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# Implementation potential of sustainability-oriented decision support in product development

Helena Zetterlund, Sophie Hallstedt\*, Göran Broman

*Blekinge Institute of Technology, 371 79 Karlskrona, Sweden*

\* Corresponding author. Tel.: +46 455 385511. E-mail address: [sophie.hallstedt@bth.se](mailto:sophie.hallstedt@bth.se)

## Abstract

This study aims to identify challenges and opportunities for implementation of sustainability-oriented decision support in product development. A literature review and interviews with field experts were performed. Most methods/tools designed to support sustainability considerations in product development have a low level of implementation. A lack of the full scope of sustainability and poor practical applicability might be reasons. Implementation could be improved by amending these deficiencies. Another opportunity is to integrate sustainability aspects in methods/tools that are often already implemented in companies. A low-hanging fruit can be to focus on the area of risk management together with defining sustainability criteria.

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**Keywords:** sustainability; product development; decision support; implementation; environmental management; risk management; lean management

## 1. Introduction

Product development can play an important role for the transformation of society towards sustainability [1]. However, in spite of increasing awareness and knowledge about sustainability in general, the implementation of sustainability considerations in product development is still weak in most companies. An important means for implementation is to use decision support [2] and there is a wide range of sustainability-oriented methods/tools for decision support in product development [3,4,5]. Many of those have significant deficiencies. Improvements regarding, e.g., usability in early phases, coverage of the whole product life-cycle, and inclusion of both quantitative and qualitative aspects have been called for [3,4,5]. Furthermore, such methods/tools should support also longer-term strategic decisions and not only assessments of the current state [6]. Product developers involved in our research have suggested that it could be beneficial to integrate sustainability aspects (more comprehensively) in already

implemented decision support. This is in line with earlier research [7].

The aim of this study is to find and analyze some main scientific publications on sustainability-oriented decision support for product development, and to capture practical experiences from users of such support, with the purpose of identifying implementation challenges and opportunities. The opportunities will likely include some 'low-hanging fruits' regarding implementation of sustainability considerations in product development. Special attention is given to methods/tools within environmental management, risk management, and lean management, as these are often, to some extent, already implemented in many companies.

## 2. Methods

### 2.1. Literature review

A systematic literature review [8] and an adapted version of a procedure suggested by Biolchini et al. [9] is applied:

i) *Question formulation*: Identification of the problem to be solved and formulation of question(s) to be answered. De-composition of question(s) to different keywords and their synonyms.

ii) *Sources selection*: Definition of characteristics for sources to be selected. Creation of appropriate search strings, which can be run in the selected sources. Decision about scope of each search string, e.g., topic or abstract.

iii) *Studies selection*: Definition of inclusion and exclusion criteria, e.g., language and time-span. Search results are sorted by chosen criteria and analyzed in a chosen order.

iv) *Information extraction*: Extraction and organization of the chosen information from selected studies.

v) *Results summarization*: Analysis and summarization of information from selected studies.

The questions to be answered were formulated as: “What are the main scientific publications regarding i) integration of sustainability aspects in decision support and ii) implementation of such support in product development? What are the implementation challenges and opportunities reported in these publications, or that can be synthesized from the collection of these publications? Selected search strings, main keywords and ‘synonyms’ are specified in Table 1.

Table 1. Keywords and synonyms used in different search strings for the literature review.

Search string no	Main keyword	Synonyms
1-5	sustainability	ecology, sustainability criteria, sustainable, sustainable development
1-5	product development	product innovation, engineering design
1	decision support	decision-making
2	environmental management system	ISO14001, EMAS
3	lean	lean management, lean process, TPS
4-5	risk management	risk, risk assessment
1, 5	integration	-
1, 5	implementation	-

The following databases were used: ISI Web of Science (Reference Database), Scopus (Reference Database) and Emerald (Article Database). The search was limited to papers where the selected keywords appeared in the topic or abstract. All search strings had one part in common: the words ‘sustainability’ and ‘product development’ and their synonyms. The initial search string was designed to incorporate a wide range of studies in the areas of sustainability, product development and decision support.

Literature published between January 2005 and December 2015 was included. Conference and journal articles written in English were included. Each search result was sorted by a criterion of relevance, and selection was performed by: first reading the abstract and keywords, and, if that was not

sufficient for exclusion, reading the introduction and conclusion, and, if that was not sufficient for exclusion, reading the full paper. Articles recommended by senior experts within the field have also been included.

The information was organized in a worksheet. A first extraction included: year, author(s), title, description, keywords, research objectives and conclusions. The most relevant papers were then analyzed regarding: challenges/opportunities, type of research, and dimensions of sustainability.

## 2.2. Interviews

An explorative interview method was used [10]. The interviews were focused on methods/tools within environmental-, risk-, and lean management.

To ensure a common language before the actual interviews, a framework for strategic sustainable development, including, e.g., an operational principled definition of sustainability was presented and discussed [11]. The sustainability definition reads:

In a sustainable society: nature is not subject to systematically increasing...

1. ...concentrations of substances extracted from the Earth’s crust.
  2. ...concentrations of substances produced by society.
  3. ...degradation by physical means.
- and people are not subject to structural obstacles to...
4. ...health.
  5. ...influence.
  6. ...competence.
  7. ...impartiality.
  8. ...meaning-making.

Open interview questions [12] were given to people in three manufacturing companies and one management consultant company in Sweden. The manufacturing companies were all business-to-business companies, two larger companies and one medium-sized company. All three had worked with one or several of the areas of special interest. The management consultant company is specialized in *lean* and could contribute with experiences from different types of companies using it. In total, nine persons were interviewed. All interviewees have the experience of being a user of the respective decision support they were interviewed about. In Table 2, the roles/positions of each interviewee are summarized.

Table 2. Positions/roles of the selected experts that have practical experiences from industrial application

Roles/position with practical experience of Environmental Management	Roles/position with practical experience of Risk Management	Roles/position with practical experience of Lean Management
Sustainability Responsible	Risk management Responsible	Process Engineer within Research & Technology
Environmental Engineer	Product risk management Responsible	Managing Director, Senior Consultant
Global Quality Manager	Global Leader Environment &	

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