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Sustainable Innovation 09

Towards a Low Carbon Innovation Revolution

Part of the 'Towards Sustainable Product Design' series of conferences

14th International Conference
26th - 27th October 2009
Farnham Castle
Farnham
UK

Organised by:
The Centre for Sustainable Design

Supported by:
The Institute of Materials, Minerals and Mining

Programme

Day 1 - 26th October 2009

Chair: Lawrence Bloom, Deputy Chairman, Noble Cities Plc, UK, Chairman, Global Agenda Council on Urban Management, World Economic Forum, Switzerland, Chairman, Green Cities, Buildings and Transport Panel, Green Economy Initiative, United Nations Environmental Programme (UNEP), Switzerland

09:00	Registration *(Location: Stone Hall).*
09:30	Welcome and Introduction *(Location: Great Hall).* Martin Charter, Director, The Centre for Sustainable Design, University for the Creative Arts.
09:40	Sustainable Innovation - Global Dimensions *(Location: Great Hall).* Martin Charter, Director, The Centre for Sustainable Design, University for the Creative Arts.
10:00	Keynote: *(Location: Great Hall).* Dr David Wheeler, Dean of Management, Dalhousie University, Canada and Pro Vice-Chancellor and Dean (Designate) - Plymouth Business School, UK
10:40	Keynote: Government Policy Instruments and Low Carbon Innovation *(Location: Great Hall).* Candice Stevens, Consultant (former Coordinator, Sustainable Development, Organisation of Economic Cooperation and Development (OECD)), France.
11:10	Coffee and Networking *(Location: Dining Room).*
11:50	Financial Opportunities and Challenges of Low Carbon Innovation *(Location: Great Hall).* Tomoo Machiba, Senior Policy Analyst, Directorate for Science, Technology and Industry, OECD, France
12:25	Sustainable Public Procurement: a Driver for Low Carbon Innovation *(Location: Great Hall).* Shaun McCarthy, Director, Action Sustainability CIC Ltd and Chair, Commission for a Sustainable London 2012, UK
13:00	Lunch *(Location: Dining Room).*
14:00	Social 'Low Carbon' Innovation *(Location: Great Hall).* Chris Church, Director, Mapping for Change, UK.
14:35	Low Carbon Innovation: Incremental Steps to Giant Leaps *(Location: Great Hall).* Dr Belinda Howell, CEO, decarbonize, UK.
15:10	Coffee and Networking *(Location: Great Hall)*
15:40	Low Carbon Innovation: Results of Two 'State of the Art' Study Tours to California

	(Location: Great Hall). Orial Pascual, Business Developer, enviu, Netherlands. Herbert Enmarch-Williams, CEO, Inventurecatalyst, UK
16:40	Panel discussion: Towards a New Low Carbon Vision *(Location: Great Hall).* Chair: Martin Charter, Director, The Centre for Sustainable Design, University for the Creative Arts Panel: Candice Stevens, Consultant, France. Dr Mark Hinnells, Senior Researcher - Low Carbon Futures, Environmental Change Institute, Oxford University, UK. Shaun McCarthy, Chair of the Commission for a Sustainable London 2012 and Director, Action Sustainability CIC Ltd, UK. Chris Church, Director, Mapping for Change, UK. Tomoo Machiba, Senior Policy Analyst, Directorate for Science, Technology and Industry, OECD, France Finn Jackson, Change Management Consultant and Founder, Transition Towns - Farnham, UK.
17:50	Conference Summary *(Location: Great Hall).* Lawrence Bloom, Deputy Chairman, Noble Cities Plc, UK
18:00	Close and Drinks *(Location: Stone Hall).*
19:00	Entertainment *(Location: Great Hall).* Ballad and Swing
20:00	Conference Dinner Dining Hall, Farnham Castle
22:00	Close

Day 2 - 27th October 2009

Chair: Lawrence Bloom, Deputy Chairman, Noble Cities Plc, UK, Chairman, Global Agenda Council on Urban Management, World Economic Forum, Switzerland, Chairman, Green Cities, Buildings and Transport Panel, Green Economy Initiative, United Nations Environmental Programme (UNEP), Switzerland

08:30	Registration *(Location: Stone Hall).*
09:00	Introduction *(Location: Great Hall).* Martin Charter, Director, The Centre for Sustainable Design, University for the Creative Arts.
09:15	Keynote: A Radical Low Carbon Innovation Future? *(Location: Great Hall).* Professor James Woudhuysen, Forecasting and Innovation, De Montfort University, UK.
09:45	Refereed Papers – 'Top 30' papers *Chairs: Refereed Speaker Sessions* • Finn Jackson, Change Management Consultant and Founder, Transition Towns - Farnham, UK • Graham Tubb, Head of Energy Policy, South-East England Development Agency (SEEDA) • John Paul Kusz, Director, Centre for Sustainable Enterprise, Stuart School of Business, Illinois Institute of Technology, US • Professor Markys G Cain, Divisional Knowledge Leader - Materials Division, National Physical Laboratory, UK • Arnold Black, Network Director, The Resource Efficiency Knowledge Transfer Network, UK
12:45	Report-back and discussion *(Location: Great Hall).*
13:15	Lunch *(Location: Dining Room).*
14:15	Designing A Low Carbon Future *(Location: Great Hall).* Gary Waterworth Owen, CEO, ResponseAbility Alliance, UK/Egypt. John Paul Kusz, Director, Centre for Sustainable Enterprise, Stuart School of Business, Illinois Institute of Technology, US.
15:15	City of Malmo: Low Carbon Innovation in Practice *(Location: Great Hall).* Trevor Graham, Head of Sustainable Development, City of Malmo, Sweden.

15:45	Coffee and networking *(Location: Dining Room).*
16:00	Panel Discussion: Low Carbon Innovation – Opportunities for Entrepreneurs, Innovators, Designers and Funders *(Location: Great Hall).* Chair: Chris Hole, Director, TTP-Carbon Trust Incubator, UK Panel: Andreas Zachariah, CEO, Carbon Hero Ltd, UK/Netherlands Simon Daniel, CEO, Moixa Energy Holdings, UK. Emily Cummins, Designer, UK. Gary Waterworth Owen, CEO, ResponseAbility Alliance, UK/Egypt.
17:00	Conference Summary *(Location: Great Hall).* Martin Charter, Director, The Centre for Sustainable Design, University for the Creative Arts, UK.
17:15	Close

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Reviewed papers: Programme and Abstracts

Title	Case Studies Location: Talbot 2	Innovation Location: Great Hall	Sustainable Product Design and Development 1 Location: Cobbett	Sustainable Product Design and Development 2 Location: Guildford Room	Tools and Methodologies Location: Library
Chair	Finn Jackson, Change Management Consultant and Founder, Transition Towns - Farnham, UK	Graham Tubb, Head of Energy Policy, South-East England Development Agency (SEEDA)	John Paul Kusz, Director, Centre for Sustainable Enterprise, Stuart School of Business, Illinois Institute of Technology, US	Professor Markys G Cain, Divisional Knowledge Leader - Materials Division, National Physical Laboratory, UK	Arnold Black, Network Director, The Resource Efficiency Knowledge Transfer Network, UK
09.45	How to Fast-track Low Carbon Cities. Morel Fourman, CEO, Gaiasoft International, UK	System Innovation for Sustainability: A Risk-Based Double-Flow Scenario Method for Product Development Teams of Manufacturing Companies. A. Idil Gaziulusoy, Carol Boyle, Ron McDowall, University of Auckland, New Zealand.	The Development and Positioning of 'The Considerate Design' Tool in the Fashion and Textile Sector. Fatemeh Eskandarypur, Research Associate, London College of Fashion, University of the Arts London, UK, Professor Sandy Black, Professor of Fashion & Textile Design & Technology, University of the Arts London, UK. Dr Claudia Eckert, Department of Design, Development, Environment and Materials (DDEM), The Open University, UK.	Expanding the Evaluation Framework in Design Projects when Seeking Transformational Sustainable Innovation. Carmela Cucuzzella, PhD Candidate, Pierre De Coninck, PhD Professeur agrégé, Université de Montréal, Canada, Daniel Pearl, Professeur agrégé, École d'Architecture, Université de Montréal, Canada.	Implementing Eco-Innovation: Case-Study Results. Jamie O'Hare and Dr Elies Dekonick, Innovative design and Manufacturing Research centre, University of Bath, UK, Dr Aidan Turnbull, Environ UK Ltd, UK.
10:15	An Investigation into Consumer Attitudes Towards Sustainability Within the Context of Fashion. Dr Claudia Eckert, Dr Stephen Potter, Philippa Crommentuijn, PhD Student, Department of	Towards carbon neutral municipalities – Innovative Finnish approach. Jyri Seppälä, Jyrki Tenhunen, Olli-Pekka Pietiläinen, Ulla Ala-Ketola, Matti Melanen, Finnish Environment	The Conflict in Designing Lightweight Passenger Vehicles to Meet the Requirements of Lower Carbon Dioxide Emissions and Recycling at End-of-life. Shaun D. Savage, Patricia H. Winfield and	HP Inkjet cartridges: Closed loop recycling. Dean Miller, Program Lead, Inkjet Supplies Recycling Solutions, HP, UK	Reducing the Environmental Impact of Consumer Products - a New Database for Designers. Douglas Tomkin, University of Technology, Sydney

	Design, Development, Environment and Materials, Faculty of MCT, The Open University, Milton Keynes, UK	Institutes SYKE, Helsinki, Finland	Allan R. Hutchinson, Sustainable Vehicle Engineering Centre, School of Technology, Oxford Brookes University, Oxford, UK		
10.45	Withdrawn	Carbon Crucible: Building Capacity in Innovative Low Carbon Interdisciplinary Research. Dr Jeff Hardy, UK Energy Research Centre, UK	Design for Sustainable Behaviour: Investigating Design Methods for Influencing User Behaviour. Dan Lockton and David Harrison, Cleaner Electronics Research Group, Brunel Design, Brunel University, UK, Neville A. Stanton, School of Civil Engineering and Environment, University of Southampton, UK	Withdrawn	Broadening Sustainable Innovation: from Eco-Innovation to Societal Innovation. Yukiko Fukasaku, PhD Innovmond, France
11:15	Business Development Through Environmental and Eenergy Innovations: Analysis of the Cleantech Innovation System in Region North Denmark. Martin Lehmann, Birgitte Gregersen, Arne Remmen and Suberia Clemmensen,Aalborg University, Denmark	Withdrawn	Value Management and Sustainable Product Design. Ahmed El Halabi and Professor Colin Taylor, Department of Civil Engineering, Faculty of Engineering, University of Bristol, UK	Sustainable Design for Innovation in the Chemistry-using Industries. Dr Mike Pitts, Dr Richard Miller and Dr Steve Fletcher, Chemistry Innovation, UK	Open Innovation for Sustainable Futures. Gerald Beck and Dennis Okukoya, Munich Group for Social Research and Sustainability, Munich, Cordula Kropp, University for Applied Sciences, Munich
11.45	"Desirability" - The Key to Success in Adopting Radical Change. Richard Poynton, Professional Consultant, Speaker and Writer, UK	Identifying the Global Innovation Leaders?! Dr. Stéphanie Engels, SAM Group, Sustainability Services, Zürich	Sector Comparisons in the Adoption of Eco-Design: Product Development and Retail Design SME's. Holly R. McCain, The Design Unit, Department of Product and Spatial Design, Faculty of Art and Design, De Montfort University, UK, Mark Lemon, Institute of Energy and Sustainable Development, De Montfort University, UK	Carbon Lite Homes - Towards Zero Carbon UK Dr Mitra Maria Hedman, Architect, UK	Sustainable Innovation Case Studies from India, China and SE Asia and their role in defining 'Management 2.0' Darrell Mann, Systematic Innovation Ltd, UK
12:15	The Role of Consultants in the Low Carbon Innovation Revolution - Bridging the Gap Between Innovation, Commercialisation and the Market Place. David Chapman, Renewable Energy Analyst, Mott MacDonald Ltd, UK	Creative Economic Emergence - Moving from Financial Crisis to Low Carbon Innovations. Tim Antoniuk, Associate Professor, University of Alberta, Canada	The GreenXchange John Wilbanks, VP for Science, Creative Commons Kelly Lauber, Global Director Sustainable Ventures, Nike	Assessing a New Model for Production and Consumption: Environmental Implications of Direct Digital Manufacturing. Charles Colby, M.App.Sc. candidate, Carmela Cucuzzella, PhD candidate, Philippe Lalande, Associate Professor	Value Addition Through Design: Handling Bamboo Cane Products in Botswana. Paulson Letsholo, PhD researcher and Dr Henri Christiaans, Associate professor, Technical University of Delft, The Netherlands, Professor Kris Lall Kumar,

				Université de Montréal, Canada, Martin Racine, Associate Professor, Concordia University, Canada	University of Botswana, Botswana

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A Scenario Method for Product Development Teams as an Aid to Plan for System Innovation: A Conceptual Framework and a Workshop Outline

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Abstract

This paper presents a conceptual framework and a workshop design for a scenario method to help product development teams of companies in planning for system innovation for sustainability. The conceptual framework for the scenario method is developed as a result of an extensive desktop research based on the newly emerging system innovation theory, recent developments in futures studies literature/practice, and previous work aimed to steer system innovation. A workshop process is designed to implement the scenario method based on the conceptual framework. An action research methodology is currently being followed to improve and validate the method through iterative cycles of expert consultation and workshops.

Keywords
System innovation, scenario development, futures studies, sustainable innovation, sustainable product development

1. Introduction

Interest in system innovation for influencing a transition to sustainability started in the early 1990s, initiated by the Dutch National Inter-Ministerial Programme for Sustainable Technology Development (see Weaver et al. 2000). This was followed by several other projects (e.g., see, Vellinga & Herb 1999, Vergragt 2000, Quist et al. 2001, Green & Vergragt 2002, Partidario 2002, Partidario & Vergragt 2002, Elzen et al. 2002, Hofman 2005, Geels 2002, Elzen et al. 2004, Raskin et al. 2006, Loorbach 2007, Tukker et al. 2008).

System innovation is defined as “a transition from one socio-technical system to another (Geels 2005a, pp.2)”. Since system innovation is a transformation which takes place at the wider societal context, it covers not only product and process innovations but also changes in user practices, markets, policy, regulations, culture, infrastructure, lifestyle, and management of firms (see, for example, Berkhout 2002, Kemp & Rotmans 2005, Sartorius 2006, Geels 2006). In other words, system innovation assumes structural changes take place in the socio-technical system. Companies are important actors in this transformation and will have important roles in developing the technologies of the new system (Charter et al. 2008). In addition, technology is not an abstract concept. It manifests itself through artefacts; i.e. infrastructure, products, and services, which are usually closely linked in a systemic structure. Products of a different technological paradigm will be

essentially different from the products of current technological paradigm in terms of both technical characteristics and social meaning. Therefore, the development of tools and methods which would enable active participation of companies through their business practices in planning for system innovation is necessary both in order to effectively implement any plan at policy level and to increase the adaptive capacity of individual companies with regards to the substantial change which will take place through transitions.

Even though system innovation has become a central focus in policy development, especially within the European Union, a systematic theory on system innovations in general and how to use this theory to influence transitions towards sustainability in particular are currently emerging yet rapidly growing areas. This paper aims to contribute to this ongoing dialogue by explaining a scenario method developed to help product development teams of companies in planning for system innovation.

Product development function is one of the key strategic business functions in companies, however; successful product development requires input from all major business functions. Therefore, product development teams, as referred to in this article, involve not only design engineers and industrial designers but essentially anyone who is involved in the process, including but not limited to, sales and marketing specialists, sustainability/environmental managers, innovation strategists/planners, technical and research experts, etc.

2. Development of the Scenario Method

2.1. The Overall Research Methodology

The methodology used to develop the scenario method was adapted from List (2005) who, to our best knowledge, was the first person to document development of a futures inquiry method in a systematic manner and up to a scholarly standard. His methodology consisted of identifying design and execution criteria to be met by futures inquiry method and then improving the method iteratively through a series of workshops with companies. The methodology followed to develop the scenario method adopted the two sets of criteria identified and the resulting futures inquiry method developed by List as the base of the scenario method. However, the scenario method proposed here has some important differences.

Firstly, List (2005) defines his futures method as a social inquiry method. The scenario method explained here is neither a social inquiry, nor a technological foresight, nor a product development aid but a unique combination of these. Secondly, List's method places the entity undertaking the futures inquiry at the centre of the process. However, the scenario method explained here is based on the conceptual sustainable technology development model (Gaziulusoy, Boyle & McDowall 2008a) and the multi-level perspective on system innovations (see Kemp 1994, Van den Ende & Kemp 1999, Kemp, Rip & Schot 2001, Geels 2005a, 2005b, Geels & Schot 2007). The scenario method emphasises that the entity (i.e. the company) is within a context of complex socio-technical systems and the ultimate aim (i.e. the vision) of undertaking the process is to sustain the society (not necessarily the entity itself). Thirdly, the aim of List's research was to develop a futures inquiry method without serving for a vision or having a normative goal. Nevertheless, the research undertaken for the development of the scenario method explained here served for the vision of achieving a sustainable society.

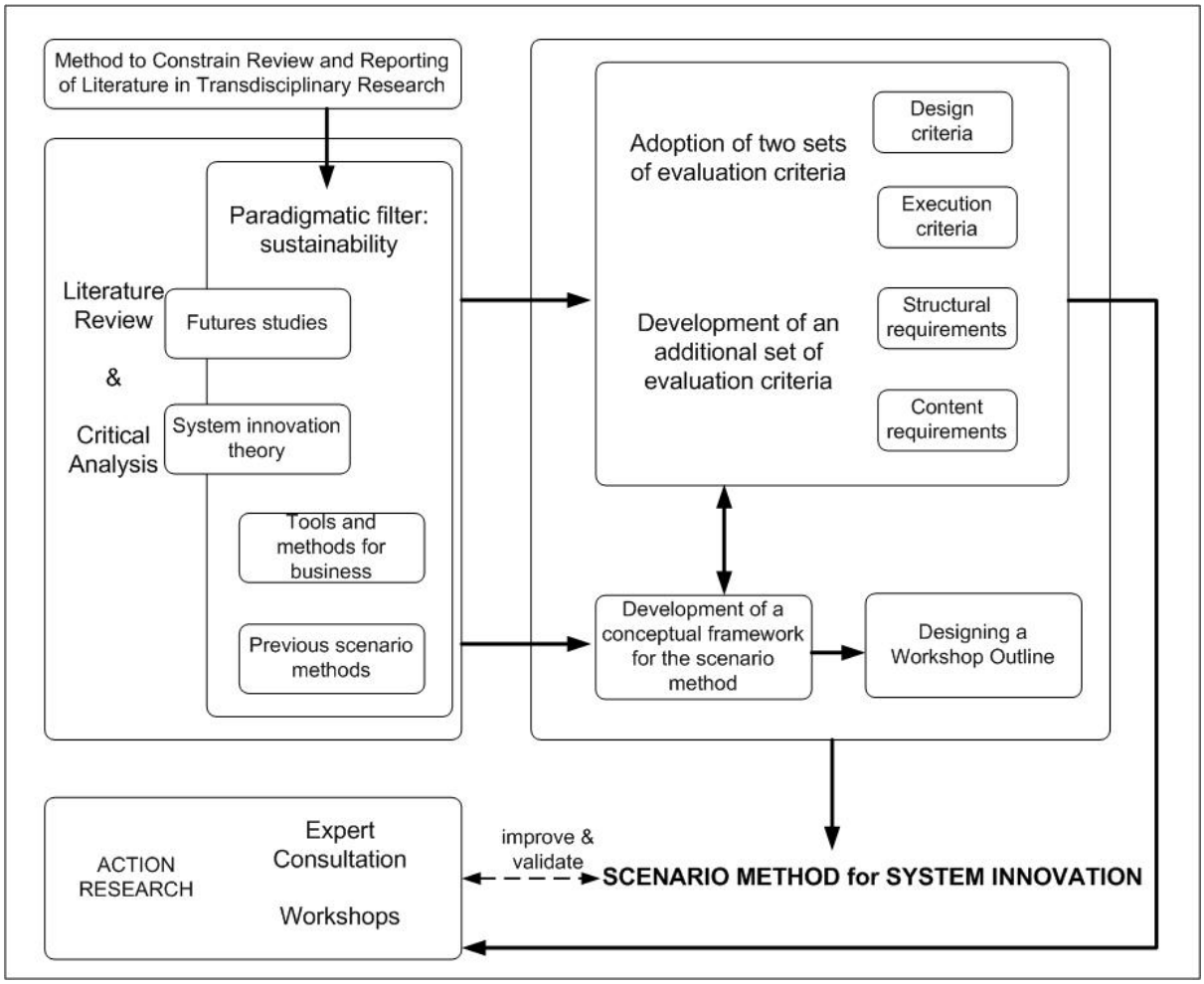

Figure 1. Overall research methodology

The overall methodology followed to develop the scenario method is shown in Figure 1. The research required review and integration of theory from a broad expanse of literature ranging from futures studies to system innovation. To ease the considerable task of selecting appropriate literature for inclusion, the vision mentioned in the previous paragraph created a foundation for the research by setting sustainability as a paradigmatic filter (see Gaziulusoy, Boyle & McDowall 2009). Futures studies and system innovation literatures are investigated more widely initially in order to wholly understand their development and current state. Sustainability and industry relationships are highlighted through the identification of drivers and barriers to commercial adoption of sustainability related practices. Critical analysis of existing tools and methods to aid companies in improving their sustainability performance provide a catalyst for novel extension. Finally, previous attempts at scenario methods related to system innovation for sustainability required critical evaluation. As has already been mentioned, List's (2005) scholarly contribution to the discourse on scenario planning provided a robust set of design and execution criteria which we adopted, with minor adjustments, to fit the particular aim of this research. In addition to these adopted criteria, structural and content requirements which needed to be met by the scenario method were identified as a result of the desktop research covering review of literature and critical analysis of previous work.

The structural and content requirements were used to identify an additional set of criteria in order to establish the conceptual framework of the scenario method. Based on the conceptual framework, a workshop was designed. Both the conceptual framework and the workshop design are being improved iteratively through expert consultation and workshops as part of a field research following action research methodology (Stringer 1996, Gray 2004). Here we present the most recent version.

2.2. The Conceptual Framework of the Scenario Method

Seven criteria (initially five) establish the conceptual framework of the scenario method. These are briefly explained below (for details, see, Gaziulusoy, Boyle & McDowall 2008b, Gaziulusoy & Boyle 2008).

Criterion 1: The scenario method should be based on the strong sustainability model (Figure 2).

In investigating and intervening in the role of businesses in achieving sustainability, the model currently being used is the weak sustainability model which is also the basis of triple bottom line approaches. The weak sustainability model assumes that either unlimited substitution among different kinds of capital is possible or that money is the universal substitute for anything. These assumptions often promote trade offs at the expense of the environment or create social injustice. Strong sustainability model represents the irreversible hierarchical dependencies between the environment, society and economy and emphasises that the different capitals subsumed by the environment, society and economy cannot be substituted and are complementary.

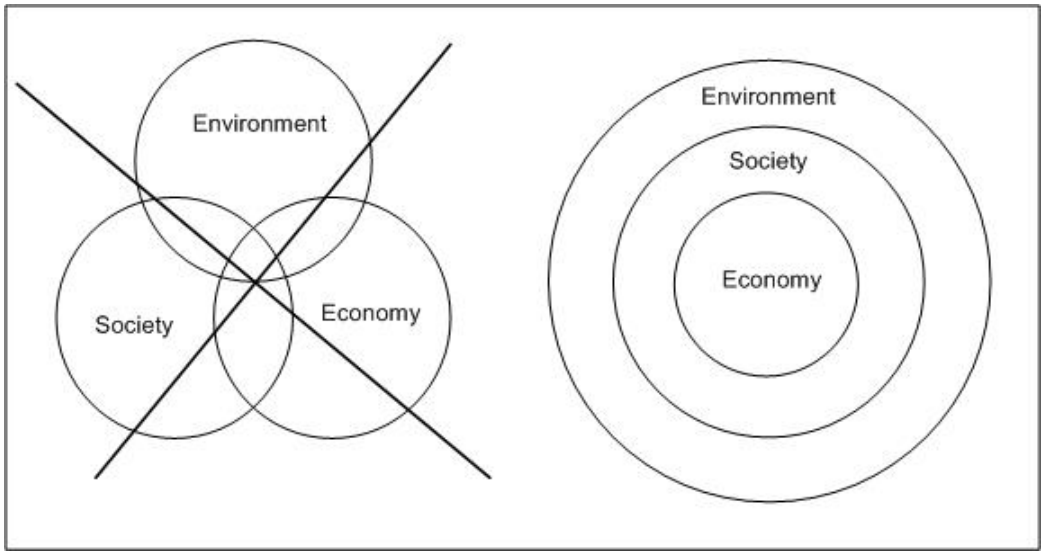

Figure 2. Criterion 1

Criterion 2: The scenario method should enable businesses to model themselves within the strong sustainability model (Figure 3).

Businesses are one of the major causes of unsustainability, but they are also one of the most important agents of technological and social change. Businesses are not entities needing to be corrected but they are mirrors of the society they operate in. They will either co-evolve with the society or become unsuccessful. It is important to emphasize that businesses are strictly subject to the irreversible hierarchy of the strong sustainability model and reference the interactions between the businesses and the environment, society and economy to this model.

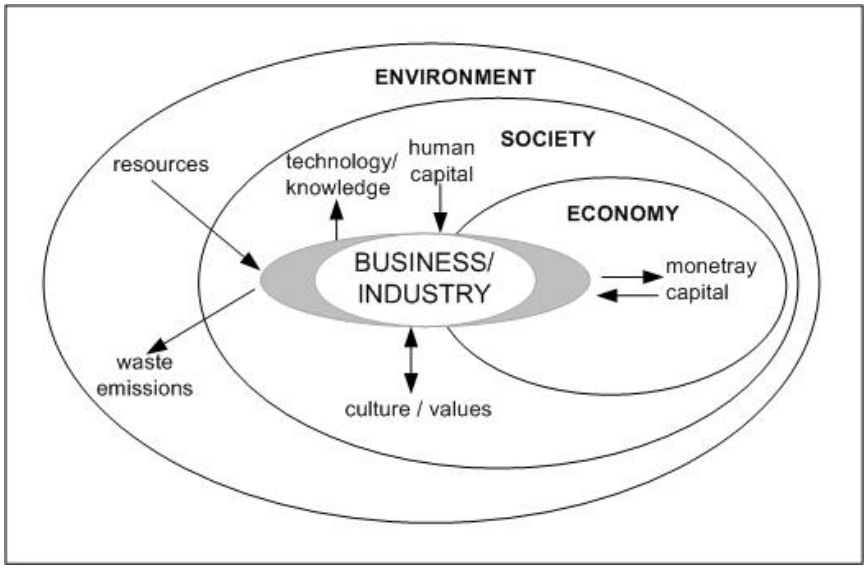

Figure 3. Criterion 2

Criterion 3: The scenario method should link the planning periods applicable to companies (operational and strategic) to the long-term planning period (visionary) in order to enable companies to address long-term societal visions in their strategies and effectively implement these strategies in product development (Figure 4).

Individual companies have very limited agency to influence change at the systemic level. Nevertheless, companies are part of society. Therefore, their strategic goals should not be contradictory to visions of society and should be aligned with the goals desired at societal level to achieve sustainability.

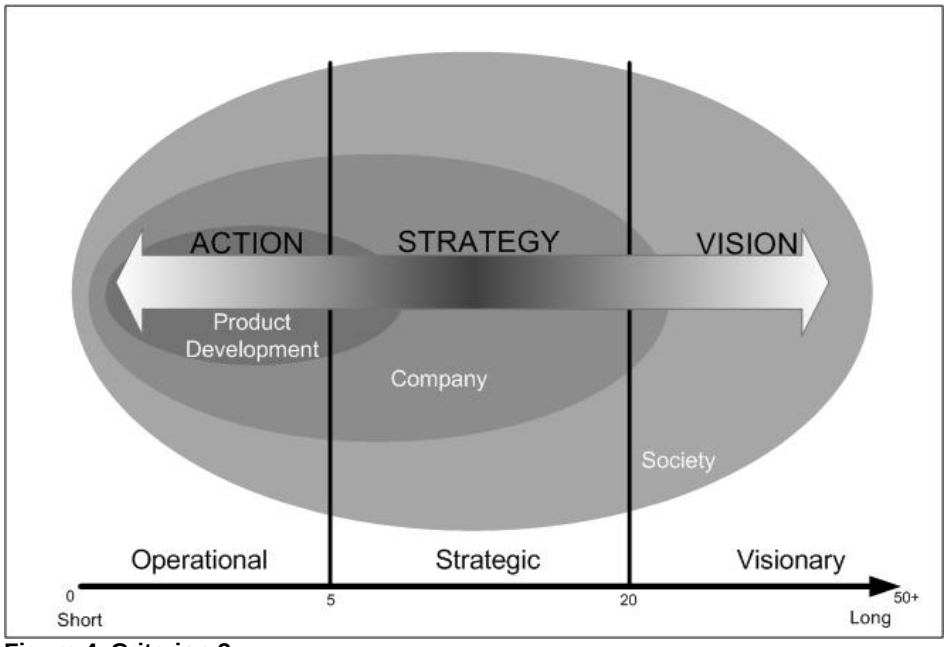

Figure 4. Criterion 3

Criterion 4: The scenario method should aid companies in identifying not only technology development requirements but also organisational/human development requirements (Figure 5).

From an organisational point of view, sustainability is ensured by adaptation to external forces through management of internal change. In addition, the organisational context will determine the success of any technical activity since the capacity, knowledge and capability to innovate is generated, assessed, developed and used within the organisational context. Organisational innovations should cover a longer time span than technological innovations in order to be able to influence technological innovations towards sustainability. Organisational innovations are planned at the company level and within the strategic period.

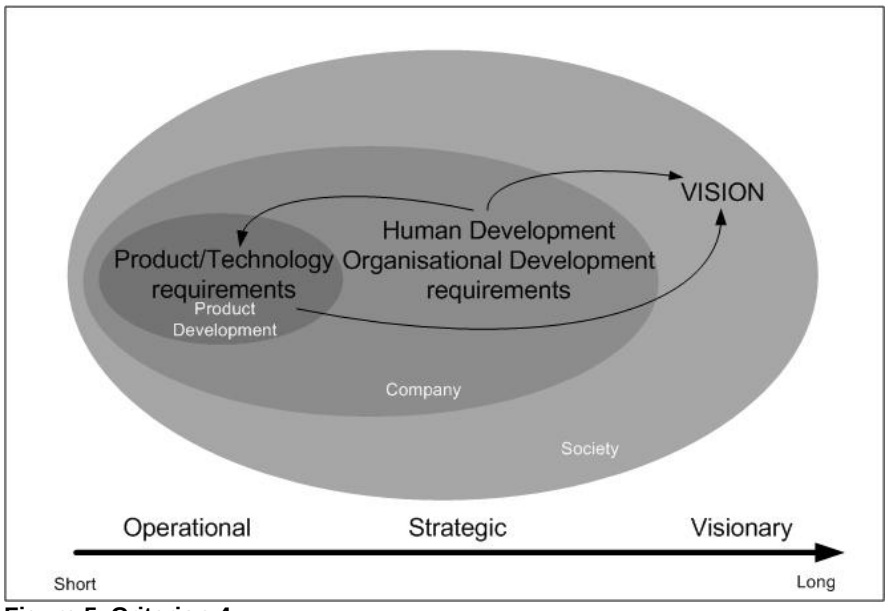

Figure 5. Criterion 4

Criterion 5: The scenario method should aid companies in developing integrated business strategies aligned with societal level sustainability visions and day-to-day business activities and should facilitate integration of all business functions in line with the company strategy (Figure 6).

The implications of a normative sustainability vision needs to be integrated into day-to-day activities at product development level. This requires internalisation of sustainability into company strategy along with other business priorities. Since successful product development requires integration of all major business functions within a company and since company strategy needs to be referenced to future visions in order to guide product development towards system innovation, the scenario method should enable integration of business functions in line with the organisational/strategic plan. Therefore, construction and organisation of product development teams will play a very important role in any attempt for system level innovation to be successful. The organisational and technological barriers to integration of business functions need to be acknowledged along with possible facilitating mechanisms in developing a scenario method for the use of companies.

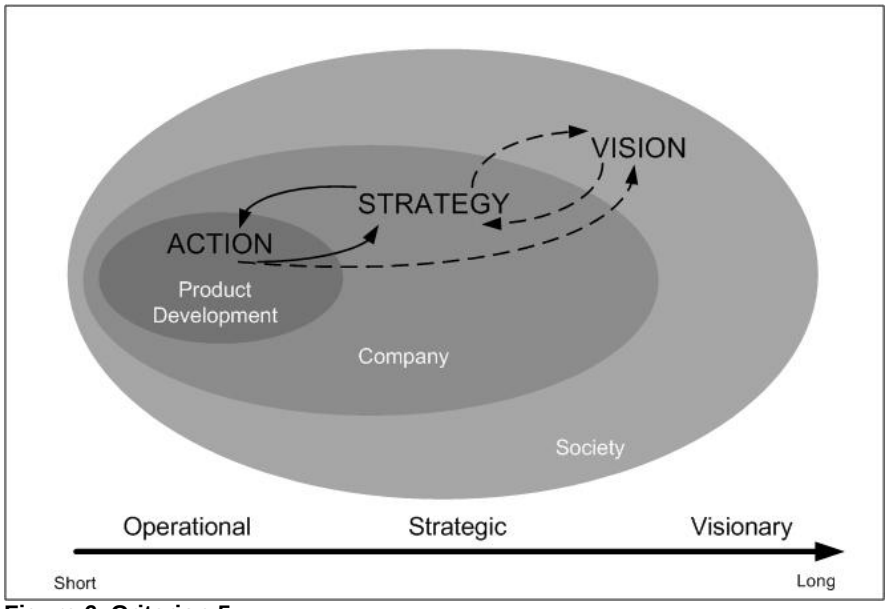

Figure 6. Criterion 5

Criterion 6: The scenario method should have a double-flow approach in order to link present and future in a realistic way and enable identification of alternative innovation paths which are possible from a technological point of view, acceptable from a social/cultural point of view and desirable from a sustainability point of view (Figure 7).

Some of the previous projects in the context of system innovation developed forward flowing, predictive or explorative scenarios which started from the present and flowed towards an undetermined future. Some other projects developed backward flowing, normative scenarios, starting from 50 years in the future towards a never-reached present. Starting only from the future may result in not being able to acknowledge the lock-ins needing to be overcome and which are embedded in the present socio-technical system. On the contrary, starting from present and developing scenarios based on strict causality may limit multiplicity of paths or even the possibility of developing a path for periods longer than medium-term.

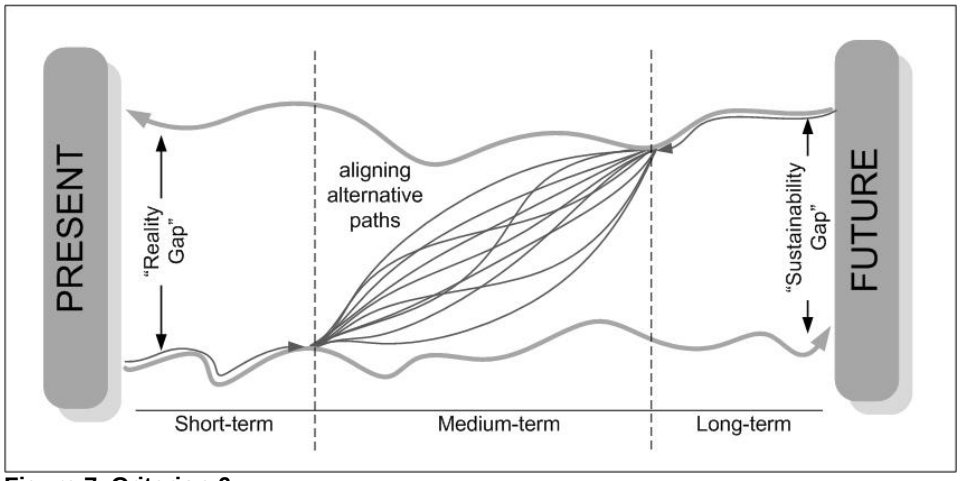

Figure 7. Criterion 6

Criterion 7: The scenario method should have a layered risk approach in order to identify implications of overarching sustainability risks on the companies' business as contextual risks. This way, sustainability can be internalised in the companies' organizational and product development strategy and active participation of companies in setting sustainability visions at societal level can be enabled (Figure 8).

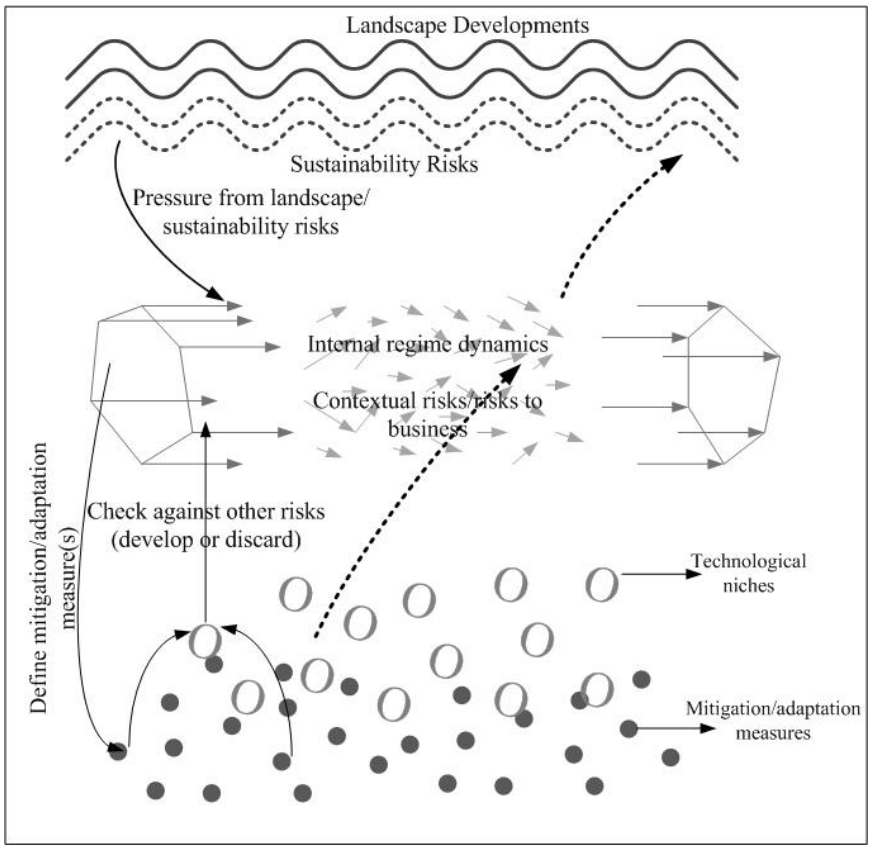

Figure 8. Risk-based innovation model (based on multi-level perspective of system innovation model)

2.3. Workshop Design: Outline and Processes for Facilitators

The scenario method is designed to be executed in two full-day or four half-day workshops. The modules and processes proposed for the implementation of this scenario method are shown in Table 1:

Table 1. Proposed outline for the scenario workshop

MODULE	PROCESSES
First Half	
We Are A System	A short exercise which involves the group building a model showing how the environment, society and economy relate to each other and positioning their company on this model **Outcome:** The group develops a model similar to the strong sustainability model and is able to show the relationships between their company and the sub-components of the model they built.
Risks	Ask the group to compile a list of sustainability risks which they think to be relevant to their company. As a guide give the group a list of sustainability risks compiled from different sources (e.g. Kates et al. 2001, MEA 2005, IPPC 2007). In the second part of this module, run a brainstorming session (see Justice & Jamieson 2006, pp. 180) in which the group thinks about the implications of the sustainability risks on

	their business and identify business-risks. Instruct the group to draw a risk map linking the business-risks to the business functions they have an impact on. Instruct the group also to draw interrelationships between the business risks. **Outcome:** A dynamic risk map; the group understands how long-term wider-scale sustainability risks which threaten the society does and will affect the company's business/products.
Identification of Social Function	Introduce the concept of social function fulfilment (e.g. Geels 2006, Tukker 2004) of a product/technology. Facilitate a quick discussion in the group to identify the function the product/service their company is producing currently meets. **Outcome:** Social function identified, the groups starts to think conceptually
Visioning	Guide the group into a visioning exercise (Justice & Jamieson 2006, pp. 185) to generate visions of a sustainable society in which the sustainability risks are managed/mitigated. If time is limited visions generated previously (e.g. Raskin et al. 2002) can be introduced. Following the development of a societal level vision, ask the group to generate a vision for the role of their organisation or how the social function identified in the previous module is being met in this society. **Outcome:** Visions of a sustainable society, the organisation and how the social function being met within that society
Second Half	
Solutions: Status Quo	Engage the group in developing forward scenarios aiming to mitigate the risks to their business. Give them two questions to simultaneously consider in scenario development: How should the product/technology evolve? How should the user behaviour change? **Outcome:** Forward flowing, explorative scenarios.
Solutions: Across the Chasm	Referring to the adopted/generated visions of a sustainable society, instruct the group to generate conceptual technology visions matching for each of the socio-technical contexts (note that each context will have to be worked separately and the group members might prefer to choose which contexts they prefer to work on and build scenarios for). Generation of a technology vision matching the particular socio-technical context is followed by developing backward scenarios (backcasting) towards present. These scenarios need to be documented on a large sheet of paper. **Outcome:** Backward flowing, normative scenarios
Third Half	
Alignment	Put the forward scenarios and backward scenarios developed on the big board, forward scenarios being on the left hand side and backward scenarios being on the right hand side with a large empty space in between. Cover this space with paper. Instruct the group that now they will solve a puzzle trying to fill in the gap between the forward and backward scenarios identifying the middle steps in technology development. Some forward and backward scenarios may not join. Identify the joining ones as alternative paths. Also, while the group is working on joining the backward and forward flows, introduce disruptive events relevant to the company's business for the group to include some "what-if?" scenarios in linking the forward and backward scenarios. Emphasise that the aim is not find correct answers but rather to generate as many feasible alternative paths as possible so that the company can take as future emerges. Also emphasise that the generated scenarios are ideal but not real and so they will need to be

	revisited and revised along the way. Once the group is done with linking the scenarios, bring them back to present and instruct them to generate some product concepts that they can start to develop today which potentially (and ideally) can evolve as specified in the alternative innovation paths. **Outcome:** scenarios for multiple alternative innovation paths, product concepts
Fourth Half	
Stakeholders	Run a session to identify the key stakeholders of the company and construct a stakeholder map showing power and place on the supply/value chain (refer to List 2005). Give a number to each stakeholder and place them on the scenario map where they can influence directly. **Outcome:** A stakeholder map, stakeholders mapped on the scenario map
Strategy/Action Plan	This module requires engaging in dialogue and decision making among the group members. Firstly facilitate a brief group discussion on the type of decision mode they would like to employ during strategy development process (see Justice & Jamieson 2006, pp. 35, 223). The group can also choose which aspects they would like to make decision on at this stage. The areas to discuss and make decision on can include research investment, capacity development, stakeholder engagement, development of new core capacity, or gradual liquidation of the business. Note that a short causal layered analysis (see Inayatullah 1998) exercise might be useful before starting this session. **Outcome:** A strategy/action plan

Different facilitators may bring different experiences with them and enrich the method or may choose to use alternative processes in the implementation of this scenario method. However, it is our belief and hope that inexperienced social-change agents in organisations will find the outline above useful as a start. In addition to Justice and Jamieson's (2006) field guide for facilitators referenced in the outline above, we found Hunter's (2007) The Art of Facilitation very useful both to learn effective group facilitation and as a process guide.

3. Discussion and Closure

The lack of systemic understanding and the blind attachment to growth oriented policies and strategies are still prevailing in business models of companies. There are good reasons to believe that such understanding will evolve shortly through crisis as a result of not being able to foresee the implications of long-term sustainability related trends on business (White 2006). A recent study which investigated two cases of firm uptake of system innovation thinking emphasized the power of companies to influence system level change (Van Bakel et al. 2007). This study, on the basis of two cases investigated, concluded that even though companies realize the opportunities rising from identifying sustainability issues at societal level, they find managing all business activities with system innovation in mind very challenging and these companies generally run such strategies as 'shadow-track' strategies. The study also suggests that the core conditions of success for running these shadow track strategies are management support, time and funding and "a gradual attunement between the shadow-track and regular policy when ideas and innovations mature (pp. 12)" as well as support at government level. Our observations in our own locality can also confirm a shift taking place in businesses towards a desire and effort to understand the implications of long-term sustainability risks on their businesses which is accelerated with the ongoing economic recession. The confusion on how to relate long-term sustainability requirements to their day to day decisions prevails as their primary problem due to the lack of models and tools. Therefore, we do believe that the scenario

method outlined in this article is timely and it hopefully will contribute the ongoing dialogue about system level innovation in product development, business management and governance areas.

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