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DEPLOYMENT AND IMPLEMENTATION OF THE GRUNDFOS' SUSTAINABILITY STRATEGY BY MEANS OF THE ECODESIGN MATURITY MODEL

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1. Introduction

Companies are increasingly realizing the needs and opportunities for implementing sustainability into their business processes and corporate culture [Carrillo-Hermosilla et al. 2009], [OECD 2010]. Increased competitive advantage, improved corporate responsibility, compliance with legislation, increased customers' requirements, innovation potential, and business opportunities are some of the reasons that drives companies to incorporate sustainability into their business strategies [Hauschild et al. 2005], [ISO 2002], [Wimmer et al. 2010].

Grundfos, one of the world's leading pump manufacturers, has been actively engaged in sustainability integration into its business over the last years. Strongly influenced by its founder's (Poul Due Jensen) beliefs in care about social and environmental issues, Grundfos has worked with different elements of sustainability throughout its existence.

In the early 1990s, for instance, Grundfos actively participated in a project together with the Technical University of Denmark (DTU), the Confederation of Danish Industries, the Danish Environmental Protection Agency and four other manufacturing companies that aimed to develop a methodology to evaluate the environmental impact of industrial products (EDIP - Environmental Design of Industrial Products) [Wenzel and Alting 1999]. The outcome of the analysis of Grundfos' products' life cycle, according to the EDIP methodology, indicated that the higher impacts were related to energy consumption during the use phase. In order to deal with this challenge, Grundfos established a strong design focus for the improvement of the energy efficiency [Gish and Hansen 2013], which enabled a solid competitive advantage and differentiation in the market in the following decades.

More recently, Grundfos published its Sustainability Strategy (2012 – 2017), which is composed of six strategic focus areas: 1) Sustainable Product Solutions; 2) People Competences; 3) Environmental Footprint; 4) Workplace; 5) Community; and 6) Responsible Business Conduct. Sustainable Product Solutions is defined as one of the most important focus areas for Grundfos, being derived from a clear business driver. Grundfos aims to have a systematic and comprehensive approach towards the development of more sustainable products and services [Grundfos 2012].

In this paper, the approach followed by Grundfos to deploy its Sustainability Strategy for the development of Sustainable Product Solutions, by means of the Ecodesign Maturity Model (EcoM2), is described and discussed. Grundfos selected the EcoM2 as a model for sustainability incorporation due to its step-by-step and process-related approaches, which could provide a consistent and systematic framework to support the company in defining how to achieve the targets defined by the Sustainability Strategy, in the strategic, tactial and operational levels.

The next section describes the Ecodesign Maturity Model and its main components. Section 3 defines the methodology followed for the application of the EcoM2 application at Grundfos. Section 4

discusses the diagnosis of the current maturity profile at the company and the proposition of projects for ecodesign implementation. Section 5 presents the deployment of a roadmap for strategic implementation of Sustainable Product Solutions at Grundfos and the ongoing projects. Summary and final remarks are presented in Section 6, which is followed by acknowledgements and references.

2. Ecodesign Maturity Model (EcoM2)

The Ecodesign Maturity Model is a management framework with a step-by-step approach, aiming to support manufacturing companies[1] in carrying out ecodesign implementation [Pigosso et al. 2013]. The model is intended to support ecodesign managers in the deployment of strategic and tactical roadmaps for ecodesign implementation. The EcoM2 is composed of three elements [Pigosso and Rozenfeld 2011]:

- Ecodesign practices: comprehensive collection of practices related to ecodesign management, technical issues of product design and associated techniques and tools;
- Ecodesign maturity levels: prescriptive set of successive stages for the incorporation of environmental issues into the product development and related processes;
- Application method: a prescriptive continuous improvement approach to support companies with ecodesign implementation and management [Pigosso et al. 2012].

In order to guide ecodesign management with the application of the EcoM2 and to establish a framework for continuous improvement through the incorporation of ecodesign practices into the product development and related processes, an application method had been developed in this research based on the PDCA (plan, do, check, and act) and business process management (BPM) approaches for process improvement. The application method comprises six steps, with a continuous improvement approach [Pigosso et al. 2013] (Figure 1):

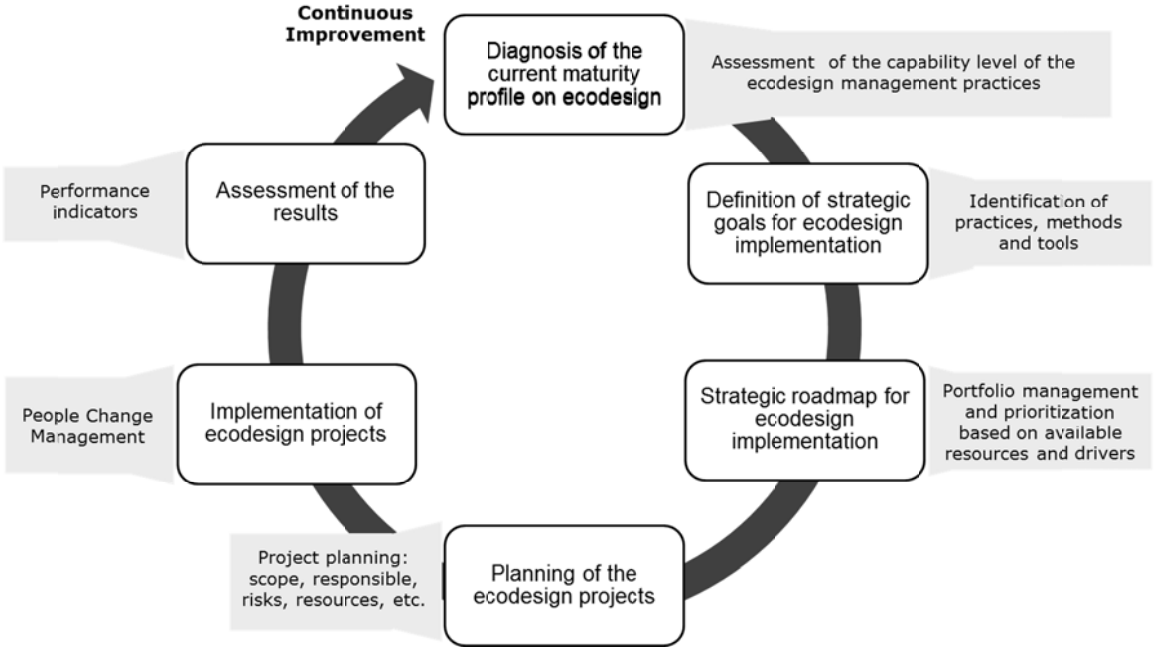

Figure 1. the EcoM2 application method comprises six steps, from the diagnosis of the current maturity profile to the assessment of results, following a continuous improvement approach (adapted from [Pigosso et al. 2013])

The model focuses on process improvement (product development and related processes) from a managerial perspective, rather than on product improvement (improved environmental performance of a product/family of products) from a technical perspective [Pigosso et al. 2013]. In other words, it

[1] The EcoM2 has already been applied into seven large multinational companies, from different sectors including aerospace, medical devices, toys and comestics.

focuses on the systematic and sustained integration of environmental considerations into the processes of a product development organization, with a view to deployment in all subsequent projects of the organization. It is assumed that if ecodesign practices are properly taken into consideration during the product development and related processes, the natural consequence will be that developed products will achieve a better environmental performance.

3. Methodology

In this paper, the results of the application of the three first steps of the EcoM2 application method at Grundfos are presented and discussed (the other steps are out of the scope of this paper).
The diagnosis of Grundfos' current maturity profile in ecodesign implementation and management was performed in three stages, according to the methodology defined by the EcoM2 [Pigosso et al. 2013]:

- Documental analysis of product development and related processes: aims to analyze how the product development process and ecodesign-related activities are organized, structured and documented at the company;
- Interviews for maturity assessment: aims to identify the capability level[2] of the application of the ecodesign management practices[3] at the company;
- Development of the maturity profile (radar): included the consolidation and analysis of the data gathered in the two previous steps, with the development of a visual representation (radar) of the current maturity profile of the company on ecodesign implementation and management.

Once Grundfos' current maturity profile was determined, the most suitable management practices to be adopted were proposed, based on a gap analysis and on the identification of the strategic goals of the company, aligned with the Sustainability Strategy for Sustainable Product Solutions. The proposition of projects was performed in three stages:

- Definition of the process improvement approach and identification of the goal for the next improvement cycle;
- Identification of ecodesign management practices and methods and tools for implementation;
- Definition of projects for ecodesign implementation in the company.

Subsequently, the development of a strategic roadmap for the improvement projects and implementation of the projects were developed in an action research at Grundfos. The action research is characterized by a problem solving focus and is applicable to understand, plan and implement changes in organizations [Coughlan and Coghlan 2009]. The central idea of the action research methodology is to use a scientific approach to study the resolution of key organizational issues together and with the participation of the people involved with these issues. The main goal of the action research is to make more effective action at the same time that scientific knowledge is created.

4. Diagnosis of the current maturity profile at Grundfos

Grundfos provided full access to all relevant internal documentation, making all the required documents available for consultation. The documents analyzed included product development process-related documents (guides, templates, tools, processes, standards and criteria for gate assessments), support-processes-related documents (input and output data, responsibilities matrix, processes definition, templates, and guides), environmental-related documents (sustainability strategy, processes, tools, guides, reports, etc.) and organograms of the company.
During this step, three key-employees (two directly related to the product development process and one from the environmental department) were interviewed in order to elucidate how the process is

[2] The capability levels qualitatively measure how well a company applies an ecodesign management practice, in five levels: 1) incomplete; 2: ad hoc; 3) formalized; 4) controlled; and 5) optimized [Pigosso et al. 2013].
[3] Management practice is defined as practices related to activities of the product development and related processes that address environmental concerns from a managerial perspective. They are generic and can be applied by any company, regardless of the type of products developed. The ecodesign management practices are used to assess the maturity profile of companies in their application of ecodesign [Pigosso et al. 2013].

performed in a daily basis and to clarify issues on the analyzed documents. Additionally, the environmental-related activities currently performed at the company were introduced during the interviews.
The employees to be interviewed were identified jointly with the company. A total of 22 employees from different areas (such as service development, engineering, maintenance, technology development, etc.), functions and hierarchical positions were selected (Table 1). The average duration of the interviews was 57 minutes.

Table 1. Job title of the employees involved in the interviews for maturity assessment

Chief process development manager	Technology director
Senior Project manager	Technical director/engineering
Chief engineer	Functional manager, technical marketing
Product development director	Director of sustainability
Product engineering manager	Functional manager
Senior product engineer	Department head
Group senior vice-president	Senior engineer
Global product line director	Group vice president
Business development manager	Product engineer
Senior designer, packaging and signage	Program manager
Senior project manager	User focused concept designer

During the interviews, the ecodesign management practices [Pigosso et al. 2013] were evaluated according to their capability level of application at Grundfos, in order to determine the current maturity profile of the company. The comments of the interviewees were documented, in order to support further analysis and provide evidences on the results obtained.
In order to consolidate the data obtained during the interviews, the answers of the employees were analyzed against their own commentaries in order to guarantee coherence and consistence of the capability levels assigned. Whenever necessary, the capability level was changed based on the commentaries and on the evidences of the documental analysis.
Within the results of the documental analysis and interviews for maturity assessment, the ecodesign maturity profile of Grundfos was developed[4]. The analysis of the profile indicated that Grundfos was in the initial stages of ecodesign implementation, meaning that the ecodesign approach had not been fully implemented in the company. Besides the increasing incorporation of the environmental issues into the Sustainability Strategy, it could be observed that the deployment to the daily activities was still incomplete. However, the employees of the company were highly engaged with the company values towards sustainability.
Whilst the diagnosis generally showed improvement potential within many of the analysed areas related to environmental and social integration into product development, other areas such as the minimization of environmental impacts during the production process and improvement of energy efficiency of the products during the use phase were already at a higher maturity due to historic efforts within this area.
In summary, the diagnosis of the current maturity profile of Grundfos clearly indicated that the deployment of the Sustainability Strategy into the product development and related processes was still incomplete, i.e. there was a lack of an organizational structure, knowledge, processes and tools to consider systematically the environmental issues during the product development and related processes.

5. Proposition of improvement projects for Sustainable Product Solutions

The first stage of this phase comprised the definition of the process improvement approach to be followed by the company. The EcoM2 allows freedom and flexibility in the choice of practices to be

[4] The maturity profile of Grundfos is not presented in this paper due to confidentiality agreements.

applied according to the company's purpose and strategic drivers . There are two approaches for process improvement defined by the EcoM2 [Pigosso et al. 2013]:

- Staged approach: provides a systematic and structured way for implementing process improvements, based on the implementation of one stage (maturity level) at a time. Each stage indicates that the process already has the necessary foundation and structure that qualifies it for the next stage.
- Continuous approach: provides maximum flexibility, since the organization can improve the application of specific practices related to a single evolution level, or can focus on several areas that are closely aligned with business goals and strategies. The relative improvement individual management practices is characterized by the capability levels.

The ecodesign maturity profile of the company indicates whether it is better to adopt the continuous or the staged approach for process improvement. Based on the selected approach and on a gap analysis, the management practices to be adopted can be defined. The staged approach for process improvement was selected as the most suitable one to be implemented by Grundfos, according to its current ecodesign maturity profile. In accordance to the staged approach, the implementation of ecodesign practices must follow the maturity levels defined by the EcoM2.

The goal for the next improvement cycle was defined by the company according to the Sustainability Strategy, more specifically to the targets of the Sustainable Product Solutions focal area, and available resources. Once the ecodesign management practices to be applied were defined, the relationships and dependencies among the ecodesign management practices, the operational practices and the ecodesign techniques/tools were assessed. As a result, a set of the most suitable ecodesign management practices, ecodesign operational practices and technique/tools to be applied by Grundfos were proposed, according to its maturity profile on ecodesign.

A cluster analysis was performed in order to identify synergies among the ecodesign management practices and propose the improvement projects for ecodesign implementation, based on Grundfos' characteristics and culture. The improvement projects were designed for the joint and integrated incorporation of the application of one or more practices. In total, 4 projects for ecodesign implementation were proposed:

- Project 1 - Set an organizational structure for ecodesign implementation: the goal of this project was to establish the organizational structure that would be responsible for the integration of the environmental issues into the product development and related processes. In order to succeed in this task, the attribution of responsibilities and resources to perform these activities is of high importance. This project comprehends the implementation of four ecodesign management practices:
    - Ensure commitment, support and resources to conduct the activities related to ecodesign;
    - Ensure appropriate communication between the departments and different levels concerning product-related environmental issues;
    - Involve the relevant functions across the company in the ecodesign implementation;
    - Deploy product-related environmental responsibilities among employees of different levels at the organization.
- Project 2 – Establish an ecodesign program: the goal of this project is to establish an ecodesign program at Grundfos to perform the deployment of the Sustainability Strategy into the product development and related processes. The ecodesign program should include the collection and dissemination of ecodesign-related knowledge, the increase of awareness and commitment of the involved people to perform the activities related to the integration of environmental issues into product development and related processes. Furthermore it should include the provision of new tools that can support development projects in the integration of the environmental dimension into decision making processes. In the scope of the ecodesign program, pilot projects should be carried out in order to test the tools and practices and understand how they work in practice and to identify the real potential benefits for the company. The results should be used to set goals for ecodesign implementation at the

company. The ecodesign management practices suggested for implementation in this project are:

- Get and disseminate knowledge on ecodesign approaches and practices;
- Examine the relevant internal drivers (as cost reduction and improvement of company's image) and external drivers (customers requirement and legislation/regulation) for ecodesign adoption
- Start the ecodesign application by increasing people consciousness about the application opportunities;
- Provide training in ecodesign approach and practices for employees involved in the product development and related processes;
- Select, customize and implement ecodesign techniques/tools according to the company's needs;
- Implement life-cycle thinking in the company.

- Project 3 - Clearly define the role and involvement of the support processes for ecodesign implementation: this project aims to spread the environmental considerations and responsibilities across the organization, especially in regards to product development and related processes. This comprises the application of the following management practices:
  - Perform benchmarking internally (to set environmental improvement goals) and externally (to understand what competitors are doing in ecodesign);
  - Identify customer and stakeholders requirements and priorities concerning the environmental issues;
  - Deploy and maintain an environmental policy/strategy for products;
  - Include packaging and distribution process under the ecodesign considerations (it brings quick wins and supports the creation of awareness of the ecodesign programs);
  - Assess technological and market trends (including new customer requirements) that embraces the trends of products with better environmental performance and develop a list of potential products and market strategies according to the new trends;
  - Formulate and monitor mandatory rules concerning environmental issues for the enterprise to comply with internal standards/goals;
  - Deploy product-related environmental responsibilities among employees of different levels at the organization;
  - Search technologies that can contribute to improve environmental performance and achieve the environmental goals.
- Project 4 – Evaluate the environmental impact of products during the product development process: the goal of this project is to provide tools, resources and the infrastructure to evaluate the environmental impact of the products during product development. The evaluation should support the decision making process and the identification of opportunities for improvements in product design. The results can also be used to support the goal definition in the context of the ecodesign program. The ecodesign management practices suggested for implementation in this project are:
  - Define and measure performance indicators for the environmental performance of ecodesign program;
  - Evaluate the environmental performance of products.

Several tools were proposed to be implemented by Grundfos, according to the suggested practices in the context of the aformentioned projects for ecodesign implementation. However, the specific tools to be used Grundfos were not defined at this stage. The selection of the specific tools to be used was subsequently performed internally by the company, being supported by the classification criteria provided by the EcoM2 [Pigosso et al. 2011].

6. Roadmap for implementation of Sustainable Product Solutions

In order to prioritize the projects to be implemented according to the company drivers and available resources, a strategic alignment was performed by means of portfolio management. The strategic drivers for ecodesign adoption (e.g., cost reduction, increased environmental awareness, new business

and innovation opportunities, etc.) were assessed and counterbalanced with the proposed projects for ecodesign implementation. As a result, a strategic roadmap for the implementation of the improvement projects was established.
Based on portfolio management of those projects, which considered strategic drivers and available resources, a strategic roadmap for implementation of Sustainable Product Solutions was developed. The roadmap represents the realization of the aforementioned projects in a 5-year timeline, linking interrelated activities through five layers:

1. Strategic implementation;
2. Measurement by key performance indicators (KPIs) and monitoring;
3. Product development process improvement;
4. Product improvement;
5. Methods and tools; and
6. Competences and skills.

The aforementioned projects suggested by the EcoM2 are detailed in activities and placed in the roadmap layers structure, as presented above. Some of the projects have already been fully implemented at Grundfos, such as the project 1, related to the definition of an organizational structure for ecodesign implementation. Currently, there are clear responsibilities assigned for members in the organization for the deployment of the Sustainability Strategy into the product development and also a established Decision Board composed of managers and directors from different areas of the company.
At this time, the company is implementing a set of other projects, as suggested by the EcoM2. Another example of a project under implementation is the development of a "Sustainable Product Solutions (SPS) Toolbox" (related to project 4), which is currently being piloted in a series of development projects at Grundfos, so to increase its maturity before starting to scaled-up in the entire organization. The SPS toolbox aims to support the definition, development and evaluation of the products with an improved sustainability performance, supporting the decision-making processes during the product development and related processes

7. Summary and final remarks

This paper presented the approach followed by Grundfos for the deployment of its Sustainability Strategy into product development and related processes, in the context of the Sustainable Product Solutions focal area.
Based on a diagnosis of the current maturity profile of Grundfos' product development and related processes regarding ecodesign implementation, the EcoM2 application resulted in the proposition of the most suitable ecodesign practices and improvement projects to be applied at Grundfos, by adopting a continuous improvement approach for process improvement. In total, four projects composed by a set of practices and tools were proposed to Grundfos, who subsequently developed a strategic 5-year roadmap for the implementation of those projects.
The application of the EcoM2 enabled Grundfos to identify the strengths and weaknesses concerning the application of ecodesign practices, to prioritize the actions and projects to be implemented following a step-by-step approach and to develop a roadmap for the integration of ecodesign improvement towards environmental sustainability. Furthermore, it provided a common language and a shared vision across the organization for ecodesign implementation and a framework for the continuous improvement towards higher maturity profiles.
Grundfos plans to perform a new assessment of the maturity profile using the EcoM2 in the near future in order to identify the extent of the improvements carried out during the first improvement cycle and to identify new best practices to be implemented in the next improvement cycle towards Sustainable Product Solutions.

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