

# **The creativity gap? – bridging creativity, design and sustainable innovation**

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## **1. Abstract**

The call for a radical transformation of global socio-technical systems to avert the worst potential impacts of climate change, global financial shocks, social inequality and resource depletion is growing louder by the day. Innovation is presented as a key mechanism for productive growth in the economy and there is an extensive body of literature addressing the interface between innovation and sustainability. Until recently, design as a creative process and business strategy has been underrepresented in the innovation literature. Design has also been underrepresented in the sustainable development and sustainable consumption and production literature. There are a number of reasons for this. Thomas [1] suggested that political scientists, economists or environmental scientists, with little or no design expertise, dominate the research field. But it is also true that design and creativity are elusive concepts and can evade formal measurement and analysis.

The general focus in the literature on technological innovations fails to prevent a complete picture of the role of design insofar as many innovations are based on novel designs or concepts as opposed to technical novelty [2,3]. While the 3rd revision of the Oslo manual has extensive treatment of innovation outside of or ancillary to the development or use of technology it remains limited in scope [4]. The understanding of design is reaching beyond traditional perspectives on the design of products, services and brands towards more strategic considerations. This is also reflected in the discussion on the role of design and sustainable development. The discussions have evolved from primarily ecological concerns to integrated discussions on sustainable consumption and production, social innovation and economic development in the broadest sense. Added to this the issue of capacities and competencies for ecodesign is increasingly important in the discussion on public policy interventions to improve the sustainability of design practice.

To date the discussion on rationales for intervention in economic systems has been dominated by the market failure perspective. Recent discussions emerging from the evolutionary economics and innovation systems literature place a greater emphasis on systems failure as a rationale for intervention [5,6]. As identified by Smith [7], some of the areas of concern include failures in infrastructure provision and investment, lock-in failures and institutional failures as opposed to recreating market conditions or optimum economic efficiency. Some of the key characteristics of systems failure interventions include increased collaboration and interactivity, learning and tacit knowledge, innovation capacity building, flexible and responsive policy frameworks and increased policy coherence.

This paper will seek to highlight the “creativity gap” in the discussion on sustainable innovation as a response to climate change. To do this it will discuss the issue of intervention to support ecodesign with a specific emphasis on capacity building,

systems failure and ecodesign practice. It will focus on key but inherently difficult entry points for intervention within small to medium sized enterprises. The paper will draw on insights from the literature alongside empirical insights from a pilot programme of ecodesign intervention in Wales. The paper will also propose a conceptual framework for interpreting capacity building for ecodesign and highlight how this framework can inform future policy interventions in the UK and Europe.

## **2. Introduction**

Innovation, in its broadest sense, will be central to any response to climate change. Innovation has become increasingly complex with a greater commercial and academic emphasis on the need for open, systemic and potentially disruptive innovation. This emerging systemic context requires interdependent approaches to innovation alongside new commutual innovation drivers (e.g. risk capital), innovation models, policy mechanisms and forms of governance. The need for commutual innovation drivers has been brought sharply into focus by the economic downturn especially for those small to medium sized enterprises (SMEs) in low-tech sectors. Ideally a lack of private investment should not halt research and development, interactive learning and knowledge exchange activities. There is a need to find new ways to bring about innovations, incremental or radical, and products and services that are better adapted to the new context of climate change and economic instability.

While innovation has been the cornerstone of national and transnational strategies for growth and competitiveness its role in addressing sustainability concerns such as climate change, sustainable consumption and the ageing society is increasingly recognised and understood. While there is no generally accepted definition, the literature has presented a number of different perspectives on the role of innovation in this context [8-13]. Terms such as sustainable innovation, eco-innovation and low carbon innovation offer complementary frameworks aimed at decreasing social and environmental impacts of products or services.

A key common theme across the various frameworks is the importance of understanding the full life cycle impacts of the innovation, and at all stages throughout the life of a product or service. In terms of environmental impacts, Huber [14] suggested that the biggest resource efficiency gains can be achieved in the upstream part of the value chain e.g. the raw material and design stage. While it is of significant importance, the downstream phase of the product life cycle (e.g. consumption, use and disposal) still is contributing less to the overall environmental burden of the economy. This contributes to the case for better interventions in the upstream stages of the value chain.

Traditionally, key factors to consider when studying an innovation (or a series of innovations) include the degree of novelty, scale of risk, level of investment required and the impact on the organisation, in particular in terms of adding value. In the debates on sustainable innovation the incremental, radical or systemic nature are of key significance. Incremental innovations are generally defined as technical, applied to existing products and services. Radical innovations are born out of technological breakthroughs leading to the development of new modes of practice, behaviour and business. They infer a technological discontinuity whereas systemic innovations require a greater degree of complementary innovations across the value chain,

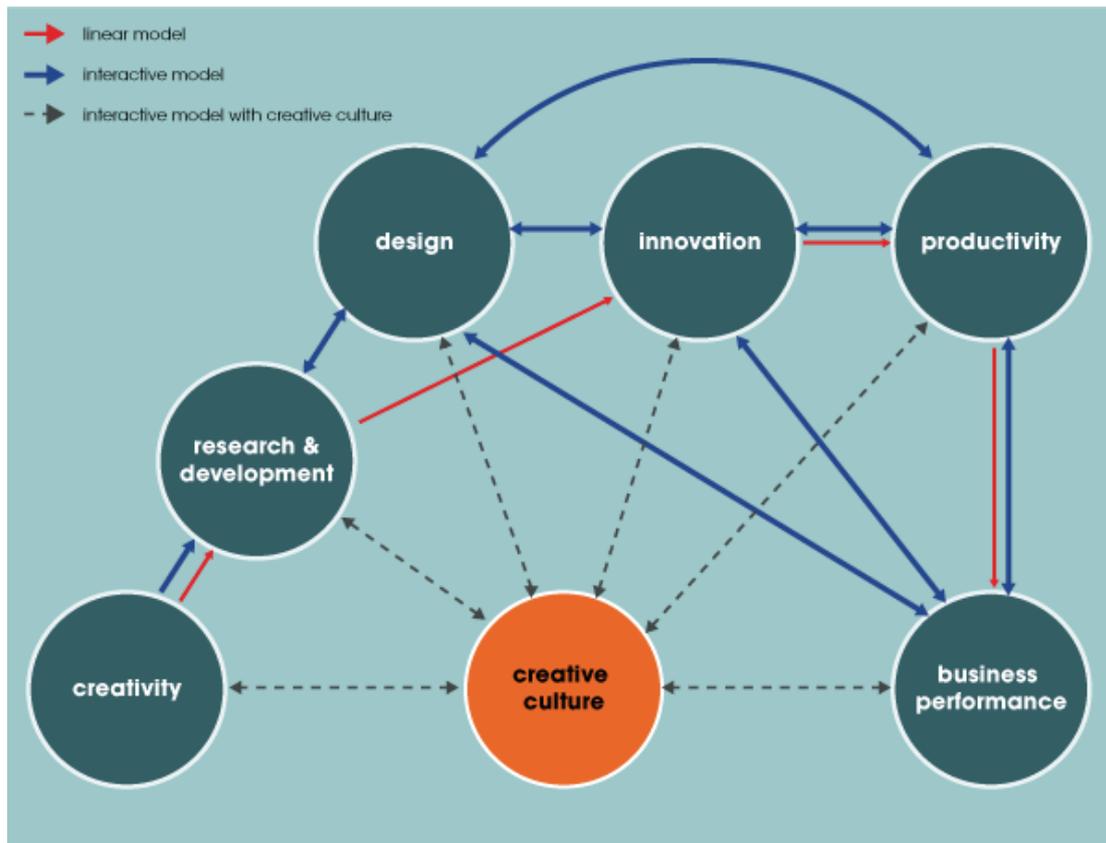
innovation system or socio-technical infrastructure. This multi-level perspective of systemic innovation has been the focus of research in recent years. It is recognised that incremental innovations are an important engine of productivity and therefore contribute to radical innovation. While radical innovations can present the greatest scope for change (e.g. renewable energy production over fossil fuels) incremental innovations can be equally important from a policy and commercial perspective.

Until recently design has been underrepresented in the innovation literature and in innovation policy discussions. In 2006, the European Commission put forward a communication document outlining its innovation strategy. This document, “Putting knowledge into practice: A broad-based innovation strategy for Europe” is a step forward in recognising the need to broaden the scope and intent of innovation policy. This strategy emphasised that ‘while technological innovation is important, there is at least as much scope for non-technological innovation, for example through changes in business models, better design and process organisation’. This broadening of scope sees a shift in emphasis from technology driven innovation towards user focussed and demand-led innovation. This incorporation of user-centred innovation allows for the development of a greater level of coherence on the role of design in innovation policy. This incorporation of user-centred innovation also increases the scope and importance of exploring the interface between creativity, design and sustainable innovation.

### **3. Creativity, design and innovation**

Creativity is regarded as one of the more enigmatic, compelling and little understood aspects of human thinking. De Bono [15] suggested that creative thinking is the ability to use a variety of unconventional methods to explore numerous innovative solutions. Csikszentmihalyi [16] suggested that creativity is the ability to communicate extraordinary thoughts, critically affect perception of reality and to develop original inventions. Thinking creatively involves perceiving situations from new perspectives and generating novel ideas for solving complex problems [17]. Florida [18] defined three different ‘types’ of creativity; technological creativity (invention), economic creativity (entrepreneurship) and artistic/cultural creativity. These different dimensions of creativity are interrelated and mutually reinforcing.

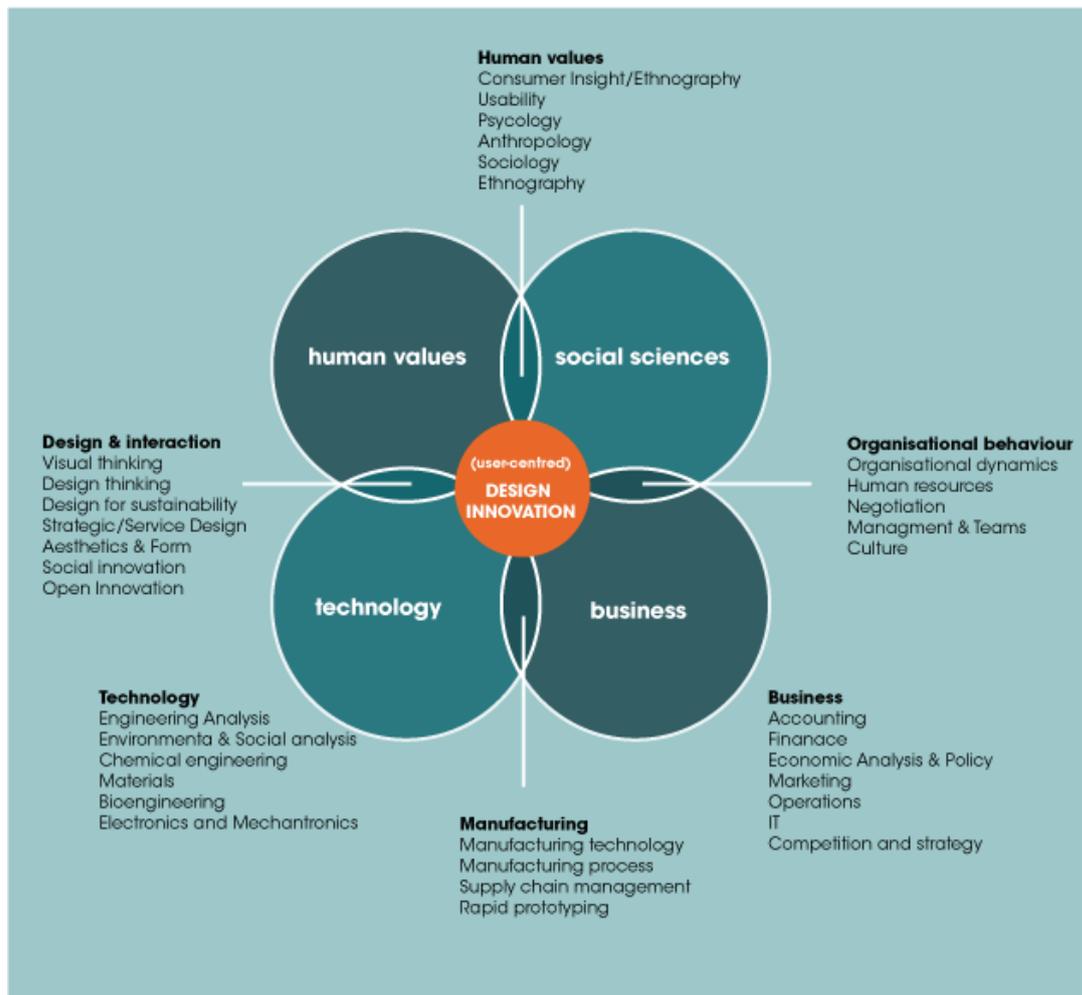
Creativity is a pre-requisite for innovation and design. Swann and Birke [19] developed three different models positively linking creativity and design to innovation (Figure 1). In these models they differentiated between the linear (red line), interactive (blue line) and interactive in the context of a “creative climate” (dashed line). The interactive model displays a greater degree of complexity than the linear model by incorporating feedback loops that occur in innovation. Through the interactive model, Swann and Birke also emphasise the importance of design. The final model that incorporates the “creative climate” is the most complete model. It has been argued that “creative climate” or creative culture is the single most important influence on the innovative potential of the company. Zaltman (in [20]) suggests that “... the daily environment provided by a firm is the single most important determinant of innovative thinking among its personnel. An effective intervention in that environment is far more productive than efforts to intervene in the individual manager’s thinking.”



**Figure 1: linking design innovation and creativity - adapted from Swann and Birke 2005 [19]**

In the context of this paper, creativity and design play a leading role in enhancing the competitiveness of business and regions. This role can be viewed through the design of new products and services to their production, marketing and distribution. The product design industry covers a very broad group of activities but is a subset of the design and creative industries. The design industries include interior, product, packaging, furniture, web and digital media, graphic, spatial, apparel, fashion and service design. In general, product designers are trained in trans-disciplinary environments incorporating notably engineering, visual arts, ergonomics, marketing, management, entrepreneurship and business. Designers are uniquely positioned to combine multidisciplinary talents of aesthetics, engineering and physical sciences while incorporating an appreciation of culture, values and preferences of clients and consumers of their products.

Design is often the link between technology, creativity, business and the user (Figure 2). The role of design, as a complementary asset for competitiveness, in SMEs is especially important in the context of mature consumer markets where technological innovations only gain marginal returns. In these markets, functional and aesthetic innovations play a greater role. Design becomes a mechanism by which the intangible assets of products and services such as lifestyle, behaviours, culture, gender and needs can be considered. Therefore, in the context of sector competition based on non-price characteristics, the command of a greater array of complimentary assets can allow design-led businesses to innovate and remain competitive.



**Figure 2: User-centred design innovation - modified from Stanford DSchool [21]**

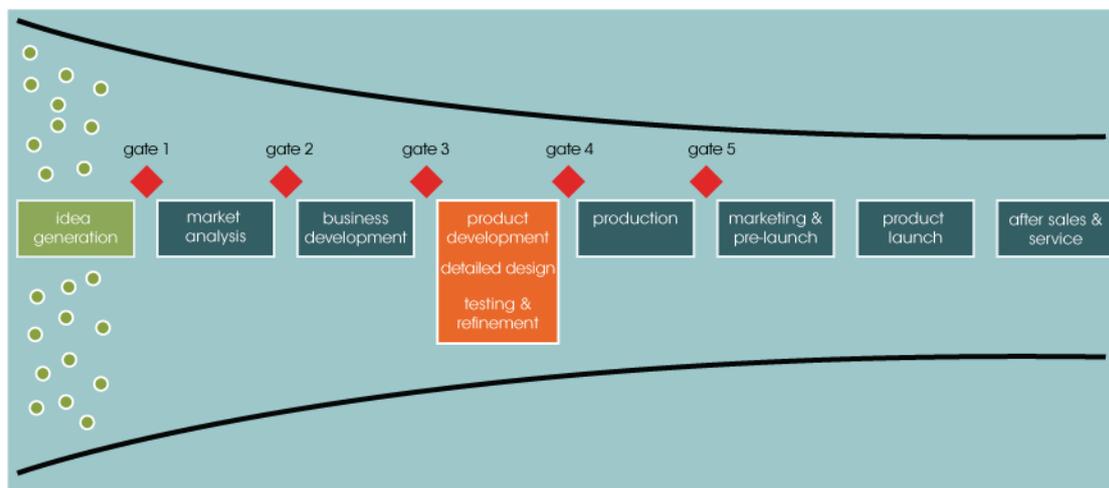
Studies on the impact of design on firm performance and regional development are hindered by the lack of commonly agreed statistical measures. This can create difficulty when establishing causality and defining any correlation between design input and firm performance. However, a number of studies have drawn correlations between expenditure of design and increased productivity and competitiveness. [22,23,2,24]. While design can be a functional element of R&D, it also plays an important role in those sectors with little or no R&D activity. Tether [2] argues that design activities link between the various categories of R&D while complementing all stages of the innovation process.

#### **4. New contexts for design practice in sustainable innovation**

As evidenced by recent European policy discussions [25], the innovation policy debate is shifting towards a user-centred approach as opposed to an emphasis on a technological push. In this debate, design is a complementary asset for competitiveness but also a facilitator of solutions for societal problems. These societal problems include sustainability challenges such as climate change, changing demographics such as an aging population and social exclusion. These new economic contexts mean that designers require new competencies in terms of design management, innovation, service and strategic design. The new social contexts mean that they require new competencies in terms of transformation and participatory

design, socio-entrepreneurship, user-centred and ethnographic design. Also, the new environmental contexts mean that designers require new competencies in terms of ecodesign, sustainable innovation and responsible design. There is a dynamic interplay between these disciplines. The authors suggest that in this interplay boundaries become blurred and definitions lose their meaning. “Good design” lies at the intersection between these disciplines.

The ongoing processes of globalisation are making design an increasingly fragmented and geographically diffuse activity that crosses international time zones and cultural barriers. Linear, staged and endogenous models have dominated research on product and service development (Figure 3). These models, while providing useful frameworks are increasingly insufficient in portraying the complexity of product and service development in the context of global supply chains, distributed manufacturing, disruptive innovation and ecodesign<sup>1</sup>. Design often has an exogenous organisational structure with complex external relationships, distributed communication channels and multiple stakeholders representing potentially higher risk.



**Figure 3: Generic product development process - adapted from Ulrich and Eppinger 2004 [26]**

Within the different design models or funnels there are a number of management frameworks and tools that provide insights on the outcomes or analytical processes of designing in a more sustainable manner. These include full life cycle analysis, full life cycle costing, new material considerations and increased standardisation. These frameworks are often challenging for designers and design managers as they incorporate processes and technical requirement outside of traditional design expertise. In the context of sustainability designers are also required to consider new social contexts such as social exclusion, poverty, gender parities and politics. There are a number of areas that often remain overlooked in the literature such as adaptations needed for business organisations to put this knowledge into practice and the key capacities and competencies required by designers to implement these frameworks and tools.

#### 4.1. *A new role for design-led businesses*

<sup>1</sup> It is important to note that when the authors use the term ecodesign they include all perspectives on the role of design in SD, e.g. sustainable design, social design and potentially transformation design.

Luttrupp [27] defined 33 key demands to be considered in product development and this may be supplemented by additional context specific demands for example in relation to particular technologies, market structures or social impacts. Environmental and sustainability considerations are one of many demands guiding a product development strategy. Therefore, it is important to emphasise that designing in a more sustainable manner is an ongoing learning process that requires strategic flexibility and adaptability. While there are many management frameworks to facilitate the process, a key challenge is the development of organisational capacity to absorb these evolving insights and to integrate them into a company's design function.

The strategic management and organisational theory literature presents a number of classifications of competencies and how these relate to design and innovation activities. Although viewed from the perspective of capabilities (range of collective skills), Hou [28] presented a framework of sensing, absorption, integration and innovation. This classification describes the competencies required within an organisation to be able to sense and understand market dynamics, absorb new knowledge and information, integrate this into existing infrastructure and innovate and develop new products and services. Another dominant classification, originally proposed by March [29], is split over the two dimensions of "exploration" and "exploitation". This perspective predominantly focuses on the ability to create value through exploratory innovation and gain competitive advantage through the commercial exploitation of that innovation.

There is no single actor that can solve the various and increasingly complex design problems. It is important to develop a shared framework of design competencies born out of mutual values and understanding of sustainable innovation. Through previous research and based on the literature, the authors proposed a conceptual framework of competencies for design practice in the context of sustainable innovation (Table 1). This framework is split across the two dimensions of "exploration" and "exploitation", as identified by March [29], and presents an integrated framework of six competency clusters. Because designers are expected to be adaptive, innovative and creative the framework is not universally prescriptive. The conceptual framework is intended to act as a guide on key competencies as opposed to an arbitrary list of skills and intended outcomes. One of the overriding characteristics of the framework is the connection and balance between explicit and implicit knowledge. This puts forward the notion that designers will have to learn to think and act in a more integrated way by taking into account the many interrelations between perspectives or issues that they may encounter.

It is accepted that to design in the context of sustainable innovation an organisation or company requires more than design process modifications or additional data analysis. The organisation requires a strategic understanding of the multi-stakeholder context - whether this context is exogenous or endogenous. There is a need for organisational learning and cross functional integration. This involves the creation or expansion of co-ordination channels and knowledge hubs. This is a challenge for the design management system as it requires communication feedback across groups that would traditionally be integrated. If companies can facilitate these strategic changes they set the conditions for proactive and agile design processes capable of sustainable innovation.

Table 1. Conceptual framework of competencies for ecodesign practice

Exploration competencies	Exploitation competencies
<p><b>Cluster 1: Creativity</b></p> <ul style="list-style-type: none"> <li>• Ecological/systems thinking</li> <li>• Collaborative and communication skills</li> <li>• Openness to ideas from all sources</li> <li>• Creative idea generation</li> <li>• Idea management</li> <li>• Integration of holistic thinking</li> <li>• Integrated problem solving</li> </ul>	<p><b>Cluster 4: Analytical</b></p> <ul style="list-style-type: none"> <li>• Environmental impact measurement</li> <li>• Life Cycle Analysis, carbon/eco footprint</li> <li>• Eco-materials knowledge</li> <li>• Understanding cost implications</li> <li>• Energy, packaging auditing</li> </ul>
<p><b>Cluster 2: Culture and values</b></p> <ul style="list-style-type: none"> <li>• Broader awareness and attention to context</li> <li>• Goal-oriented problem identification and problem-solving</li> <li>• Questioning and challenging</li> <li>• Respect for individuals</li> <li>• Cross cultural/gender awareness</li> <li>• Acquisition of environmental / sustainability knowledge</li> <li>• A desire and ability to facilitate change</li> </ul>	<p><b>Cluster 5: Organisational</b></p> <ul style="list-style-type: none"> <li>• Legislation and Regulatory Compliance</li> <li>• Understanding of risk</li> <li>• Understanding low carbon and resource efficiency</li> <li>• 3R Implementation (Reduce, Reuse, Recycle)</li> <li>• Ability to blend of creativity &amp; control</li> </ul>
<p><b>Cluster 3: Intelligence &amp; insight</b></p> <ul style="list-style-type: none"> <li>• T-shaped skills profiles</li> <li>• Eco-literacy/sustainability issues</li> <li>• Understanding and using networks for learning</li> <li>• Understand new contexts for design &amp; innovation</li> <li>• Awareness of own performance and limitations</li> <li>• Commitment to understanding both current and future (unarticulated) needs</li> <li>• Structured thinking about the future / scanning the horizon</li> <li>• Ability to deal with ambiguity, contradiction and trade-offs</li> <li>• Awareness of future trends</li> </ul>	<p><b>Cluster 6: Methodological</b></p> <ul style="list-style-type: none"> <li>• Design methods, methodologies and processes</li> <li>• Knowledge of manufacturing techniques, materials and impacts</li> <li>• Understanding of consumer behaviour/psychology</li> <li>• Technology, prototyping, modelling and visualisation</li> <li>• Design for X's (e.g. recycling, disassembly, re-use, remanufacture)</li> <li>• Ability to develop new core competencies</li> <li>• Ability to filter and select ideas on basis of fit to core competencies</li> <li>• Recognition, screening and selection of new ideas</li> </ul>

## 5. Public policy interventions for ecodesign

While there is extensive literature on methodologies, strategic and operational drivers and potential first and second order additionality from applying ecodesign and sustainable innovation, the implementation by industry remains low or marginal to overall business strategies [30,10,31-36]. In the context of climate change and sustainable consumption and production, the authors contest that this represents a rationale for government intervention and an exploration on possible short-coming on current models of intervention. Over, the last decade a number of regional and local consulting programmes on sustainability issues for companies across Europe have been developed. A number of these programmes and interventions related to the implementation of ecodesign in SMEs. While these programmes took many forms [32,37], the primary mechanisms of intervention included the provision of information services, demonstration projects, R&D financing, grants, establishing co-ordination bodies and ‘brokering’ services.

Although longitudinal data is lacking, research suggests that many interventions do not facilitate second order additionality or sustainable changes in SME ecodesign practice. Previous research by the authors identified potential reasons for this including limited project scope, restrictive budget cycles, fragmented support mechanisms and lack of consideration of broader institutional contexts [32]. This research also highlighted that the perceived low level of additionality may be related

to how the intervention was monitored and evaluated. Difficulties in evaluation of these interventions include attribution of intervention to additionality and spill-over effects, time-lag between commercialisation and intervention, the measurement of qualitative effects such as improved absorptive capacity, competencies of SMEs and improved networks [38].

O'Rafferty et al [39] also suggested that these interventions were based upon linear, neoclassical interpretations of innovation. This approach assumed that knowledge is generic, codified, immediately accessible and directly productive and that there is no difference between capabilities, knowledge and information [40]. This allowed interventions to occur without consideration of the wider institutional context. This linear model of innovation is broadly contested and has given way to the recognition that innovation is an interactive, dynamic and non-linear process. It is therefore important to establish a framework of analysis that can incorporate the richness and interactivity of innovation in the context of national and regional innovation systems.

### *5.1. A systems failure rationale for ecodesign intervention*

The dominant rationale for state intervention in economic systems is market failure. This dominant rationale, grounded in the neo-classical economic perspective. The neo-classical perspective does not emphasize the economic structure and the institutional framework in which innovation takes place [41]. Recent discussions emerging from the evolutionary economics and innovation systems literature place a greater emphasis on systems failure as a rationale for intervention [5,6]. System failures refer to the regulatory, structural and institutional deficiencies that effect innovation activities.

Following from this, the system failures rationale provides for interventions that address structural and institutional deficiencies. It explicitly infers that innovation is driven by the collaboration and interaction between different actors, institutions, knowledge flows and market conditions. In this context the systemic approach is less focussed on the micro level (e.g. firms and consumers) and more geared towards the collective level (e.g. regions). The systems perspective emphasises the importance of interaction and interactive learning among all actors in the system. In the case of systems failure, the processes of intervention are similar in the case of market failure although the process is not focussed on recreating market conditions or optimum economic efficiency. Some of the key characteristics of systems failure interventions include increased collaboration and interactivity, a focus on learning and tacit knowledge, innovation capacity building, flexible and responsive policy frameworks and increased policy coherence. Scott-Kemmis et al. [42] identified a selection of key principles that may be adhered to when developing interventions based on system failure. The intervention should;

- Provide mechanisms for increased collaboration, particularly in the area of public-private partnerships for the purpose of analysing opportunities, diagnosing problems, exploring options and strategic planning
- Facilitate learning and build company sustainable innovation capability
- Ensure flexibility within the policy framework itself to ensure responsiveness to changes in the innovation landscape as interventions impact on the elements within the system

Based on the empirical and theoretical evidence of barriers to ecodesign implementation and intervention the authors present a framework of evidence towards systems failure (Table 2) as a rationale for ecodesign intervention. This is based upon a systems failure framework put forward by Woolthuis [6].

*Table 2: Systems failure framework*

Category	Failure
Infrastructure	<ul style="list-style-type: none"> <li>Low representation of ecodesign indicators in government R&amp;D programs</li> <li>Low levels of investment in ecodesign related R&amp;D</li> <li>Inadequate numbers of ecodesign support providers</li> <li>Low awareness by firms of emerging ecodesign related issues in key markets</li> <li>Lack of exposure to formal and informal ecodesign education and training</li> <li>Lack of alignment between ecodesign providers and industry</li> <li>Low utilisation of external knowledge providers</li> <li>Lack of support for intermediary organisations to build capacity in ecodesign</li> <li>Unclear market signals and demands</li> </ul>
Institutions	<ul style="list-style-type: none"> <li>Actors can not or will not act due to uncertainty and poor appropriability</li> <li>Competing policy rationales (e.g. environment and innovation)</li> <li>Government information asymmetries</li> <li>“Public-good” nature of investment</li> <li>Lack of policy supply and demand coherence leading to uncertainty and investment inefficiencies</li> <li>Regulators inflexible and too slow to change</li> <li>Regulators lack resources and expertise to address ecodesign issues</li> <li>Time lag between R&amp;D intervention and commercialisation</li> </ul>
Interaction and networks	<ul style="list-style-type: none"> <li>Little structured co-ordination of public-private partnerships or triple helix networks</li> <li>Lack of external support (training, advisory services etc.) to develop ecodesign led innovations</li> <li>Organisational thinness in innovation and ecodesign support</li> <li>Lack of information on potential markets (niches)</li> <li>Limitations of the local markets (too small, low expenditure)</li> <li>Fragmented value chain structures</li> <li>Low levels of collaboration between technology commercialisers, international partners and R&amp;D providers</li> </ul>
SME capability	<ul style="list-style-type: none"> <li>Fragmented product development process in SMEs</li> <li>Lack of managerial and operational resources</li> <li>Failure of managers to harness the strategic considerations</li> <li>Lack of viable technology options or alternatives</li> <li>Lack of awareness of viable technology options</li> <li>Lack of clear internal ecodesign or innovation strategies</li> </ul>
Culture	<ul style="list-style-type: none"> <li>Lack of top management commitment</li> <li>Lack of awareness, training, and motivation of employees</li> <li>Sustainability (environmental and social) viewed as periphery of core business</li> <li>Poor perception of ecodesign by investors</li> <li>Risk averse attitudes and resistance to engaging in new business opportunities through ecodesign</li> <li>Low levels of trust in intermediary and business support organisations</li> <li>Focus on short-term investments</li> </ul>

## 5.2. *A new role for governments*

The system failure rationale is a recognition that many innovations and many aspects of the innovation process occur outside the market economy. Therefore, in the context of this paper, the role of the government is taken as develop, promoting and evaluating policy structures that facilitate creativity, sustainable innovation and interactive learning. National innovation systems require governance and oversight but the system failure rationale also implies a central role for government not only in providing key elements in the innovation system (intermediary organisations, policy

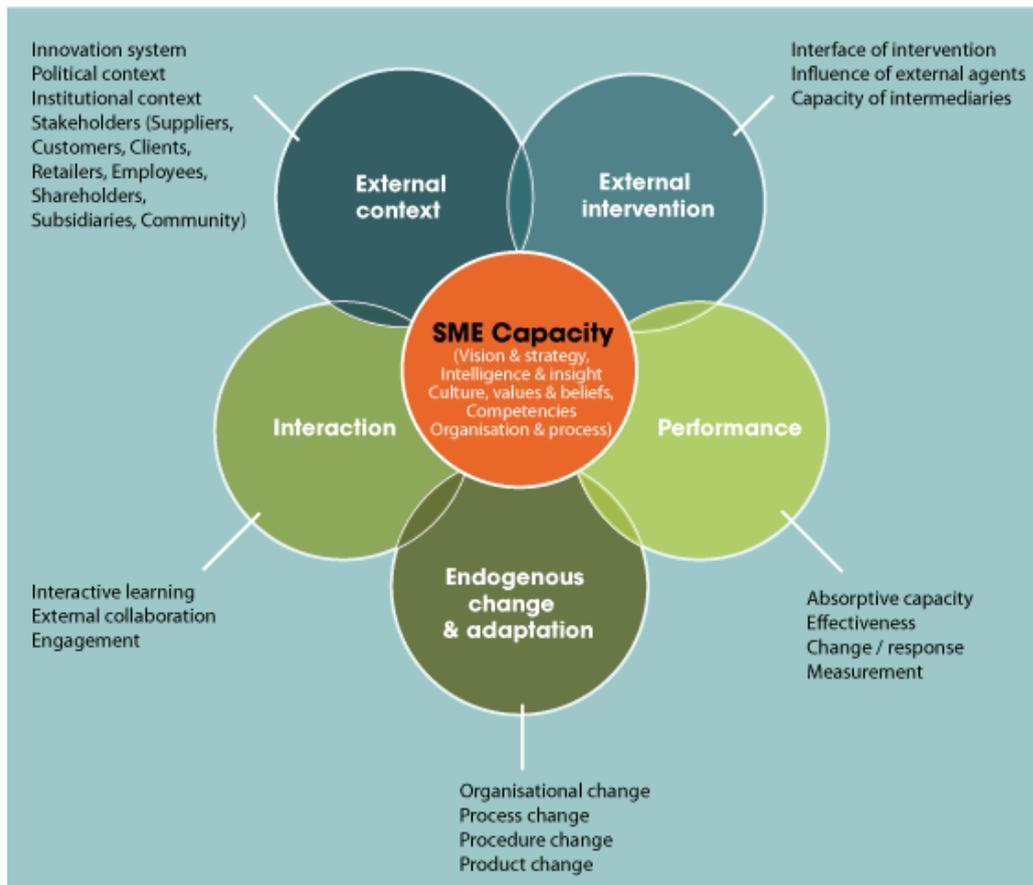
departments, education systems), but also in identifying the linkages and networks between actors which make up the system. Where links are missing, suboptimal, or non-existent, government has a role in identifying such systems failure and providing resources to address the problem.

Through ensuring appropriate framework conditions the government can affect a variety of factors outside of the direct control of industry. These factors include the regulatory framework, intellectual property rights, the competitive environment and networks across and between different creative sectors. Governments can also play a leading role in creating demand for ecodesign and sustainable innovation through the procurement process. Governments also have a role through facilitating change in formal education systems. This includes enhancing the supply of creativity and design skills suitable for sustainable innovation but also ensuring that the strategic management and general business skills are improved.

In a previous publication, O'Rafferty and O'Connor [43] presented a capacity building framework to inform the discussion on interventions for ecodesign (Figure 4). The concept of capacity building provides a useful vocabulary by which the dynamic context of ecodesign and ecodesign interventions can be explored. The complexity underpinning ecodesign intervention in SMEs is partly born out of the interdependency between the internal and external contexts of ecodesign practice. The framework is informed in part through the systems failure literature, empirical evidence from national ecodesign interventions and a capacity building framework developed by Morgan [44]. The framework contributes to the discussion through consideration of several dimensions of ecodesign intervention. These different dimensions include the role of interaction and learning networks, company capabilities, absorptive capacity and structural conditions. This framework allows for the evaluation of ecodesign interventions in the context of system failure while providing an analytical structure through which the development of new interventions can be explored.

Within the framework, the external context broadly refers to the main elements of the innovation system within which the SME is operating. While there are many different contextual, theoretical, normative and temporal interpretations, the innovation system broadly refers to the institutional, organisational, economic, socio-political factors that determine and diffuse innovations. This representation highlights the role of the institutional or structural framework of a region, the companies of that region (including knowledge structures) and the public and semi-public knowledge exchange institutions. It also highlights the role of clusters, networks, incubation centres.

Because an optimum level is difficult to define it would suggest that there is a dynamic interplay across the dimensions of capacity building. This interplay can be observed through the interface between the SMEs and the intervention, the types of endogenous change and the varying level of performance across a range of businesses. Other common issues of interest include the behavioural additionality that can be observed through a range of endogenous changes, deterioration and decay of performance during the post-intervention period the role of interactive and inter-company learning. The time lag between intervention and commercialisation can prevent a robust analysis of these dimensions of capacity building.



**Figure 4: Capacity building framework**

Evidence suggests that the interaction between SMEs and between SMEs and intermediary organisations requires structured co-ordination. Therefore future processes of intervention should focus on a longer term strategy of building knowledge infrastructure aimed at innovative capacities on the regional or national level. Despite the differing local contexts, organisational characteristics and performance measures the systems failure framework presented suggests a number of common capacity building themes that should be built into future intervention strategies. These include;

- using and developing local knowledge networks and partnerships
- facilitating longer-term trust-based relationship between businesses and intermediary organisations
- improving supply and demand side policy coherence
- facilitating higher order innovation (e.g. organisational and managerial innovation)
- balancing a technology focus with other forms of innovation
- providing inspirational platforms that allow for interactive learning
- improving formal and non-formal education systems for sustainable innovation
- setting framework conditions that enable open innovation – and potentially disruptive innovation
- supporting more demand than supply side of innovation (ex ante analysis)
- developing social capital

## **6. Conclusions and discussion**

This paper highlighted the need for a deeper understanding of the link between creativity, design and sustainable innovation. To achieve this, the paper discussed the issue of intervention to support ecodesign with a specific emphasis on capacity building, systems failure and ecodesign practice. It addressed some key but inherently difficult entry points for intervention within SMEs. The paper also presented a conceptual framework for interpreting capacity building for ecodesign while highlighting how this framework can inform future policy interventions in UK and Europe.

The theoretical foundation of systems failure builds a new dimension to the literature on interventions for ecodesign. It highlights a possible framework through which national and regional governments can reconsider capacity building interventions for ecodesign, especially in SMEs. The supporting research also highlighted the potential complexity of meso-level interventions that seek to address the content and direction of micro-level design practice. This complexity is primarily driven by the idiosyncrasies of SME organisations and their behaviour along with the multi-dimensional nature of ecodesign.

Evidence suggests that SMEs require a flexible and evolving intervention model that can compensate for a lack of structured coordination of ecodesign activities. The intervention requires guiding structures, both formal and informal, while not being overly prescriptive. There is a potential risk of an overly rigid and linear intervention model giving rise to the formalisation paradox, where the key actors seek to formalise processes and activities that are generally intuitive and open leading to static and rigid development. This would run counter to the often intuitive and non-linear process of product design and development in SMEs.

Above all, the research reinforces the need to break old social and organisational 'silos' while creating new collaborative contexts for design and innovation. This is especially important in the context of sustainable innovation and ecodesign as potentially key aspects of an overall solution to combat climate change. Capacity building interventions should enable creativity and interactive learning at a personal, organisational and regional level.

## 7. References

- [1] A. Thomas, "Design and sustainable development: what is the contribution that design can make? A case study of the Welsh Woollen Industry," *Proceedings of DRS2008*, Sheffield, UK : 2008.
- [2] B. Tether, *Think piece on the role of design in business performance*, London : DTI, 2005.
- [3] J. Whyte, *Management of creativity and design within the firm*, London: DTI, 2005.
- [4] OECD, *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, Brussels: OECD Publishing, 2005.
- [5] C. Chaminade and C. Edquist, "Rationales for public policy intervention in the innovation process: A systems of innovation approach," 2007.
- [6] R. Woolthuis, M. Lankhuizen, and V. Gilsing, "A system failure framework for innovation policy design," *Technovation*, vol. 25, Jun. 2005, pp. 609-619.
- [7] K. Smith, "Innovation as a Systemic Phenomenon: Rethinking the Role of Policy ," *Enterprise & Innovation Management Studies*, vol. 1, 2000, pp. 73-102.
- [8] J. Speirs, P. Pearson, and T. Foxon, "Adapting Innovation Systems Indicators to assess Eco-Innovation," France: 2008.
- [9] UNU-MERIT, ZEW, RISO, ICL, and LEIA, *Measuring Eco-Innovation*, 2008.
- [10] K. Rennings, R. Kemp, M. Bartolomeo, J. Hemmelskamp, and D. Hitchens, *Blueprints for an Integration of Science, Technology and Environmental Policy (BLUEPRINT)*, Centre for European Economic Research (ZEW), Mannheim, 2004.
- [11] R. Kemp, M.M. Andersen, and M. Butter, *Background report about strategies for ecoinnovation*, Netherlands: VROM, 2004.
- [12] M.M. Andersen, "An Innovation System approach to Eco-innovation – Aligning policy rationales," Berlin, Germany: Risø National Laboratory, 2004.
- [13] M.M. Andersen, "Eco-innovation – towards a taxonomy and a theory," *DRUID Conference Entrepreneurship and Innovation*, Denmark: 2008.
- [14] J. Huber, "Technological environmental innovations (TEIs) in a chain-analytical and life-cycle-analytical perspective," *Journal of Cleaner Production*, vol. 16, Dec. 2008, pp. 1980-1986.
- [15] E.D. Bono, *Lateral Thinking: A Textbook of Creativity*, Penguin, 1990.
- [16] M. Csikszentmihalyi, *Creativity: Flow and the Psychology of Discovery and Invention*, Harper Perennial, 1997.
- [17] R. Coyne, "Creativity as commonplace," *Design Studies*, vol. 18, Apr. 1997, pp. 135-141.
- [18] R. Florida, *The Rise of the Creative Class: And How It's Transforming Work, Leisure, Community and Everyday Life*, Basic Books, 2002.
- [19] P. Swann and D. Birke, *How do creativity and design enhance business performance?*, London: DTI, 2005.
- [20] B. von Stamm, *Managing Innovation, Design and Creativity*, John Wiley & Sons, 2003.
- [21] "Stanford Institute of Design | d.school | multidisciplinary approach," [http://www.stanford.edu/group/dschool/big\\_picture/multidisciplinary\\_approach\\_detail.html](http://www.stanford.edu/group/dschool/big_picture/multidisciplinary_approach_detail.html), 2009.
- [22] J. Haskel, M. Cereda, G. Crespi, and C. Criscuolo, "Creativity and Design Study for DTI using the Community Innovation Survey: DTI Think Piece," 2005.

- [23] M. Cereda, G. Crespi, C. Criscuolo, and J. Haskel, *Design and company performance*, London : DTI, 2005.
- [24] Design Council, *Design Index: The Impact of Design on Stock Market Performance*, London: Design Council, 2005.
- [25] EC, *Commission staff working document: Design as a driver of user-centred innovation*, Brussels: 2009.
- [26] K.T. Ulrich and S.D. Eppinger, *Product design and development*, Boston: McGraw-Hill/Irwin, 2004.
- [27] C. Luttrupp, "New focus on EcoDesign in the context of environmental demands and business options," *Growth through business innovation and entrepreneurship*, Lausanne, Switzerland: International Association for Management of Technology, 2001.
- [28] J. Hou and H. Chang, "Exploring the Core Components of Dynamic Capabilities," Seoul: 2008.
- [29] J. March, "Exploration and Exploitation in Organizational Learning," *Organization Science*, vol. 2, 1991, pp. 71-87.
- [30] I. Belmane, I. Karaliunaite, H. Moora, R. Uselyte, and V. Viire, *Feasibility Study for Eco-Design in the Baltic States Industry, 2003-2004*, Copenhagen: 2003.
- [31] H. Millward and A. Lewis, "Barriers to successful new product development within small manufacturing companies," *Journal of Small Business and Enterprise Development*, vol. 12, 2005, pp. 379-394.
- [32] F. O'Connor and S. O'Rafferty, *Developing a Welsh Ecodesign Initiative Stage 1. Interim Report submitted to the Welsh Assembly Government, Cardiff. (unpublished, contact authors for details)*, Cardiff, UK: 2005.
- [33] A. Jönbrink and H.E. Melin, *How central authorities can support ecodesign: company perspectives*, Copenhagen: Norden, 2008.
- [34] A. Tukker, G.J. Ellen, and P. Eder, *Eco-design: Strategies for Dissemination to SMEs. Pt. 1, Overall Analysis and conclusions*, Brussels: Joint Research Centre, European Commission, 2000.
- [35] D. Maxwell and R. van der Vorst, "Developing sustainable products and services," *Journal of Cleaner Production*, vol. 11, 2003, pp. 883-895.
- [36] C. Nauwelaers and R. Wintjes, "Towards a new paradigm for innovation policy," *Regional Innovation Policy for Small-medium Enterprises*, UK: Edward Elgar Publishing Ltd, 2003, pp. 193-220.
- [37] A. Tukker and P. Eder, *Eco-design: Strategies for Dissemination to SMEs. Pt. 2, Specific studies*, Brussels: Joint Research Centre, European Commission, 2000.
- [38] P. Boekholt and J. Laroose, *Innovation Policy and Sustainable Development: Can Innovation Incentives make a Difference?*, Brussels: IWT-Observatory, 2002.
- [39] S. O'Rafferty, F. O'Connor, and I. Cox, "Supporting sustainable regional innovation and ecodesign in small to medium enterprises: a discussion on the issue with insights from Wales," Brussels: 2007.
- [40] J. Hauknes and L. Nordgren, "Economic rationales of government involvement in innovation and the supply of innovation-related services," 2000.
- [41] R. Lipsey and K. Carlaw, *Technology Policies in Neo-Classical and Structuralist-Evolutionary Models*, Paris: 1998.
- [42] D. Scott-Kemmis, M. Holmen, and A. Balaguer, *No simple solutions : how sectoral innovation systems can be transformed*, Canberra: Australian National University, 2005.

- [43] S. O'Rafferty and F. O'Connor, "Regional perspectives on capacity building for ecodesign – insights from Wales," *Sustainable Innovation, global and local partnerships (Tentative - In Print)*, 2009.
- [44] P. Morgan, H. Morgan, J. Bolger, D. Brinkerhoff, A. Land, S. Taschereau, D. Watson, and J. Zinke, *Capacity, Change and Performance: Study Report*, Brussels: ECDPM, 2008.