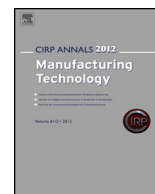


Contents lists available at [SciVerse ScienceDirect](http://www.sciencedirect.com)

## CIRP Annals - Manufacturing Technology

journal homepage: <http://ees.elsevier.com/cirp/default.asp>

# An engineering platform to support a practical integrated eco-design methodology

Maud Dufrene, Peggy Zwolinski, Daniel Brissaud (1)\*

Université de Grenoble Alpes, G-SCOP Laboratory, 38000 Grenoble, France

## ARTICLE INFO

## Keywords:

Product development  
Environment  
Eco-design methodology

## ABSTRACT

Eco-design is now popular and companies ask for support in implementing in everyday work. Dedicated methods and tools were first developed but an engineering platform is now needed to professionalize eco-design activities. The paper defines the integrated eco-design methodology developed for company product development in a project team and integrating both environmental assessment and improvement advice techniques.

© 2013 CIRP.

## 1. Introduction

Concurrent engineering supports the different points of view to be taken into account to achieve the best compromise in a product development process [1]. A point of view is the vision and expertise of an expert involved in a design team [2]. An expert can see the product under consideration in a particular phase of its life cycle from his own perspective and then he can describe the objectives and the constraints that the product will meet at a particular stage of its life cycle. This concept of perspective allows him to express the objectives related to the product. The different experts' viewpoints have then to be considered simultaneously to make the final solution emerge. The approach that supports this viewpoint integration is called integrated design [3]. Thus, integrated design is a practice to integrate different values of the product life cycle in the early phases of the design process, values that include not only the primary functions of the product, but also aesthetics, manufacturability, assemblability, recyclability [4,5]. The question raised in this paper is: How to support the integration of eco-design activities in a design team, knowing that numerous expertises are addressed by the environmental concerns.

Eco-design projects are very various in nature [6]. A first approach could be the integration of new experts into the design team. But design teams cannot continue to grow at the pace of the integration of every new expertise and as highlighted by Asquin et al. [7], this form of organization may leave some employees distraught. A second solution is to ask a team member to assume multiple roles by becoming multi-experts. The example of quality engineers who are now Quality/Safety/Environment expert illustrates it. The difficulty here is mainly due to the fact that increasing the number of areas of expertise of the same person will inevitably reduce its level of expertise. A third option is to support the integration of the new expertise by tools and methods. Therefore expert knowledge and skills are made available for the project. For environment-based knowledge, dedicated methods and tools were

first developed but did not achieve the expected performance because of their difficulty to be used coherently and complementary. Researchers and professionals are now working together to develop engineering platforms to professionalize eco-design activities. The paper presents the platform we are developing in a collaborative project with industry. Section 2 provides fundamentals on the specificities of the environmental expertise integration and the main existing approaches. Section 3 proposes the platform and the methodology developed. Then Section 4 concludes the work.

## 2. Integrated design and eco-design

### 2.1. The integration of the environmental point of view

Given the definition of integrated design, eco-design results in the introduction of an additional perspective in integrated design teams: the environmental point of view. Specificities of this knowledge are

- As Bovea and Pérez-Belis [8] said, eco-design needs integrate early the environmental point of view while considering the entire product life cycle with a multi-criteria approach. These "life cycle" and "multi-criteria" approaches are the core pillars of any environmental assessment to prevent the transfer of environmental impacts when changing product solutions.
- Another feature is that a huge variety of data is necessary for conducting environmental assessments and for advising product improvements. These data are both technical and organizational. Moreover they can be outside the company, from the material extraction to the product end of life. This requires the involvement of all divisions of the company [9] and it implies new strategic decisions that affect the organization and relationships with customers and suppliers.
- Due to the novelty of the environmental expertise, there is always a "green wall" [10] because of the separation of "environmental divisions" and conventional structures. But all the company's business is concerned by eco-design. Thus, to promote relational flows within and outside the company, the

\* Corresponding author.

creation of a new network of internal and external actors and changes in the way the project teams functions are needed.

- New tools and new knowledge have been developed and are candidate to operate in the product development process [11] technical and management aspects. This leads to define new indicators, to handle new data, to implement new procedures, but also to consider a new value when defining the company objectives. The environmental value makes the transform the hierarchy of company values under strategic discussions and may lead to reconsider the offering to consumers.

### 3. Proposal: the eco-design methodology and the platform

The elements needed to support the methodology are first presented: the involved stakeholders, the tools for project management support, the tools for operating design activities and the vehicles of the environmental information. The methodology is then explained. Fig. 1 represents the main elements of the platform. Different stakeholders are likely to develop products using the different tools of the platform.

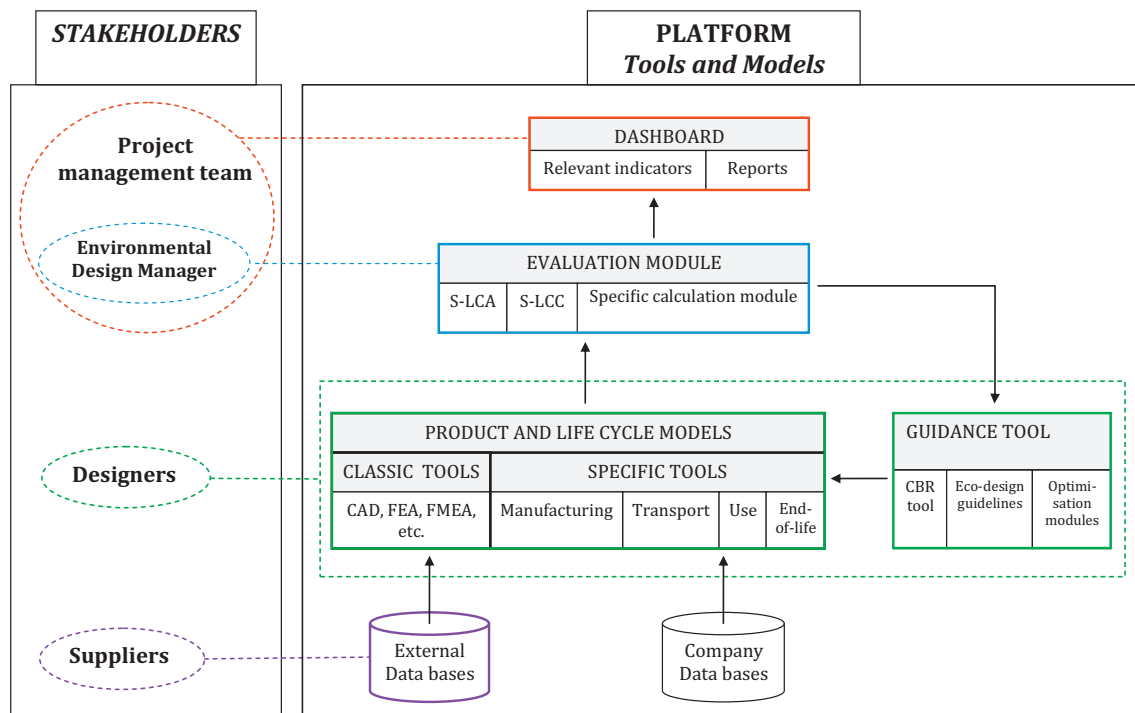


Fig. 1. Elements required for the platform supporting the methodology.

## 2.2. Existing approaches

Three broad categories of methods and tools dedicated to environmental assessment to help eco-design decision-making were first developed: quantitative environmental assessments often used in detailed design phase or for a product redesign, qualitative tools such as "guidelines" used at the conceptual design phase (i.e. The Ten Golden Rules [12]), even if they do not return quantitative indications to designers, indicators (rate of recyclability, energy use, etc.) that are often indicators developed in-house in order to have a reference to ensure compliance with standards and guidelines.

Despite the great number of tools and methods, their use is still limited [13]. One reason for this low utilization is that tools and methods are for expert because they require specific knowledge [9]; another is that there is a lack of information about how to use them [14]. Furthermore, the compatibility between tools is not guaranteed [9]. Thus a methodology is needed to choose and use the existing tools: The ISO 14062 describes how to integrate environmental aspects into product development, Fargnoli and Kimura [14] propose a new design process for the development of sustainable products, supported by a series of indications providing information on how to apply the most common eco-design tools. But those approaches are still too theoretical to be used by designers' teams. In the next section, an eco-design methodology supported by an engineering platform is proposed to ensure the best consistency between eco-design tools.

## 3.1. Involved stakeholders

The design project team consists of designers from the design office but also from every department relevant for the project, mainly R&D, production, purchasing department, quality, etc. *Designer* is used as the universal term to refer to every stakeholder of the design team, regardless of the department they come from. The design project is managed by a steering team, so called the project management team (PMT). It can be usually reduced to one person known as the project manager (PM). The project manager has a multidisciplinary role. He ensures the coordination between the different stakeholders and the integration of their points of view in order to meet all the constraints. For ecodesign purpose, an environment expert, called the Environmental Design Manager (EDM), is strongly recommended to manage environmental issues in the product development process. Indeed, PM needs to be assisted by EDM because he usually does not have the skills to understand the environmental data and thus cannot make informed decisions. Thus EDM is a member of the steering team. He is the environmental expert of the company if any or an external consultant. By working closely alongside EDM, PM will learn environmental skills. As his knowledge increases, environmental responsibilities will tend to be shared throughout the design team and the need for a distinct EDM would reduce. A product stewardship manager (PSM) is also required in PMT to manage legislation concerns. He can be internal or external, one among PM and EDM or specific. Large environmental data is needed to assess environmental issues, including data known by suppliers and related to their business. The suppliers are therefore

Download English Version:

<https://daneshyari.com/en/article/10674381>

Download Persian Version:

<https://daneshyari.com/article/10674381>

[Daneshyari.com](https://daneshyari.com)