



G.EN.ESI - Integrated software platform for Green ENgineering dESIgn and product sustainability

PROJECT DESCRIPTION

Currently, there is an increasing worldwide need for products and services which are qualified in terms of environmental sustainability. This need can be satisfied if environmental impact considerations become an integral part of the product design process. Decisions made during the design phase of a product can have a significant effect on the product's environmental impact. It is estimated that 80% percent of the environmental impact of a product is determined during the design stage.

While already affirmed design methods and advanced software tools support designers in their functional, structural, aesthetical choices during the cited design stages, no easy to use and robust tools exist for the environmental evaluation. Several eco-design procedures and tools have been developed but these ones are not recognized by companies and their engineering departments as solutions for a daily usage. Moreover it's not ensured the necessary integration between the available eco-design software platforms and other design tools.

In this context many further improvements can be achieved through a rethinking of the design process, integrating the eco-design activities (and the related tools). The environmental considerations have to be integrated with the other classical design aspects, such as performances and costs. From the environmental point of view, the objective is to stimulate the designers to apply the Life Cycle Design paradigm, in order to consider the entire product life cycle. This idea can favor the creation of a new generation of design tools where environmental considerations become a key factor since the beginning of the design process.

PROJECT PHASES

The G.EN.ESI project wants to make up for the lacks of the current existing solutions and to develop an eco-design methodology with related software design platform to help product designers in ecological design choices, without losing sight of the costs and the typical practicalities of the design process. The main objectives and activities performed in the context of the project were the following:

Definition of an eco-design methodology based on traditional design tools and new tools created for the improvement of the ecological and economical aspects of the products during the entire life cycle. Five different phases occur during a product life cycle: choice and extraction of the material, manufacturing and assembly processes, transportation, use and final disposal. With the new eco-design methodology all phases can be taken into consideration simultaneously resulting in improvements of the performances under different aspects.

Development of easy to use software tools for the evaluation of the product environmental and economic sustainability during the whole life cycle. The G.EN.ESI project had the aim to overcome the gaps in the state of the art and existing solutions, developing a methodology and an eco-design platform to support designers in making the correct choices on environmental aspects, while not losing sight of the costs and other classical design drivers.

The objectives and main activities were the following:

- Definition of an eco-design methodology based both on traditional design tools (e.g. CAD) and on new tools developed on purposes to improve the environmental and economic performances of the products' life cycle. Generally a product's life cycle is composed of 5 main phases: extraction and selection of the material, production and assembly, transportation, use and end of life. The methodology developed within G.EN.ESI allows simultaneous consideration of all the five phases, improving their performances from different points of view.
- Development of easy to use software tools for the evaluation of the product environmental and economic sustainability along the whole life cycle. A simplified assessment tool, accessible directly from the CAD system, from the PLM system or via web, allows to perform quick preliminary analysis mainly considering the materials and manufacturing phase. Dedicated tools oriented to specific life cycle phases (transportation, use, disassembly and end of life) allows to perform detailed assessments to discover potential criticalities. Finally an LCA compliant tool allows for the implementation of a full environmental analysis of the product taking into account the results obtained by the use of the other tools.
- Integration of the software tools by using a standard exchange file able to guarantee tools interoperability. The standard exchange file is populated by each software with the aim to exchange data and to define the product model with more and more data calculated by each tool. The databases of each system are integrated with the databases of all the other systems of the platform in order to have a unique source of data.
- Integration of the G.EN.ESI eco-design software tools and platform with the traditional software tools used for industrial design (CAD, PLM). Due to this integration a great added value in design processes has been reached, since the synergic cooperation of these tools completes the design process, taking into account many different aspects such as geometrical features, structural data, material selection, cost aspects and environmental parameters during the whole life cycle.
- Development of a web portal to integrate a green supply-chain in the eco-design methodology. Suppliers with a certified environmental product (such as EMAS certification) can provide, via web, information about their company and products. The information is structured following a specific template form in order to be available to the designers which use the G.EN.ESI platform.
- Validation of the G.EN.ESI platform in two different case studies (domestic cooker hoods and industrial electric motors). The design phase of the products and their relative components have been carried out using the G.EN.ESI platform. The new products showed significant improvements in terms of environmental performances in comparison with the old product versions. The G.EN.ESI platform usability evaluation, as well as its benchmarking with commercial software tools and experimental tests have been carried out to guarantee the applicability of the platform in real design context and to validate the calculated indicators.

Development of learning, teaching an training materials to support the implementation and use of the G.EN.ESI platform in industrial contexts and to foster the dissemination of eco-design principles.

PROJECT RESULTS

The main results of the G.EN.ESI project are the followings:

- **G.EN.ESI Methodology.** This methodology, composed of six simple steps, provides support for the effective implementation of eco-design strategies and the integration of environmental information within the existing design and development processes. The methodology has been developed to support a strategic and systematic approach to the implementation of eco-design in industrial contexts. As such it is aimed at design management teams who are introducing eco-design for the first time or attempting to improve their existing eco-design efforts.
- **G.EN.ESI Software Platform.** It represents a fully interoperable set of software tools that supports the user in the integration of environmental considerations into traditional product design. The G.EN.ESI platform is composed of several tools, which provide a wide range of assessment functionality and covers the products' whole life cycle, such as:

- [Eco-Audit tool](#) to realize fast and simplified Environmental and Economic assessments;
- [DfEE tool](#) to analyse the energy efficiency of the product's components;
- [0 km tool](#) to quantify the environmental and cost efficiency during the transport phase;
- [LeanDfD tool](#) to evaluate the product's end of life phase through disassembly and recyclability analysis;
- [eVerDEE tool](#) to perform simplified but detailed environmental Life Cycle Assessment (LCA);
- Supplier Web Portal to allow suppliers to provide environmental information about their products.

The platform also provides support for product improvements by:

- [Eco-material tool](#), which allows to evaluate alternatives of materials and processes;
- [CBR tool](#) supporting the designer in the improvement phase, taking into account the ecodesign guidelines and company knowledge beside the standard design criteria.

The GRANTA MI:MATERIALS Gateway, which is integrated with CAD and PLM systems, is an entry point to the G.EN.ESI platform. The interoperability between the platform components allows data and results to be exchanged between platform components, fully supporting the user in the design process. The integration of the G.EN.ESI Platform with traditional design tools (e.g.) represents a great added value in the design processes, since the synergic cooperation of these tools completes the design process and allows to take into account many different aspects (e.g. structural data, cost aspects and environmental parameters).

Redesigned sustainable cooker hood. Thanks to the implementation in the FABER company of the G.EN.ESI Methodology and Platform, a new cooker hood and an optimized electric motor has been designed and realized. The new products are characterized by a high value of sustainability (ecological and economical aspects) in all phases of life cycle and in particular:

- Reduction along the entire life cycle of about the 50% of the environmental impact indicators; Climate Change, Consumption of mineral resources and Consumption of renewable and non-renewable energy;
- Reduction of more than 55% of the energy consumption during the use phase;
- Improvement of the total recyclability rate, from about 70% to about 77%;
- Reduction of the disassembly time for the blower (-18%), the transformer (-27%) and the electric motor (-18%);
- Reduction of the number of electronic boards to be manually disassembled at the end of life;
- Reduction of more than 30% of the total life cycle cost;

G.EN.ESI Education Centre. It includes learning, teaching and training materials for implementing eco-design within an industrial context. These varied media resources cover both introductory and advanced topics. The material is available for download directly from the G.EN.ESI website.

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