Sustainable Innovation in Product and Service Development

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Biographical Information

Dorothy Maxwell

Dorothy Maxwell has worked in the environmental arena for over twelve years in mainstream environmental consultancy to the public and private sectors. Her specialist areas of expertise include
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Clean Technology, Cleaner Production, Environmental Management Systems, Waste Minimisation and Sustainable Product Development. A native of New York City, she has worked as an environmental specialist in Europe, USA and Asia with international consultancies Andersen Consulting (now Accenture) and Willis Corroon Group. Currently based in the Environment Unit, Enterprise Ireland, she provides environmental expertise to business and industry and is managing the first Irish Sustainable Product Development initiative Environmentally Superior Products (ESP). She currently combines her professional work on ESP with a PhD research project on Sustainable Product and Service Development with the Environmental Policy & Management Group (EPMG), Environment Science and Technology Dept., Imperial College, London. She has produced a range of environmental publications, regularly lectures on environmental topics to industry and is a visiting lecturer on the Environmental Technology MSc at Imperial College, London. Dorothy has a BSc (Hons) in Physics (1989) from University College Dublin and an MSc, DIC in Environmental Technology (1992) from Imperial College London.

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Rita van der Vorst is Honorary Senior Lecturer in Clean Technology in the Department of Environmental Science and Technology. She has acted as the Deputy Director for the MSc in Environmental Technology and as Option Convenor for the Pollution Management strand of the Course until the beginning of the year. Before joining Imperial College in 1996 she worked as a lecturer at Brunel University where she developed and ran an undergraduate engineering programme with industry input focusing on environmental preventative engineering. Her research in Clean Technology mainly focuses on environmental systems design, including industrial ecology and permaculture, and organisational development. It also addresses waste minimization, environmental product and process design, LCA and environmental management. Rita has a Dipl.-Ing. (Mech. and Process Engineering) University of Technology Aachen 1991, Postgraduate diploma in Education, Brunel University 1994 and a PhD Brunel University (1997). Aachen 1991, PGD Education, Brunel University 1994 and a PhD Brunel University (1997).

Abstract

This paper focuses on Sustainable Innovation in terms of the development of sustainable products, services and Product Service Systems (PSS). It is relevant to the following themes of the Sustainable Innovation 03 Creating Sustainable Products, Services and Product-Service Systems conference with key focuses on barriers to innovation and innovation in management and business models:-

- Innovation in technology, design and development practices;
- Triggers and barriers to innovation;
- International supply and value networks;
- Innovation in management and business models.

The paper focuses on two main elements. Firstly, it highlights barriers to innovation relating to sustainable product and/or service development in industry. Secondly, it describes an approach which aims to
overcome these barriers. This approach, called Sustainable Product and Service Development (SPSD), has been developed by the authors at the Environmental Policy & Management Group (EPMG), Department of Environmental Science and Technology, Imperial College London and was introduced at the 2002 TSPD#7 conference (Maxwell and van der Vorst, 2002). SPSD builds on existing Sustainable Product Development approaches and represents a new management model for developing sustainable products and/or services in industry. Industry case examples have illustrated how this approach reduces these barriers and facilitates not only the development of sustainable products and/or services, but more holistically, innovation and business benefits.

Following an assessment by the authors of industry requirements and available supports relating to Sustainable Product Development, a number of barriers to the effective development of sustainable products and services were identified. Examples of some of the barriers include:-

- Lack of focus on all triple bottom line sustainability criteria;
- Not optimizing sustainability with traditional product and service criteria to ensure a realistic outcome;
- Focus on “cleaning up” product end of life environmental impacts rather than eliminating or minimising these problems at product and/or service conception and design stages;
- Lack of focus on product functionality and the options for achieving this through a service or PSS combination;
- Lack of focus on the product supply and value chains;
- Not incorporating sustainability at a strategic corporate level and integrating it into key business systems;
- Lack of pragmatic supports incorporating industry requirements and constraints regarding product development;
- Use of different “languages” and terminology between industry and sustainability related practitioners.
Having identified these barriers, the SPSD approach aims to resolve these problems using a pragmatic approach which meets the needs of key stakeholders, most notably industry, people and the planet. SPSD provides a framework for implementing SPSD throughout the complete lifecycle of a product and/or service and the associated supply chain. It aims to identify, assess and implement the options for optimising sustainability in product and/or service development. The SPSD approach integrates with existing Sustainable Development approaches for industry e.g. Clean Technology and builds on existing Sustainable Product Development initiatives. However, SPSD uses a new approach which targets the product supply chain rather than individual companies which traditional environmental performance improvement methods target. SPSD represents an innovation in the approach and framework conditions for developing sustainable products and services in industry.

**Keywords**

Sustainable Product Development, Sustainability, Design for Environment, Eco-design, PSS, Supply Chain Management

### 1.0 Introduction

Sustainable Innovation is seen as innovation aiming to generate benefits that are collective (STP, 2003) in terms of the environment, society and economy and reflecting a new out of the box approach often challenging traditional systems (Charter and Kajzer, 2002). This paper focuses on one aspect of the very holistic Sustainable Innovation topic - the development of sustainable products, services and Product Service Systems (PSS) in industry. It contributes towards this discussion by identifying some of the barriers to the development of sustainable products and services in industry and a new model for overcoming these barriers.

### 2.0 Barriers to developing sustainable products and services
As part of a wider research project on Sustainable Product and Service Development (SPSD) in manufacturing industry (Maxwell and van der Vorst, 2003), a number of barriers to the effective development of sustainable products and services in industry were identified. (Effective development was defined as resulting in sustainable products and services as well as meeting manufacturing industry requirements). These obstacles were identified from research into and application of current SPSD type activities in industry, an assessment of existing concepts, supports/tools and the views of practitioners and stakeholders in industry and academia. The barriers identified are introduced in sections 2.1 – 2.8 below. For further information on the barriers as well as the wider research project see Maxwell and van der Vorst, 2003.

2.1 Lack of focus on all triple bottom line sustainability criteria

The environmental aspect of the triple bottom line sustainability criteria (environmental, social and economic) (Elkington, 1997) was the key focus in general of SPSD type approaches where they existed in industry (mainly in the form of ecodesign). The incorporation and integration of economic and social parameters with environment to form a true sustainable product and service goal was rarely found in practice. This provides a key barrier towards true sustainable product and service development as distinct from solely reducing the environmental impacts of products.

2.2 Not optimizing sustainability with traditional product and service criteria to ensure a realistic outcome

Following on from 2.1 above, sustainability criteria (albeit mainly regarding only environmental issues) were seen as an add on, rather than an integral part of the product and/or service specification. Lack of integration and optimization of all triple bottom line sustainability criteria (environmental, social and economic) with existing product and service criteria such as market demand, customer requirements, quality, technical feasibility etc. were seen as barriers to the identification of realistic, workable sustainable products and services.
2.3 **Focus on “cleaning-up” product end-of life environmental impacts rather than eliminating or minimising these problems at product and/or service conception and design stages**

Where SPSD type approaches were used (mainly ecodesign) the focus was on optimising environmental impact at specific lifecycle stages (largely driven by legal obligations relating to reducing waste at end of life) and not incorporating all lifecycle stages especially the all important conception and design phases where key sustainability innovations can be identified from source.

2.4 **Lack of focus on product functionality and the options for achieving this through a service or PSS combination**

Coupled with 2.3 above, the focus was typically on the provision of a product rather than meeting a functional requirement or consumer need. Hence this was a barrier to assessing how the functional need could be met in terms of the bigger picture, to include via the provision of a product, service or PSS.

2.5 **Lack of focus on the product supply and value chains**

A key barrier to the effective development of sustainable products and services was a current focus on reducing the sustainability impacts (again mainly environmental only) of the product and service provided by a specific company, irrespective of their role in the supply chain. This is in line with traditional environmental improvement approaches implemented in industry e.g. EMS which are about managing an organisation’s environmental impacts of activities, products and services at their respective sites. Much product and service provision (with the exception of products manufactured in a direct business to consumer relationship) is via supply and value chains involving a range of companies often in diverse locations and performing different roles. It was identified that effective SPSD required application across supply chains from the Original Equipment Manufacturer upwards and downwards, as relevant, and largely being driven by those companies with control over product and service lifecycle phases key to achieving significant sustainability benefits e.g. conception and design (Maxwell and van der Vorst, 2002).
2.6 Not incorporating sustainability at a strategic corporate level and integrating it into key business systems

A lack of incorporation of sustainability at corporate strategy level and from their downwards into all business systems (e.g. purchasing, marketing, and most notably product and service development) was a key barrier.

2.7 Lack of pragmatic supports incorporating industry requirements and constraints regarding product development;

A lack of realistic, pragmatic mainstream approaches reflecting the requirements, drivers and constraints of manufacturing industry were seen as a barrier for facilitating SPSD implementation in industry.

2.8 Use of different “languages” and terminology between industry and sustainability related practitioners.

The dynamic generation and use of sustainability terminology vs. business language and the communication difficulties that generates was seen as a key barrier. For this reason, in implementing the SPSD approach in industry (see 3.0 below), the language and terms used were based on existing company culture and language.

3.0 Breaking down the barriers & building a new model

Having identified the barriers to developing sustainable products and services in industry, ways to overcome these obstacles were incorporated in a new model for SPSD developed by the authors at EPMG, Imperial College London. The SPSD model is briefly outlined in this section and the ways it aims to overcome the barriers identified.
Based on the overall SPSD research project, it was concluded that a number of factors were important for the effective development of sustainable products and services in manufacturing industry. These factors were designed, *inter alia*, to overcome the barriers identified above. The factors were incorporated into a SPSD approach for manufacturing industry to effectively develop sustainable products and services. The SPSD approach was developed following an assessment of existing approaches in line with the factors identified for effectively developing sustainable products and services in industry (Maxwell and van der Vorst, 2003). This resulted in a rethink of the existing approaches, largely designed with only environment in mind, and to incorporate the increasing shift towards the more holistic sustainability requirements as well as other key factors identified as necessary for effective implementation.

SPSD is the process of making products and/or services in a more sustainable way in terms of achieving an optimum balance between environmental protection, social equity and economic prosperity throughout their entire lifecycle (cradle to cradle) while still meeting traditional product and service requirements. The SPSD approach is a model for implementing SPSD throughout the complete lifecycle of a product and/or service and the associated supply chain. It aims to identify, assess and implement the options for optimising sustainability in product and/or service development. The SPSD approach integrates with existing Sustainable Development approaches for industry e.g. Clean Technology and builds on existing Sustainable Product Development initiatives. However, SPSD uses a new approach which targets the product supply chain rather than individual companies which traditional environmental performance improvement methods target. SPSD represents an innovation in the approach and framework conditions for developing sustainable products and services in industry.

The SPSD approach incorporates measures to eliminate, where possible, or overcome the barriers identified. Key elements of the SPSD approach which are designed to overcome the identified barriers discussed in section 3.0 above include the following:-
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• Using the supply chain dynamics for specific product and service supply chains to determine the most effective target organisations and ways to implement SPSD in the first place.

• In implementing SPSD in an organisation:-

  ⇒ Use of a strategy level approach with sustainability and the development of sustainable products and services as a corporate aim, which is integrated into existing business systems to include product and service development systems;
  ⇒ Use of a simple, flexible, practical approach incorporating the requirements of industry;
  ⇒ Use of existing business language.

• In product and service development:-

  ⇒ Focus on the provision of functions rather than products and determine the optimum sustainable system to provide the function to include the consideration of services and PSS;
  ⇒ Incorporate all lifecycle phases from product conception (when their only is a function) through to end of life (incorporating all reuse, recycling and disposal options, as relevant);
  ⇒ Optimise sustainability criteria (environmental, social and economic issues) with traditional product and service criteria.

3.1 Applying the SPSD Approach

The SPSD approach was tested on a representative group of companies (with varying activities, products and services, industry sectors, sizes, role in supply/value chain). The results of the implementation of
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SPSD illustrated sustainability benefits as well as other benefits. The original barriers were overcome with the exception of the social impacts.

The key sustainability benefit was the development of more sustainable products and services in terms of their ecological soundness and economic efficiency with some albeit limited social impact. The limited social impact reduction was due to a number of factors, but mainly as the companies were hesitant to investigate the social impacts to the same comprehensive level as the environmental and economic impacts, hence greater social impact reduction could not be achieved. The reduced environmental impacts varied per product and service but included dematerialization through a PSS approach as well as a range of eco-efficiencies e.g.

- Reduced volume of raw materials;
- Eliminated and/or reduced hazardous raw materials usage;
- Reduced energy usage;
- Eliminated/reduced waste generation.

On the economic front cost savings and competitive advantage were the key benefits. Other benefits identified included:–

- improved product and/or service functionality;
- new markets;
- new marketing opportunities;
- opportunities for innovation;
- capability building;
- improved supplier relationships;
- enhanced corporate reputation.
4.0 Conclusion

This paper highlights some of the barriers (identified as part of a larger research project on SPSD) to the development of sustainable products and services within existing product systems in industry and suggests ways to eliminate or overcome these barriers.

Overall, the proposed way to eliminate or overcome the barriers outlined is to be cognisant of their existence and eliminate/overcome their occurrence through the SPSD approach introduced. SPSD provides a model for the development of sustainable products and services with this in mind. Having identified these barriers, the SPSD model aims to resolve these problems using a pragmatic implementation method designed to meet the needs of key stakeholders, most notably industry, people and the planet. While the focus of this paper has been on overcoming the barriers identified, further details on the wider SPSD model are available in Maxwell and van der Vorst, 2003. Having tested this model in manufacturing industry, the main barriers outlined were eliminated or reduced. The results were the development of more sustainable products and services with key sustainability benefits (in particular environmental and economic) as well as other benefits which include improved corporate reputation, supplier relationships, capability building and opportunities for new markets and innovation.

References


STP, (2003), Sustainable Technologies Programme (STP) of the UK Economic and Social Research Council (ESRC) website, www.sustainabletechnologies.ac.uk/home.htm