Success Factors for Integration of Ecodesign in Product Development – A Review of State-of-the-art

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Keywords: Ecodesign, Integration, Success factors

Summary

On the basis of a literature review, twenty success factors for integration of Ecodesign in product development are identified in this paper. The success factors are structured according to six areas of concern; management, customer relationships, supplier relationships, development process, competence and motivation. By relating the success factors to other factors that are acknowledged to affect the success of product development, it is indicated that to a great extent the integration of Ecodesign depends on the same factors. Some success factors are also identified to be specific for the integration of Ecodesign. These are the factors clustered within the areas of competence and motivation. However, as many of the success factors for the integration of Ecodesign relate to those factors that are acknowledged to affect the success of product development, this implies that if a company manages product development well, the likelihood increases that Ecodesign can be successfully integrated.

Introduction

Today it is widely acknowledged that companies need to reduce the environmental impact of their activities. In the early days of industrial environmental consciousness focus was set on so-called “end-of-pipe” solutions, i.e. solutions aimed at reducing the amount of harmful emissions and substances from manufacturing facilities. Recently, focus has changed towards the environmental performance of the products and consequently product development has become of great importance, because a product’s environmental performance is mainly determined during the product development process.

During the last decade a substantial amount of research has been addressed to Ecodesign, which refers to actions taken in product development aimed at minimising a product’s environmental impact during its whole life cycle, without compromising other essential product criteria such as performance and cost. Research in the area of Ecodesign covers a wide range of different topics. One topic concerns how Ecodesign should be integrated into the product development process. Research output regarding this topic includes different factors essential for a prosperous integration of Ecodesign in product development. However, in the literature these success factors have been reported quite fragmented resulting in that no clear picture has emerged regarding which factors are important to successfully integrate Ecodesign in product development. Therefore, the aim of this paper is to identify the success factors presented in the literature for the integration of Ecodesign in product development and to provide a structured overview of the factors.
Method

The paper is based on a literature review covering dissertations, books, journal articles and conference papers in the research area of Ecodesign. As the amount of Ecodesign literature is extensive it has been impossible to cover all literature, but arguably the review has covered a number of key publications within the research area.

Frame of Reference: Factors Affecting the Success of Product Development

Research on product development can be distinguished into three different streams, i.e. rational plan, communication web and disciplined problem solving [6]. ’The rational plan stream’ has focused on finding what determines a product’s financial performance. The success of a product development project is measured by the product’s profit, sales and market share. Basically, this research stream suggests that success is achieved by careful planning of a unique product having superior quality and cost advantages, directed towards an attractive market. The plans are executed by a co-ordinated and competent cross-functional team, including people from different functions, supported by senior management. Other important ingredients for success are early involvement of both customers and suppliers.

Compared to the previous stream, ’the communication web stream’ adopts a more narrow view of product development. Focus is set on how a project team’s internal and external communication affect the project performance, which is measured by team and management ratings. The results produced in this stream indicate that success in product development much depends on external communication. Gatekeepers, who encourage development teams to communicate with outsiders, and powerful project managers, who communicate externally to ensure resources, are pointed out as being of major importance for successful product development. Success is also related to cross-functional teams that communicate internally about concrete tasks and novel routines, for example.

The third stream is the ’disciplined problem solving stream’. Successful product development is seen as being dependant on structured and disciplined problem solving by a relatively autonomous cross-functional project team directed by a clear product vision. A heavyweight project manager, cross-functional teams, extensive use of supplier networks, emphasis on pre-project activities, overlapping development stages are also seen as important ingredients for successful product development. Success is measured in terms of the development speed and the quality of the product.

As has been presented above, the three research streams have tried to find out what makes product development become successful. Recognising that the findings in each stream provide complementary and sometimes overlapping insights, Brown and Eisenhardt [6] have developed a model of factors affecting success in product development. The model, illustrated in figure 1, synthesises the most prominent findings in each stream.

The heart of product development is the project team consisting of the members who are doing the actual product development work. The team composition is therefore vital for the product development performance. Cross-functional teams are important, because functional diversity increases the amount and the variety of information to develop products. Gatekeepers, i.e. individuals that frequently obtain external information and share it with the team, also increase the amount and the variety of information available in the development process. Team tenure is a third factor the plays a role in affecting product development performance. A moderate level of team tenure, i.e. the team members have had neither too short nor too long a history together, is most preferable because then the team members engage in both extensive internal and external communication.
Communication within the team as well as external communication are factors that influence the success of product development. Frequent internal communication builds team cohesion and cuts misunderstandings and barriers for interchange. Frequent external communication opens the project team to new information which can be useful in the development process.

The structure of the development process affects the development performance. For stable and relatively mature products (e.g. cars) a process which is thoroughly planned and includes overlapping stages might be the most appropriate. For products associated with more uncertainty in rapidly changing industries (e.g. microcomputers) a development process based on frequent iterations, extensive testing and short milestones might be more appropriate. The underlying rationale is that under conditions of uncertainty it is less helpful to plan.

The power of the project leaders is acknowledged to be of great importance for the success of a product development project. This is due to the fact that such strong leaders are effective in acquiring resources in terms of personnel and budget for the project. A clear project leader vision is also essential and refers, among other things, to the ability to put together the suitable competencies in order to develop a product that is appreciated in the market.

Senior management support, which means provision of financial and political resources, is critical for product development success. This support is essential for obtaining the resources necessary to attract team members, to gain a go-ahead decision for the project and to provide the funding for the project. Subtle control, which includes giving the project team enough autonomy to be motivated and creative, but still work closely together with the project management to develop a successful product concept, is another essential senior management responsibility.

Involving suppliers in the development project can reduce the project’s complexity and thus contribute to an efficient project. Customer involvement has also been identified to contribute to product development success.

Note: Capital letters and thickened lines indicate robust findings
Success Factors for Integration of Ecodesign in Product Development

Within the Ecodesign literature, a number of factors have, explicitly or implicitly, been presented as being essential when integrating Ecodesign in product development. These factors are in this paper denoted as ‘success factors’, because in general, the term ‘success’ refers to the achievement of something that one has been trying to do. The success factors are derived from both empirical studies and conceptual discussions.

One frequently mentioned factor is management commitment and support [1,2,10,20,23,25]. This refers to the provision of enough resources, for example. An essential responsibility for management is to establish clear environmental goals not only for the development organisation as a whole, but also for the individual product development projects as well [10,12,19,25]. This implies that environmental considerations should be addressed as a business issue, i.e. the environmental considerations must be balanced with commercial aspects [16,25,27]. It also implies that Ecodesign should not only be treated on an operational level, but also on a strategic level [7]. The strategic level relates to how a company wants to position itself concerning environmental issues and includes, among other things, the establishment of an environmental product development policy. The need to balance environmental considerations and commercial aspects has been underscored by Bird and Prentis [4], who argue that the route to long term integration of environmental considerations into the business activities is to adopt strong customer focus. Also Ritzén [25] mention that customer focus is essential and that, for example, market investigations should include environmental issues. Some researchers have even gone one step further and argued that companies should train their customers in environmental issues [15].

The environmental impact from different technologies varies. Hence, the choices made concerning which technology to use in a product is vital for the product’s environmental performance and as a product, being of reasonable complexity, includes a number of different technologies, environmental issues should be included when establishing a company’s technology strategy [24]. It is obvious that Ecodesign does not only concern the product development phases following the establishment of the design specification, but also the phases prior to the design specification [3]. This implies that environmental issues should be considered at the very beginning of the product development process [2,12,21].

It has also been described in the literature that an important source of information is the supplier network when it comes to environmental alternatives of materials, components and processes. According to McAlone [20], the expertise that the suppliers have in the specific issues related to their materials and components can be a valuable input when environmentally favourable product designs are searched for. Hence, this implies that close supplier relationships is an important factor when developing environmentally conscious products.

As environmental considerations are new to many companies it is essential to establish a new mindset emphasising the importance of environmental considerations [14,29]. For management the new mindset relates to which level of emphasis on environmental considerations the company should aim at, i.e. which strategic environmental position the company should adopt. Other management issues are to establish the right conditions for the operative Ecodesign work as well as the measurement systems incorporating the environmental issues. On operational level, the new mindset means that the project team members should consider the environmental issues in all of the product development activities they perform.
To facilitate the new mindset being established, Ritzén [25] suggests that the individuals are encouraged to take active part in the integration of Ecodesign into the product development process. Therefore, education and training of the product development personnel are important means to support the new mindset [1,10,15,19,25]. General education of all personnel on environmental issues is mentioned in the literature as being an important factor in raising a company’s consciousness about the link between the company’s activities and the environmental impact. It is also claimed that training that addresses the specific need of the different project team members is essential. For example, designers need training in using different Ecodesign methods and tools [22]. Another way of supporting the designers’ learning about environmental issues is to utilise examples of good design solutions [21].

To initiate and facilitate the Ecodesign activities, it is also essential to have someone with environmental expertise in the product development organisation [9]. From a broad survey of Ecodesign practise in U.S. manufacturing firms Lenox et al [18] found that the product development staff appeared to be predominantly referring to the environmental staff to provide information on environmental impacts. This implies that an environmental expert should support the development activities. The task of an environmental expert is to provide correct environmental data and tools to ensure the environmental issues are carefully considered in the process. Environmental experts may also act as advisers in a more strategic sense by helping management to determine the importance of different environmental issues for the company and by suggesting how the issues can be incorporated in the overall business strategy [5].

A number of researchers have argued that for a prosperous integration of environmental issues in the product development process it is vital that an environmental champion exist in the development organisation, i.e. an enthusiastic person who can inspire the organisation to consider environmental issues [10,13,20,26]. McAloone and Evans [21] actually argue that a person showing enthusiasm about environmental issues actually may be as effective in making environmental product improvements happen as an environmental subject specialist. The ‘product stewards’ established at Hewlett-Packard’s computer organisation are examples of environmental champions. These product stewards act as champions for the company’s Ecodesign programme [17].

Several competencies are needed to develop a product including representatives from R&D, supply, marketing, environmental affairs and production, for example. As product development is complex and as the environmental impact related to a product’s life cycle is complex it has been maintained that Ecodesign should be performed in cross-functional teams [21,23,28]. This means that the development team should include individuals representing all the competencies being vital for the development of a product, including individuals having environmental competence.

In the Ecodesign literature it is often stated that environmental considerations should be integrated into the existing product development process [5,11,26]. This implies that the overall development process should be kept intact. Some modifications might, however, be necessary, e.g. the use of various Ecodesign methods and tools. To ensure that the environmental issues are considered it has been suggested that environmental checkpoints, reviews and environmental milestone questions should be introduced into the product development process [13,16]. The importance of implementing company-specific environmental design guidelines, rules and standards has also been maintained [1,8].

In table 1, the factors that have been discussed above are structured according to six areas of concern. It should be noted that the factors are not presented in any order of priority and that it is not claimed that table 1 contains all of the existing success factors, because, as discussed in the method section, it is impossible to cover all literature. Furthermore, as Ecodesign research is a relatively new area of research it is not likely that all factors have yet been identified.
<table>
<thead>
<tr>
<th>Area of concern</th>
<th>Success factors</th>
<th>Researcher(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Management</strong></td>
<td>♦ Commitment and support are provided</td>
<td>[1,2,10,20,23,25]</td>
</tr>
<tr>
<td></td>
<td>♦ Clear environmental goals are established</td>
<td>[10,12,19,25]</td>
</tr>
<tr>
<td></td>
<td>♦ The environmental issues are addressed as business issues</td>
<td>[16,25,27]</td>
</tr>
<tr>
<td></td>
<td>♦ Ecodesign are not only treated on an operational level, but also on a strategic level</td>
<td>[7]</td>
</tr>
<tr>
<td></td>
<td>♦ Environmental issues are included when establishing a company’s technology strategy</td>
<td>[24]</td>
</tr>
<tr>
<td><strong>Customer relationships</strong></td>
<td>♦ A strong customer focus is adopted</td>
<td>[4,25]</td>
</tr>
<tr>
<td></td>
<td>♦ Companies train their customers in environmental issues</td>
<td>[15]</td>
</tr>
<tr>
<td><strong>Supplier relationships</strong></td>
<td>♦ Close supplier relationships are established</td>
<td>[20]</td>
</tr>
<tr>
<td><strong>Development process</strong></td>
<td>♦ Environmental issues are considered at the very beginning of the product development process</td>
<td>[2,3,12,21]</td>
</tr>
<tr>
<td></td>
<td>♦ Environmental issues are integrated into the existing product development process</td>
<td>[5,11,25,26]</td>
</tr>
<tr>
<td></td>
<td>♦ Environmental checkpoints, reviews and environmental milestone questions are introduced into the product development process</td>
<td>[13,16]</td>
</tr>
<tr>
<td></td>
<td>♦ Company-specific environmental design principles, rules and standards are used</td>
<td>[1,8]</td>
</tr>
<tr>
<td></td>
<td>♦ Ecodesign is performed in cross-functional teams</td>
<td>[21,23,28]</td>
</tr>
<tr>
<td></td>
<td>♦ Support tools are applied</td>
<td>[22,25]</td>
</tr>
<tr>
<td><strong>Competence</strong></td>
<td>♦ Education and training are provided to the product development personnel</td>
<td>[1,10,15,19,22,25]</td>
</tr>
<tr>
<td></td>
<td>♦ An environmental expert supports the development activities</td>
<td>[5,9,18]</td>
</tr>
<tr>
<td></td>
<td>♦ Examples of good design solutions are utilised</td>
<td>[21]</td>
</tr>
<tr>
<td><strong>Motivation</strong></td>
<td>♦ A new mindset emphasising the importance of the environmental issues is established</td>
<td>[14,29]</td>
</tr>
<tr>
<td></td>
<td>♦ An environmental champion exists</td>
<td>[10,13,17,20,21,26]</td>
</tr>
<tr>
<td></td>
<td>♦ Individuals are encouraged to take active part in the integration of Ecodesign</td>
<td>[25]</td>
</tr>
</tbody>
</table>
Discussion

As can be seen from table 1, the success factors can be clustered according to six areas of concern; management, customer relationships, supplier relationships, development process, competence and motivation. If relating these areas of concern to the model presented in figure 1, it is indicated that the integration of Ecodesign to a great extent depends on the same factors that are generally claimed to affect the product development success. Management plays an important role for the success of product development, primarily by providing support to the development activities. In table 1 it can be seen that also a number of the success factors are related to the management area as regards the integration of Ecodesign in product development. Customer involvement is another factor that has been identified to affect the success of product development and the review showed the importance of adopting a strong customer focus when integrating Ecodesign in product development. Supplier involvement in product development has been identified as one factor that can contribute to product development efficiency. Close supplier relationships also increase the possibilities to get access to the expertise that the suppliers have in the specific issues related to their materials and components, which in turn can be a valuable input when environmentally favourable product designs are searched for. The structure of the development process affects the outcome of product development and as can be seen from table 1, a number of the success factors for integration of Ecodesign relate to the development process.

The discussion above shows that many of the success factors for integration of Ecodesign in product development relate to those factors which are generally seen as important in product development. However, some of the success factors are specific for integration of Ecodesign. These are the success factors clustered within the areas of competence and motivation. However, as most of the success factors for integration of Ecodesign relate to the factors that are acknowledged to affect success of product development, this implies that if a company manage product development well, the likelihood increases that Ecodesign can be successfully integrated.

A similar finding has been presented by Ritzén [25], who relates so-called common themes that support success of the product development process to activities for integrating environmental issues. The common themes overlap to some extent the factors presented in the frame of reference. The perspective adopted by Ritzén differs, however, slightly from the one adopted in this paper. The question asked by Ritzén is whether integration of environmental issues restrain product development efficiency and Ritzén argue that the environmental issues not necessarily have to affect product development efficiency negatively.

Table 1 also indicates that there is a strong consensus in the research community about the importance of some of the success factors. The factors that were found to be most frequently mentioned in the reviewed literature were management commitment and support, education and training of product development personnel and the presence of an environmental champion. This is, however, not any evidence that these factors are more important than others. It just indicates that several researchers seem to agree that these factors are important for integration of Ecodesign in product development.

The value of table 1 is twofold. First, the table provides a framework for practitioners to understand which factors are essential when integrating Ecodesign in product development. It can thus be helpful for companies wanting to become more environmentally conscious in product development. For academia the table can function as a starting point for identifying more factors or for studying how the factors interrelate with each other as well as with other factors being of importance for the development of competitive products.
Acknowledgements

The financing for this research is gratefully acknowledged and has been provided by the Swedish Foundation for Strategic Research, the Swedish Environmental Protection Agency and the company Ericsson Radio Systems.

References


