisors**

- First PhD Supervisor: Dr. Andreas Riel (Prof.)
- Secondary PhD Supervisor: Dr. Maud Rio (Associate Prof.)
- Phone: +33 4.76.82.51.56
- E-mail addresses: andreas.riel@grenoble-inp.fr, maud.rio@g-scop.eu
- Laboratory: G-SCOP - http://www.g-scop.grenoble-inp.fr
- Employer – 3 years contract: Grenoble University - http://www.univ-grenoble-alpes.fr
- Doctoral School of attachment:
  IMEP2 - http://www.adum.fr/as/ed/page.pl?site=edimep2&page=accueil

3. **PhD research subject presentation**

In a sustainable world tomorrow's industries would anticipate on the environmental burden of every life cycle stage of the products and services they are developing to minimise their global footprint. In that world there would probably be as much ecodesign practices as there are industrial contexts: aligned with company strategies, with the management processes, with the internal operational activities and supports, the technologic domains, the product types, the experts involved within the supply chain, etc. Ecodesign can be considered at the product designers scale (design process). Their tools, their skills, as well as the organisational design processes in which they are collaborating would in this sense be the focus of the research.

Observing how is performed ecodesign in industry shows that an environmental expertise is requested during the design process. However the capacity of product designers to be proactives regarding the environmental expertise is necessary to allow ecodesign practices. Product designers would be proactives if they had the capacity to dynamically exchange information with the environmental expert as early as possible during the design process. This exchange would be in regard to their proper requirements and focus. The environmental expert would then deploy the adapted environmental assessment tools to answer accordingly to product designers. A transversal piloting device would be additionally requested to manage the realignment of the local designers proactivity with the context of the design project in the company. The resources available or global sustainable strategy of the company would be important aspects of this context.

Improving ecodesign practices in industry is included in the *Collaborative Life Cycle Engineering* field of research. The environmental dimension is viewed as additional to the usual quality-cost-delay considerations over the life cycle stages of the product under development. Industries and researchers have therefore showed that a number of functions were required to allow the previously-described proactive situation to occur [Riel et al. 2010]. To name some, but many:

- Sharing available life cycle information about the product under development;
- Allowing an evolving environmental expertise along other product design activities: having accessible tools, diversified and specific knowledge [Knight and Jenkins 2008] (in particular,

transversal environmental tools, such as Life Cycle Assessment (LCA)), as well as support to share environmental constraints;

- Providing stakeholders views of the product [Roucoules and Tichkiewitch 2000]; in particular a "local view" (*i.e*. for each product designer) and transversal or "global" one (embracing the multi-constrained and systemic environmental dimension) [Zang et al. 2013];
- Promoting information translation mechanisms between the environmental expertise and stakeholders whose choices influence the environmental footprint [Rio et al. 2013];
- Co-constructing the explicit knowledge [Polanyi 1966] between stakeholders and environment experts.

Information System of the company (IT support) usually supports those functions. By definition the application of the company strategy by every service and operational activities are made possible by the IT support (*e.g.* to ecodesign the products). Computing devices, electronic and human applications are combined to organise, and to spread the information through the company. The IT would therefore harmonises the technological and managerial (*Knowledge Management (KM)*) approaches together, as well as integrating the experts involved, including the environmental one (*cf*. [Grunstein, 2006] approach).

In some case the IT facilitates the information exchanges between the product designers tools and the global environmental ones [Wijk, 2011]. However an environmental expert is requested to manage the information flow, and, at least, to analyse the environmental results. In practice the environmental expert is facing some difficulties to share data with multi-domain product designers (knowledge and tools): technical limitations regarding standards, lack of modularity and flexibility, semantic losses associate to the information exchanged exist, etc. To summarise, a dynamic feedback from the environmental analysis tools to the product designers' activities (contributing to the environmental performance of the product under development) is rarely effective. Possibilities would exist to connect dynamically those tools, and to avoid determinant information losses. Model federation could be used through the FESTivE method developed by [Rio et al. 2014] for instance. Industrial case studies using FESTivE have shown that it is possible to create interoperable systems (federative types) within the exiting design processes of the company (adapted to the software environment of the company: PLM, PDM, expert supports, etc.) to support ecodesign practice by expert activities (knowledge and known-how).

In this context this PhD proposes **to develop efficient knowledge transformations mechanism between product designers and environmental expert activities. The focus would be made on the generation, the management, and the capitalisation of such knowledge transformations**.

Several opportunities have been already identified to generate and support a transformation knowledge route along the product design process, such as the:

- Capitalisation of the information exchanges occurring during a project: process trace, semantic links between information coming from various activities, product and project memories;
- Anticipation of the completion level of heterogeneous models inputs required to fulfil a target (environmental) model: risk evaluation during key decision stages in design;
- Transformation model evolution to support the transition of a product design team integrating the environmental concern to an auto-learning organisation: knowledge view, idea associations, concepts interactions, etc.

A specific method will therefore be proposed by the PhD student to support the generation, the management, and the capitalisation of knowledge transformation occurring between the product designers, and environmental expert activities. The method will be constructed on at least two different industrial case studies to offer a scientific research design context of high quality. The validation of the method proposed will involve the development of an industrial demonstrator combining mock-ups and prototypes.

The *real* design situations studied leading to the *industrial demonstrator* developed during the PhD will be supported by technical, economic and environmental data coming from Rhône-Alpes industries, and from a closed collaboration with relevant external laboratories (*abroad: Prof. Stark from Fraunhofer IPK and TU Berlin in Germany within the CRC 1026: « Sustainable Manufacturing, Shaping global value création »*). The PhD candidate will carefully conduct this collaboration during the three year contract.

This PhD project will be leaded by the G-SCOP laboratory of the Rhône-Alpes region during the 3 years contract. The G-SCOP laboratory members have more than 20 years of expertise in terms integrated design. The integration of environmental concerns within the product design process is of particular focus. A number of effective models and tools have been developed with industries, leading to innovative approaches to reduce the environmental impacts generated during the life cycle of products and services developed. Remanufacturing life cycle models, Product-Service-Systems (PSS), upgrading supports, user centred approaches (etc.) are examples of ongoing research leaded by the G-SCOP in current French and international projects.

Selection criteria of the PhD candidate
Prerequisites:

- Engineering diploma or master in engineering
- Strong interest in the subjects of environmental sustainability and eco-design, as well as in the related processes, methods and tools (in particular LCA – Life Cycle Analysis, environmental impact analysis, environmental regulations)
- Familiarity with design processes and process modelling
- Capability of interdisciplinary thinking and communication (mechanics, electronics, software, etc.)

Appreciated additional skills:

- Practical experiences in the fields mentioned above.
- Good level of English and/or German language (a collaboration with Fraunhofer IPK in Germany is envisaged).
- Process and/or software modelling skills.

Documents to provide to Prof. Andreas Riel (andreas.riel@grenoble-inp.fr) and As. Prof. Maud Rio (maud.rio@g-scop.eu):

- A letter of motivation.
- A Curriculum Vitae (with ranking if any).

Please feel free to contact us for any kind of questions or further information. You may also consult the websites
http://www.adum.fr/as/ed/page.pl?site=edimep2&page=accueil, and
http://www.arc8-industrialisation.rhonealpes.fr/

References of PhD supervisors in this research topic

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[Wijk 2011] Wijk, D. V., Contribution à l'amélioration de la collaboration PLM dans la chaîne de sous- traitance aéronautique, 2011.