

## **ECO-INNOVATION IN SMALL TO MEDIUM SIZED ENTERPRISES: NEEDS AND OPPORTUNITIES FOR ACTION**

*Working paper and speakers' notes*

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*This working paper is based largely on the eco-innovation activities ongoing at the Technical University of Denmark (DTU), in particular including excerpts from references [1, 5, 7, 8, 12].*

### **Why eco-innovation?**

The rapidly increasing diversity and complexity of environmental sustainability challenges faced by industry points at an urgent need for approaches that can deliver step change improvements in the environmental performance of products. Eco-innovation is an approach that has the potential to meet this need [2, 3]. However, despite two decades of on-going research in this area, a relatively low level of maturity is seen in the field, particularly if industry adoption is to be seen as a measure of maturity [5, 6]. An additional concern is that the highly inter-disciplinary nature of eco-innovation means that there is a higher risk of a fragmented research domain resulting, which in turn may lead to poor support for practitioners [9].

The engineering design research community is in a position to contribute to the advancement of the theory and practice of eco-innovation in a number of areas, as the product development process lies at the core of the eco-innovation concept. To capitalise on this potential, it is important to understand the existing body of knowledge and the future research opportunities. This working paper discusses key elements from recent research works on eco-innovation, to provide a review and reflection of on the current status of eco-innovation and to suggest areas where the design community can contribute to developing the maturity of this approach [7]. The working paper is a compilation of recent contributions to the UNEP Eco-innovation manual, the DESIGN conference and local research notes and presentations. As a working paper it is not an externally reviewed manuscript.

### **What is eco-innovation?**

There exist a number of definitions of eco-innovation, but for the work of the group behind this working paper, two main definitions are dominant. The first definition comes from James, who states:

*"Eco-innovation aims to develop new products and processes which provide customer and business value but significantly decrease environmental impact." [3]*

To supplement this and provide a more operational framework for eco-innovation, the recently produced UNEP Eco-Innovation Manual (the authorship of which was headed by a group including the authors of this working paper) created its own operational approach to eco-innovation, defined as follows:

*"Eco-innovation is the development and application of a business model, shaped by a new business strategy that incorporates sustainability throughout all business operations based on life cycle thinking and in cooperation with partners across the value chain. It entails a coordinated set of modifications or novel solutions to products (goods / services), processes, market approach and organizational structure which leads to a company's enhanced performance and competitiveness." [8]*

A conceptual model of eco-innovation that is based on the UNEP definition is shown in Figure 1 below.

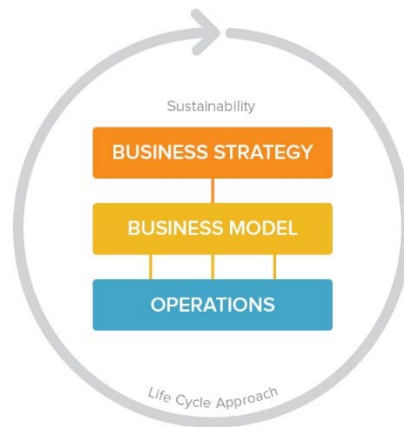


Figure 1 - Conceptual model of eco-innovation [8]

### Why do companies need to eco-innovate?

In recent decades, there has been a growing recognition amongst manufacturing business leaders that sustainability challenges such as climate change, worker welfare and resource constraints are having a significant impact on the way manufacturing companies do business. These sustainability challenges give rise to drivers for change in the way that companies operate. Sticking with the ‘business as usual’ approach will leave companies unable to respond to issues such as rising energy costs, disruptions to supply of their raw materials or changes in legislation. Ultimately, companies that do not take action now run a higher risk of failure when these issues inevitably take effect in their industry [8].

There is therefore an increasing need to find alternative approaches that can help to address sustainability-related business drivers, whilst at the same time offering opportunities for growth, cost reduction and competitive advantage. Eco-innovation is an approach that aims to fulfil these multiple requirements by identifying the key sustainability challenges and opportunities and then using these to drive changes throughout the company and its value chain, from the business strategy and business model, through to the operational level [8].

Figure 2 highlights some of the pressures and drivers for companies to consider eco-innovation, taken from UNEP’s publication “Business Case for Eco-Innovation”.

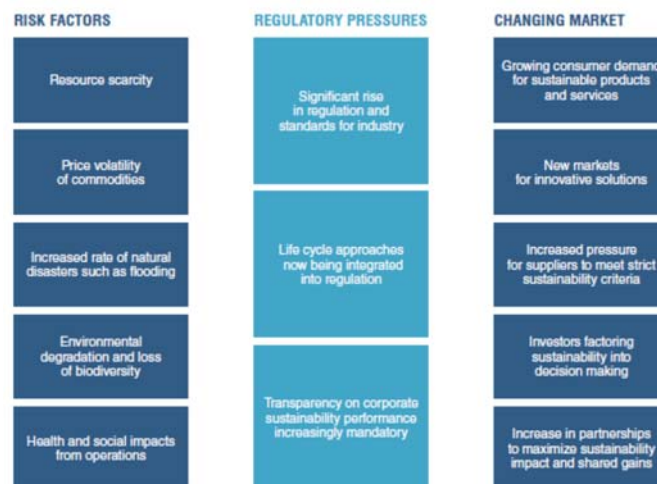


Figure 2 - The world changing and its potential impacts on business [1]

## What is the potential impact of eco-innovation?

There is no doubt from the literature that eco-innovation is seen as being the most promising answer to many of the problems and external pressures (business-led, society-led and nature-driven) that mankind is encountering regarding the achievement of sustainability. In their recent eco-innovation project, UNEP has boldly described everything other than eco-innovation as “tinkering around the edges” of the environmental and sustainability problem, see Figure 3.

### What is the potential impact?

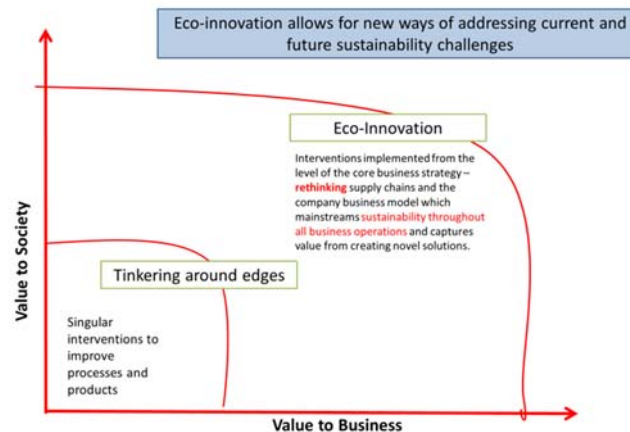


Figure 3 - The potential impact of eco-innovation [1]

## What does eco-innovation entail?

In our paper from DESIGN 2014 [7], we dissected James’ definition of eco-innovation (Eco-innovation aims to develop new products and processes which provide customer and business value but significantly decrease environmental impact) in the following manner:

- ‘...develop new products and processes...’ = engineering design
- ‘...which provide customer and business value...’ = strategy and management
- ‘...but significantly decrease environmental impact’ = environmental science

This led us to a conceptual model of eco-innovation, as seen in Figure 4.

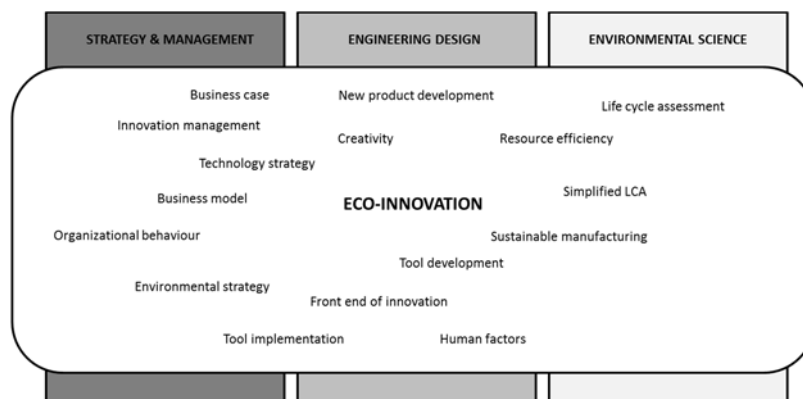


Figure 4 - Conceptual model of eco-innovation [7]

The conceptual model led us, in the DESIGN 2014 paper, to investigate the contents of eco-innovation, by studying the related fields of research and professional activity that would be beneficial to include in a consolidated model of eco-innovation.

Referring to figure 4, in the area of STRATEGY AND MANAGEMENT, the consideration of the **business case** is paramount. Eco-innovation is reliant on the creation of new business ideas and proposals that are mature in their consideration of cost-benefit, so this area is important to include in such a model. **Innovation management** is also important, as this covers the consideration of how to nurture an innovation project to completion. Innovation management is necessary to understand, as the innovation process is necessarily quite different from “business as usual” in a company. **Technology strategy** is also an important focus area, not least as a great deal of potential environmental improvements can be achieved by understanding how to attain systematic technology improvements to the products and equipment that are utilised in providing desired utility to the user. The **business model** is extremely important to understand and to master, so that all aspects of a new and innovative idea for eco-innovation can be considered, conceptualised and communicated, in terms of the main value proposition and also the necessary inputs and desired outward channels and customers of the new solution. Depending on the level of change through the eco-innovation concept, the company may undergo sincere changes in the way in which it organises itself. The field of **organizational behaviour** is therefore also interesting and important to consider. Finally, from a strategic perspective, it is clear that **environmental strategy** is paramount to consider, when working with eco-innovation; without such, any company would not adequately be able to measure its success and improvement.

Referring to figure 4, in the area of ENGINEERING DESIGN, it is clear that **new product development** (NPD) is a field that can lend a great deal of wisdom and methodology to the act and process of eco-innovation, ensuring that the eco-innovation process is systematic, repeatable and considered. Needless to say, **creativity** is a virtue that any form of innovation has a need for, whether it be addressed at the main problem itself, or a subcomponent hereof. Creativity can be trained, through techniques and through practice. **Tool development** is an activity that lies very firmly in the engineering designer’s resort, with the large majority of tools and methods for both engineering design and eco-innovation coming from the engineering design community. Tool development is closely related to **tool implementation** (shared with category STRATEGY & MANAGEMENT), which describes the activity of laying out a methodological approach to eco-innovation, ensuring that the necessary toolbox exists to aid the implementation of eco-innovation, aided by tools. **Front end of innovation** describes the early stages of the NPD process, where the creative ideas begin to take form, into concepts of eco-innovation solutions. Finally, **human factors** are important to consider, both when designing eco-innovative solutions and also when designing the eco-innovation process itself. Human factors is not traditionally a field that is seen close to the engineering design domain, but recent years have seen an increasing awareness and understanding of the need and merits of considering human factors in design.

Referring to figure 4, in the area of ENVIRONMENTAL SCIENCE, it is clear that the act of eco-innovation will require a number of important areas to be considered. **Life cycle assessment** is a well-established approach to creating an assessment of the environmental footprint of a product, service or system, which helps the designer to set improvement goals for the forthcoming eco-innovation project. The nature of innovation and also the nature of some of the projects that are characterised as eco-innovation projects leads to the need to find faster, more abridged ways of getting an overview of environmental footprints. Therefore **simplified LCA** is an approach that will lead to a greater usability of LCA approaches earlier on in the eco-innovation process. **Resource efficiency** (shared with category ENGINEERING DESIGN) is often seen as the precursor (and sometimes the predecessor) to eco-innovation, and focuses on how to get the most functional unit out of the least effort, materials and/or energy as possible. Although resource efficiency is seen as being an increasingly reductionist approach (especially when compared to e.g. eco-innovation,

Cradle2Cradle), the field is vitally important for eco-innovation as it is very rich in tools and methods for environmental improvement. Finally, **sustainable manufacturing** (shared with category ENGINEERING DESIGN) is an important contributory field to eco-innovation, as there lies a wealth of information, methods, tools and cases, regarding the successful transition of certain manufacturing forms to sustainability.

### Simply the sum of the parts?

So is eco-innovation merely the sum of the parts described in the previous section? The simple answer to this question is no – however, there are many contributory fields and approaches that are akin to eco-innovation and that can be collected to create a solid basis for eco-innovation as a methodology and an innovation strategy. In the next and final section of this working paper, we will introduce some of the new elements that we bring to eco-innovation, through our collaboration with UNEP.

### The UNEP Eco-innovation methodology

Through a close collaboration with UNEP on a global eco-innovation project running from 2013-2016, we have created a methodology for eco-innovation. The methodology builds on the many contributory fields to eco-innovation described in the previous section of this paper, plus a bespoke eco-innovation process that has the clear purpose of assisting small to medium sized enterprises in developing economies around the world. The methodology is described in a manual and has six phases: PREPARE, SET STRATEGY, SET BUSINESS MODEL, BUILD ROADMAP, IMPLEMENT, and REVIEW - see Figure 5.



Figure 5 - UNEP Eco-innovation methodology [8]

Each phase – and corresponding section of the manual – consists of an overview of the phase, a description of the main content, a checklist of activities, a list of supporting tools and a link to important references and resources. In addition to the manual, we have created an eco-innovation tools supplement to the manual, consisting of eighteen eco-innovation tools.

The UNEP eco-innovation methodology was developed in close cooperation with experts and potential users of the manual and methodology from five global regions: East Asia; West Asia & Middle East; Eastern Europe & Russia; Africa; and Latin America & Caribbean. This first development and test period took place in 2013-2014. Upon completion of the first full draft of the methodology, the manual was subsequently tested on a number of “live” eco-innovation projects globally, in the period 2014-2015, after which time the final version of the manual is scheduled to be edited and published.

### What can the engineering design research community contribute with?

As we have detailed in this working paper, eco-innovation is well underway and there are a number of activities in action already. But as engineers, what is there for us to contribute with? In our paper from DEISGN 2014 [7], we point at ten opportunities for how the engineering design research community can help with eco-innovation. These ten opportunities are as follows:

1. Contribute to a widely accepted typology of approaches to environmental product design
2. Produce a comprehensive and rigorous review of tools to support eco-innovation
3. Give guidance on when and where eco-innovation is relevant
4. Initiate collaborative research at the interfaces of ‘strategy & management’, ‘engineering design’ and ‘environmental science’
5. Carry out studies of eco-innovation implementation
6. Ensure greater reporting of case studies of failures
7. Continue to contribute methodological innovation
8. Bring design thinking to business model innovation
9. Help to understand the role of LCA in supporting eco-innovative product development
10. Develop an interface with policy research and engineering research [7].

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