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Developing a Framework for Mapping Sustainable Design Activities

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Abstract

The notion of sustainable design has become increasingly prominent within the design community. As a result, numerous design theories, strategies and tools are available to designers. Yet, limited attempts in the field evaluate these activities by placing them in relation to each other or within the broader context of sustainable development. Based on a literature review this study develops an integrated framework which connects the areas of sustainable development and sustainable design. This framework may be utilised in two ways: firstly, to visualise the interdependencies of sustainable design and sustainable development; secondly, as an assessment tool to measure and compare the potential of sustainable design activities.

Keywords
Sustainable Design; Sustainable Development; Design Strategy; Framework.

Sustainable design is a widely used phrase amongst a number of synonyms which all reflect a contemporary trend in the design community to respond to environmental and socio-economic concerns. The focus of attention is thereby the concept of sustainable development which became increasingly popular over the last few decades. As the idea of sustainable development itself is open to various interpretations it may not be surprising to find a large number of theories, strategies and tools when it is married with design, a discipline similarly regarded as being broad-ranging and hard to define.

So far, sustainable design is rarely conceptualised in direct relation to the bigger picture of sustainable development. Moreover, literature is lacking in appropriate evaluation methods which are capable of classifying sustainable design activities in this multi-dimensional context. In this regard Baumann *et al.* (2000) state that “there are too many tools around, but we should try to use the already existing ones, instead of introducing now ones”. Then they conclude by saying that there is “too little linkage between strategic intent and content [and] too little about the larger context of product development”.

This study aims to develop a criteria-based compound framework which allows both the visualisation of the relationship between sustainable design and sustainable development as well as the classification of sustainable design theories, strategies and tools according to this context. Thereby the study merges appropriate models from both disciplines to generate an integrated framework with aims to be able to:

i) provide understanding of how sustainable design may be seen in the context of sustainable development
ii) allocate a given design activity in terms of its position within this context
iii) classify a given design activity in terms of other design activities
iv) specify the individual ‘sustainability potential’ of a given design activity

In order to create a framework featuring those characteristics the following questions form the focus:

a) How are the areas of sustainable development and sustainable design conceptualised so far?
b) Which visual representations of these concepts may be useful in terms of this study?
c) How can we generate a compound framework based on the existing models?

The study is based on a literature review which is presented in the first half of the paper. The review covers the areas of sustainable development and sustainable design and focuses on the

first two questions stated above. The compound framework itself is introduced in the second part of this paper, where we deal with the third question. The paper concludes with a discussion of the framework, which includes the introduction of possible implications of both a theoretical and practical nature.

1. Reviewing the scene

The following review is divided into two parts. The first part discusses the nature and relationship of the concepts of sustainable design and sustainable development, in order to establish clarity in terms of basic definitions. In the second part the emphasise is on visual models of sustainable design and sustainable development. Here innovation models are also discussed as sustainable design strategy is increasingly described with the aid of innovation theory.

1.1 Sustainable design in the context of sustainable development

By nature, sustainable design corresponds with the concept of sustainable development. Yet, as sustainable development is to be seen as a concept emerging from the environmental discourse it is imperative to shed light on the evolution of environmentalism to fully understand the complex and partly conflicting nature of sustainable development. In this sense, the evolution of sustainable development may be traced back to the most fundamental concepts of value which are reflected in the basic world views. The following paragraphs briefly introduce each 'mile stone' of this journey.

1.1.1 The two major world views

According to many scholars (Glacken, 1967; Passmore, 1974; O'Riordan, 1981; Capra, 1982; and Milbrath, 1984) two major world views have been developed in the history of humankind which define the relationship of humans to their environment. Commonly a distinction is made between the '*conservative-nurturing'* and the '*radical-manipulative'* world views. The underlying mind sets of these views are almost contradictory: Favouring the conservative-nurturing world view humans regard themselves as part of nature, considering the environment to be the focus of attention. It follows that "the task of human beings [is] to tend the Earth" (O'Riordan, 1989). The radical-manipulative world view, in contrast, shapes a moral pattern of action which is based on the belief that humankind not only has the right, but also the obligation to shape the world in order to create a better place. In the light of the success-oriented western culture Merchant (1992) suggests a further differentiation of the radical-manipulative world view which finally leads to the following classification:

i) 'Ego-centric' – describing a moral mind set based on ones 'self';
ii) 'Homo-centric' – specifying a moral principle resting upon 'society'; and
iii) 'Eco-centric' – characterising the conservative-nurturing world view.

In literature the categories *(i)* and *(ii)* are often summarised under the umbrella term '*anthopo-centric*', or '*techno-centric*' when the industrial nature of the western culture is emphasised.

1.1.2 The emergence of ecology

As occidental history is closely related to the Christian tradition proclaiming the manipulative world view, the environment has historically been seen as external to humanity (Hopwood *et al.*, 2005). A first step towards environmental awareness was the emergence of the academic discipline of *'ecology'* (Von Haeckel, 1866). This resulted in the discovery of interdependencies of the non-human world and the human world. Finally, ecological matters were seen as an integrated system on a local, regional and global level. As a consequence, environmental awareness began to affect action in many parts of western society. However, 'ecology' is not only a domain of knowledge but also a terminology for movements which aim to change things for the sake of a better (more 'eco-centred') future. Terms such as *'Radical ecology'* (Merchant, 1992) or *'deep ecology'* (Pearce, 1993) may be mentioned in this context and be seen as part of a spectrum of environmental considerations.

1.1.3 About environmentalism

Whereas the early environmentalism in the late 19th century was predominantly concerned with landscape conservation (Kuester, 2009), modern environmentalism since the 1950's promotes a departure from the status quo in industrialism (Dryzek 1997) and takes an all-embracing view of environmental issues. Ultimately, environmentalism developed a broad ranging spectrum of values which all have their origin in one of the basic world views introduced earlier. Therefore, it is evident that different viewpoints may have considerably contrasting beliefs in what environmentalism can be. In his largely used categorisation O'Riordan (1989) tackles this issue and introduces a classification of four different *'trends in environmentalism'*, ranging from the extreme eco-centric to the extreme techno-centric side. Pearce (1993) presents a very similar categorisation but also refers to the discussion of *'sustainability'* by adding *'sustainability labels'* to each of the four categories *(fig. 1)*.

	Ecocentrism		Technocentrism	
	Deep ecolpgy	Communalism	Accomodation	Cornucopian
Green Labels	Extreme **preservationist** position	Resource **preservationist** position	Resource **conservationist** and managerial position	Resource **exploitative** and growth orientated position
Type of economy	» **Very deep green** economy, » heavily regulated to minimise 'resource-take'	» **Deep green economy**, steady-state economy » regulated by macro-environmental standards and supplemented by Els.	» **Green economy**, green markets » guided by economic encentive instruments (Els) (e.g. pollution charges etc)	» **Anti-green** economy » Unfettered free markets
Management statistics	» **Reduced** scale of economy and population » Scale reduction imperative » at the extreme for some there is a literal interpretation of Gaia as a personalised agent to which moral obligations are owed	» **Zero** economic growth, zero population growth » Decoupling plus no increase in scale. » Systems perspective – health of whole ecosystems is very important Gaia hypothesis and implications	» **Modified** economic growth (adjusted green accounting to measure GNP) » Decoupling important but infinite substitution rejected. » Sustainability rules: constant capital rule	» **Primary** economic policy objective, maximise economic growth (Gross National Product (GNP)) » Taken as axiomatic that unfettered free markets in conjunction with technical progress will ensure infinite substitute possibilities capable of mitigating all "scarcity/limits" constraints (environmental sources and sinks)
Ethics	**Acceptance of bioethics** » moral rights and interests conferred on all non-human species and even the abiotic parts of the environment » intrinsic value in nature (ie. valuable in its own right regardless of human experience)	**Further extension of ethical reasoning** » interests of the collective take precedence over those of the individual » primary value of ecosystems and secondary value of component funcions and services.	**Extension of ethical reasoning** » 'caring for others' motive – intragene rational and intergenerational equity (i.e. contemporary poor and future people) » instrumental value in nature	**Support for traditional ethical reasoning** » rights and interests of contemporary individual humans » instrumental value (ie. of recognised value to humans) in nature
Sustainability Labels	**Very strong sustainability**	**Strong sustainability**	**Weak sustainability**	**Very weak sustainability**

Figure 1: The sustainable spectrum (Pearce, 1993) [redrafted]

1.1.4 The concept of sustainability

The principle of sustainability was first mentioned by Von Carlowitz (1713), at a time, when the term 'ecology' had not even been coined. In these early days, sustainability was clearly linked to resource management in the forest industry. Current conceptions of sustainability which are conceived of in this way carry the term *'sustainable utilisation'* (IUCN, 1980) and can be viewed as rather anthropo-centric as their aim is to maintain a certain status quo in nature in order to sustain resources. Subsequently, an eco-centric perspective on sustainability has been introduced in literature as well which is normally used in ecology to refer to an ecosystem's potential to subsist over time (Jabareen, 2006). Tonkinwise (in Gregory *at al.* 2008) states: "Sustainability is the measure of the capacity of a system [...] to reproduce itself in the changing circumstances upon which it depends [...] which might involve changing [...] or evolving in form and function." The different arguments stated above clearly show the contradictions in the conception of sustainability and here again, the two basic world views define the positions. However, despite its inherent polarity, the concept of sustainability is to be seen as a key aspect in the environmental discourse (Hopwood *et al.*, 2005). In this context the previously mentioned sustainability labels should be considered which correspond with the environmental spectrum as described before (Pearce, 1993; Haughton and Hunter, 1994).

1.1.5 Towards sustainable development: the evolution of a paradox

Whereas the notion of sustainability can be viewed under the umbrella of environmentalism, the concept of 'sustainable development' (Brown, 1982) reaches beyond purely environmental considerations. The so called *'Brundtland report'* (WCED, 1987) observes: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Here it is evident that this concept also embraces social and economic issues. What seems to be a modest statement is ultimately quite remarkable: O'Riordan (1989) points out that sustainable development is "bridging the gap between developers and environmentalists". A consequence of this is the unification of the techno-centric and the eco-centric world view, which were previously considered incompatible. However, this achievement produces an "ethical paradox" based on the "dialectical relations between sustainability and development" (Sachs, 1993) which is highly problematic as it causes constant contention (Hopwood *et al.*, 2005). Furthermore, many scholars lament the ambiguity of sustainable development (Middleton *et al.,* 1993; Wackernagel and Rees, 1996; Holden, 2007) as it "is open to interpretation of being anything from almost meaningless to of extreme importance to humanity" (Hopwood *et al.*, 2005). However, despite all criticism, to date sustainable development is considered to be the most promising concept to tackle contemporary problems.

1.1.6 About sustainable design

In order to understand the nature of sustainable design it may be helpful to consider a fundamental mode of design. According to McLennan (2004) the action of design is always informed by the mind-set of the person conducting a particular design activity. Furthermore, the activity of design, rather than being an isolated end in itself, is an applied activity which always answers a purpose (Dorschel, 2003). In this light, the following paragraphs may be seen:

The origin of sustainable design is not entirely new. In fact, sustainable action in design has been conducted in many cultures within living memory, as those cultures never abandoned their sustainable life style. McLennan (2004) goes even beyond the human sphere when introducing his four 'evolutionary stages' of sustainable design. However, this study concentrates on the modern conception of sustainable design in the industrialised world which might be almost understood as a re-invention of this concept after a time of highly unsustainable development. The renewed interest in this concept had been encouraged by design theorists such as Buckminster Fuller (1963) and Papanek (1971).

Yet, sustainable design should not be understood as a design discipline such as graphic or industrial design. According to McLennan (2004), it is rather to be seen as an underlying notion which has the potential to inform all design activities. On this philosophic level sustainable design responds to the concept of sustainable development by raising questions about the optimal transition scenario for a more sustainable future, the idea of well-being, or the optimal status of goods (Vezzoli and Manzini, 2008). However, it might not be surprising that answers to these questions can diverge considerably, again, according to the basic world view. By trying to overcome these differences, system design approaches become increasingly important (Vezzoli and Manzini, 2008).

Theoretical considerations as discussed above naturally inform decisions on more applied levels such as design strategy and finally the actual design activity. At this point the direct correlation between the fundamental world views and the modern design process becomes evident.

1.2 Models capturing the scene

Considering the ambiguity of sustainable development as well as the diversity of sustainable design, it might not be surprising that literature provides a multitude of models which each aim to visualise either one, or both, concepts. To provide structure, the present study works with a classification of two main categories. Thereby the first category deals with nominative visual explanations which aim to comprehensively display a concept from an overall point of view, whereas the second category is reserved for evaluative frameworks which apply defined criteria to discuss a concept under certain conditions. Furthermore, visual models of both categories may be utilised in two different ways. Firstly, as cognitive maps which visually represent theoretical

constructs, and, secondly, as assessment tools which promote the categorisation of further knowledge material (Choucri, 2007).

1.2.1 Models for sustainable development

Although the purpose of nominative models for sustainable development is clearly defined, the variety of attempts is extensive. A further distinction may be made between '*domain-based models'* (which concentrate on the different areas sustainable development is referring to), and '*principle-based models'* (which try to capture the concept by identifying its underlying principles). Generally principle-based models may also be seen 'just as sets of criteria' as their graphical sophistication tends to be limited. However, a classic example for a domain-based nominative model is the well known 'Venn diagram' which introduces the "three pillars" (Sutcliffe, 2009) of sustainable development (environment, economy, and society). Further basic examples are introduced by Giddens *et al.* (2002). In contrast, Choucri (2007) presents a comprehensive nominative framework. Typical principle-based models, on the other hand, are introduced by Jabareen (2006) and Haugton (1999). Finally, Pawflowsky (2008) and Spangenberg (1997) present nominative models which are based on a combined approach, featuring domain-based and principle-based elements.

By looking into the area of evaluative models one is confronted with considerable diversity. This is due to the very nature of this category, as each model features certain aspects of sustainable development according to the criteria applied (*cf.* Holden, 2007). Of particular interest for this study, however, is a model developed by Hopwood *et al.* (2005) *(fig. 2)*. Based on the environmental spectra of O'Riordan (1989) and Pearce (1993) *(fig. 1)* the framework maps different approaches in the field of sustainable development according to their "attitude towards change" (Hopwood *et al*., 2005). Thereby the whole spectrum from eco-centrism to techno-centrism is applied to both the *x*- and the *y*-axis, each respectively describing environmental and socio-economic concerns. The resulting space between the axes enables allocation of any sustainable development principle in relation to its position concerning both directions: the range from eco-centric to techno-centric in addition to the spectrum from environmental preferences to socio-economic concerns. Finally, the space is divided into three zones ranging from 'Status quo' through 'Reform' to 'Transformation'.

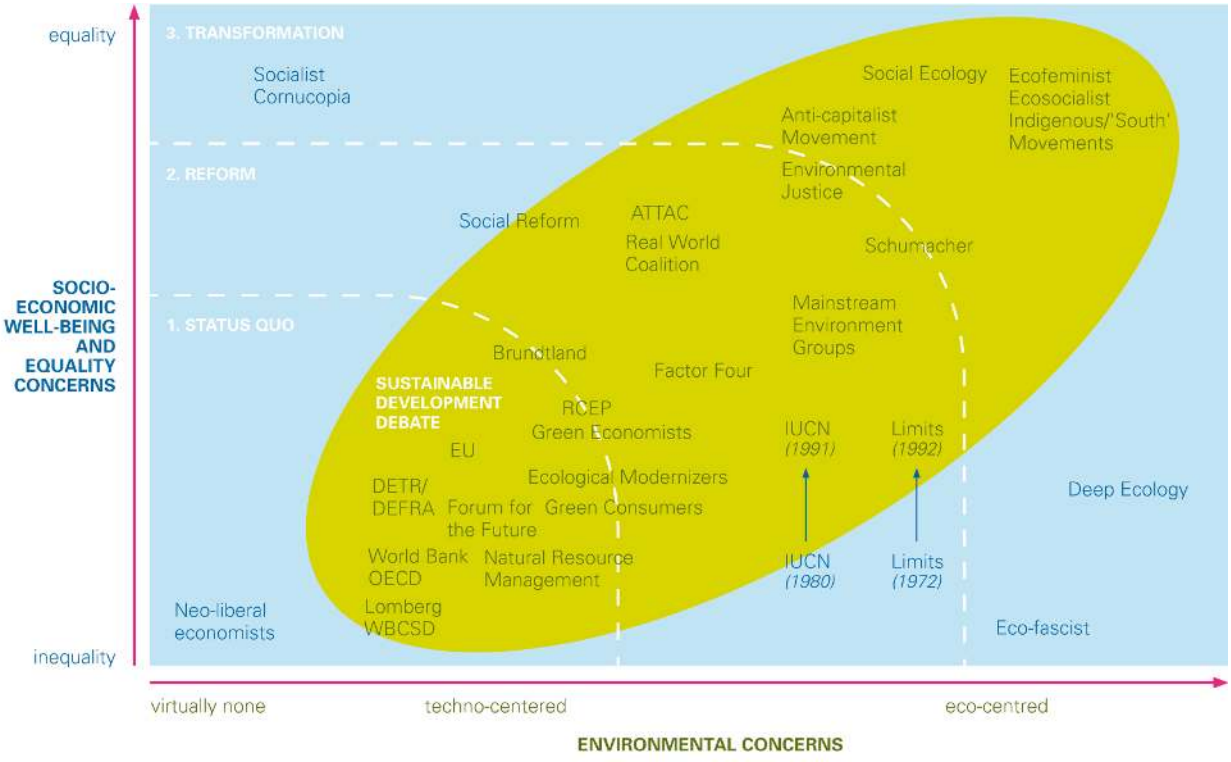


Figure 2: Mapping the views on sustainable development (Hopwood *et al.,* 2005) [redrafted]

1.2.2 Models for sustainable design

Nominative models for sustainable design may be also divided into domain-based and principle-based models. Examples of domain-based models are introduced by McDonough and Braungart (1998) and Fuad-Luke (2009). Here, all authors aim to present a complete picture of what sustainable design might be according to their conception. Principle-based models of different complexity are introduced by Van der Ryn and Cohen (1996), McDonough (1992) and McLennan (2004).

Regarding evaluative models for sustainable design, naturally the situation is comparable with the circumstances already described for evaluative models for sustainable development: Innumerable visualisations are provided in literature which are all concerned with a specific problem (e.g. Porter, 1985; James, 2001). Yet, Vezzoli and Manzini (2008) provide a model which is of relevance to this study. Here, the field of sustainable design is described by four different *'levels of intervention'* with increasing potential to depart from the status quo in the industrialised world. Thus, each of the four levels is connected with a certain stage of transformation in technology and society in order to achieve a more sustainable livestyle:

Level 1: Environmental redesign of existing products
Level 2: Designing new products and services
Level 3: Designing new production-consumption systems
Level 4: Creating new scenarios for sustainable life styles

In essence, the model described by Vezzoli and Manzini is strongly informed by innovation theory, an area which is discussed in the next section.

1.2.3 Innovation Models

Innovation models are increasingly used by scholars to address aspects of sustainable design (Tischner, 2008). Whereas basic models distinguish between incremental and radical innovation, many scholars have introduced more advanced models to be able to better understand the nature of radical innovations (Abanathy and Clark, 1985; Freeman and Perez, 1988; Clark and Staunton 1989). In this context the term 'system innovation' was coined which refers to "far-reaching changes in technology [which may influence] several branches of the economy [or even] give rise to entire new sectors" (Freeman and Perez, 1988). In a conventional context these innovation models are clearly linked to an economic environment. The finite goal of innovation in this sense is therefore economic success (Arrow, 1961). However, when it comes to the issue of sustainable development, additional success criteria of a social or environmental nature play a decisive role.

In order to visualise the sustainability potential of different innovation types Foster's (1986) classic 'S-curve model' is used as a basis by many scholars (Brezet, 1997; Weterings et al., 1997; Halila and Hoerte, 2006). The 'levels of intervention' introduced by Vezzoli and Manzini (2008) may also be seen in this respect. Yet, Magnussen (2001) presents a framework which draws on a different approach. By building on Abanathy and Clark (1985) he introduces a two-by-two matrix which not only allows the visualisation of different types of innovation, but also sets them in context with each other by applying specific criteria on the x- and y-axis of the matrix. Konrad *et al.* (2003), finally, follow this tradition and introduce a framework which aims to highlight the sustainability potential of certain innovation types in the context of product development at a company or industrial level. Thereby "changes in market-actor relations" and "changes in knowledge, technology and organisation" are defined as the criteria which establish the coordinates for the framework *(fig. 3).* As a result, the following innovation types are defined: *'incremental innovations'* (minor changes in both market-actor relations and technology), *'radical innovations'* (minor changes in market-actor relations paired with major changes in technology), *'behavioural innovation'* (major changes in market-actor relations but minor changes in technology) and *'system innovation'* (major changes in both, market-actor relations and well as technology). Regarding this model, system innovation has the highest sustainability potential as it sits on the radical end of both axes.

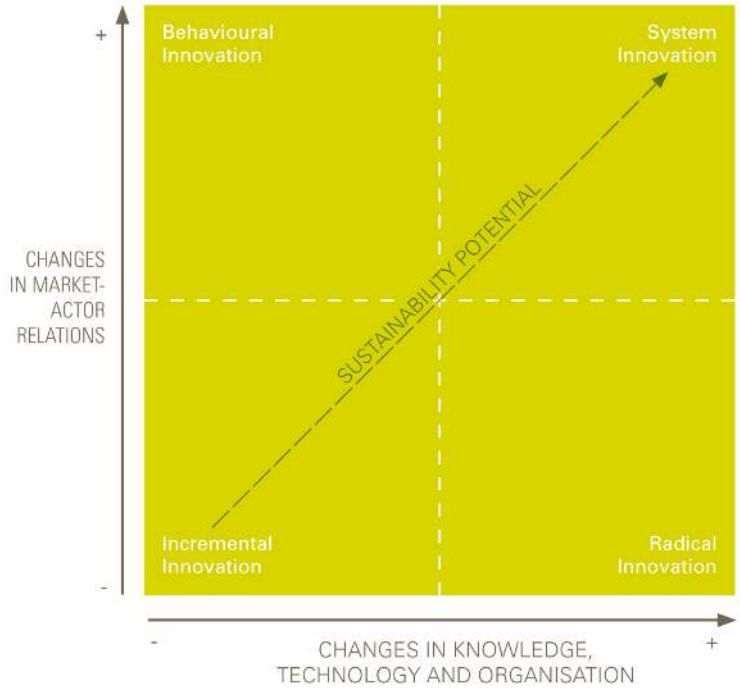


Figure 3: Differentiation of innovation types and their sustainability potential (Konrad *et al.,* 2003) [redrafted]

2. Building the compound framework

After reflecting on the scene, now the compound framework is introduced. The section is divided in two parts. The first part presents basic specifications, whereas the second one finally introduces and discusses the compound framework itself.

2.1 The basic approach

To generate the compound framework this study builds on visual explanations already introduced in chapter one. The following issues are therefore considered:

2.1.1 The nature of the compound framework

Owed to the objectives stated in the introduction of this paper, evaluative models of sustainable development and sustainable design are the core of interest. Moreover the study's focus is on those models which have the potential to accommodate further knowledge material and work as assessment tools (see section 1.2). To integrate models of both spheres a 'frame and picture' analogy is chosen which captures the subject of sustainable design within the wider context of sustainable development.

2.1.2 Specifications of the compound framework

Generally the framework aims to capture the issue of sustainable design in the context of sustainable development on an overall level. As a consequence, different aspects can be covered, ranging from the product development level to matters embracing society as a whole. Naturally the position of the frame, capturing the area of sustainable development may be seen as slightly tuned towards the issues of sustainable design, owing to the very nature of the study. Technically both parts of the compound framework are intended to have the same perspective in order to be compatible. That is achieved by applying equitable criteria.

2.1.3 Criteria applied to the compound framework

The fundamental idea of sustainable development is the departure from status quo towards more sustainable scenarios, although there are different beliefs in how this could be done most successfully. Sustainable design is corresponding to this issue which is particularly expressed in the models of innovation theory. Therefore the criteria applied to the compound framework are designed to measure the potential of any mapped design activity to depart from the status quo in society.

2.2 The compound framework

To build the compound framework different models are introduced and adapted in order to meet the specifications as discussed above.

2.2.1 Building the frame – capturing sustainable development

To establish the frame, the study follows Hopwood *et al.* (2005) *(fig. 2)* and builds on the classifications of O'Riordan (1989) and Pearce (1993) *(fig. 1)*. However, in contrast to Hopwood *et al*.'s model, the environmental spectrum established by O'Riordan (1989) and Pearce (1993) is not applied to the full length of the x- and the y-axis. To emphasise the fundamental discrepancies between the eco-centric and the techno-centric world view, the spectrum is divided into two halves which are depicted by one of each axis. The resulting L-section constitutes the frame of the compound framework, representing the two basic attitudes in the environmental debate in terms of how to migrate from the status quo in the industrialised world towards more sustainable scenarios *(fig 4).*

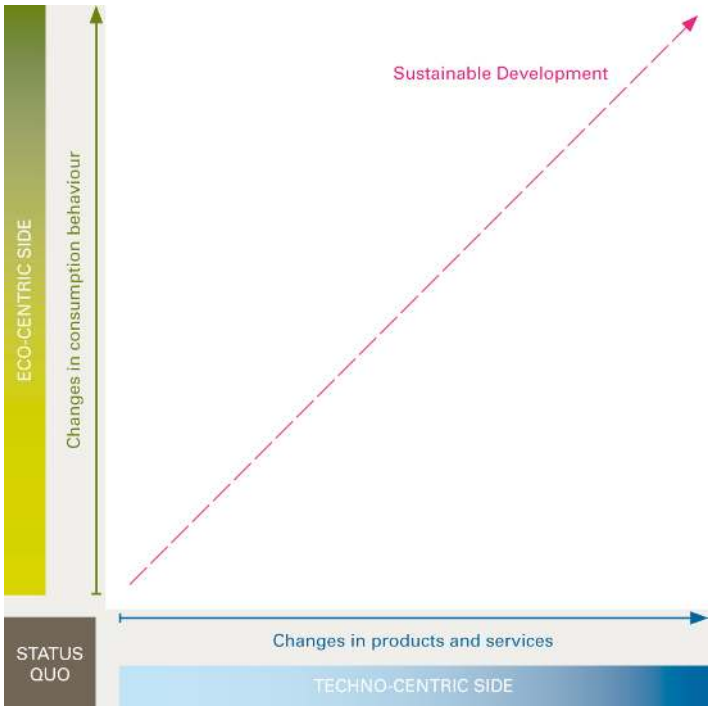


Figure 4: The 'frame' of the compound framework capturing sustainable development

In essence the eco-centric side stands for the conservative-nurturing world view and may be seen as the 'sustainability-side' of sustainable development (Sachs, 1993). Supporters of this perspective believe in the idea that humankind needs to change its behaviour in favour of a more sustainable life style (O'Riordan, 1989 and Pearce, 1993). In the light of consumerism in western

society the proposed changes target mainly consumption behaviours, provoking the demand for lower consumption (Vezzoli and Manzini, 2008).

The techno-centric side represents the radical manipulative world view and could be interpreted as the ‘development-side’ of sustainable development (Sachs, 1993). Here, supporters strongly believe in technical sophistication and development to overcome social and environmental problems (O’Riordan, 1989 and Pearce, 1993). So, moderation in consumption may be viewed as a lower priority. However, with ‘doing things better, rather then less’ the basic attitude seems to be appropriately described, resulting in the need to constantly refine production techniques, products and services. (Vezzoli and Manzini, 2008).

According to (O’Riordan, 1989) the notion of sustainable development may be located in between the eco-centric and the techno-centric side trying to marry both spheres. This position is indicated by the pink arrow in figure 4.

2.2.2 Building the picture – capturing sustainable design

The core part of the compound framework mainly builds on the system innovation model introduced by Konrad *et al.* (2003) *(fig. 3)* but is also informed by Vezzoli and Manzini (2008). The choice of this particular innovation model is based on reasoning that it works according to the same criteria as the frame of the compound framework introduced above: It evaluates the potential for certain innovation types to depart from the status quo towards more sustainable scenarios. Yet, Konrad *et al.* (2003) explicitly focus on a company or industry level. As this study is aimed at an overall level the following implications are to be taken into account.

Firstly, the notion of ‘systems’ change as they may not be seen as purely economic structures in future. In the new context systems should be understood as “existing arrangement[s] of technologies and supporting organisational, economic, regulatory, knowledge, and cultural structures” (Vergargt, 1999).

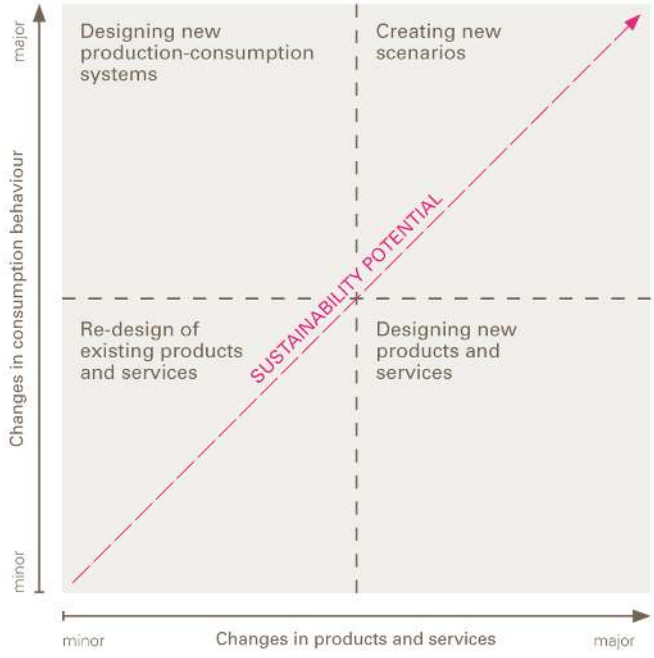


Figure 5: The ‘picture’ of the compound framework capturing sustainable design

Secondly, the criteria of the original framework are modified from ‘changes in market-actor relations’ and ‘changes in knowledge, technology and organisation’ to ‘changes in consumption behaviour’ and ‘changes in products and services’. This step supports both the alignment of the criteria to the more general orientation of the final framework, and a consistent compatibility between the final framework’s ‘frame’ and ‘picture’.

Finally, the four different innovation types introduced by Konrad et al. (2003) are replaced by a set of four ‘modes of designing’ which are closely informed by the “four levels of intervention” (Vezzoli and Manzini, 2008) discussed in section 1.2.2. These design modes conform with the meaning of the innovation types they replace but have greater potential to represent the issue of sustainable design (rather than that of innovation theory).

The resulting framework *(fig. 5)* ultimately shows a coherent conception of sustainable design: Two fundamental constants of design – the user (or consumer) and the designed product or service itself – determine a set of transition scenarios towards a more sustainable lifestyle. Additionally, the sustainable potential is maximised when both sides are brought together.

2.2.3 Frame and picture – the compound framework

By finally integrating ‘frame’ and ‘picture’ the compound framework is built as displayed in figure 6. The following paragraphs discuss the function of the framework as well as its utilisation as an assessment tool.

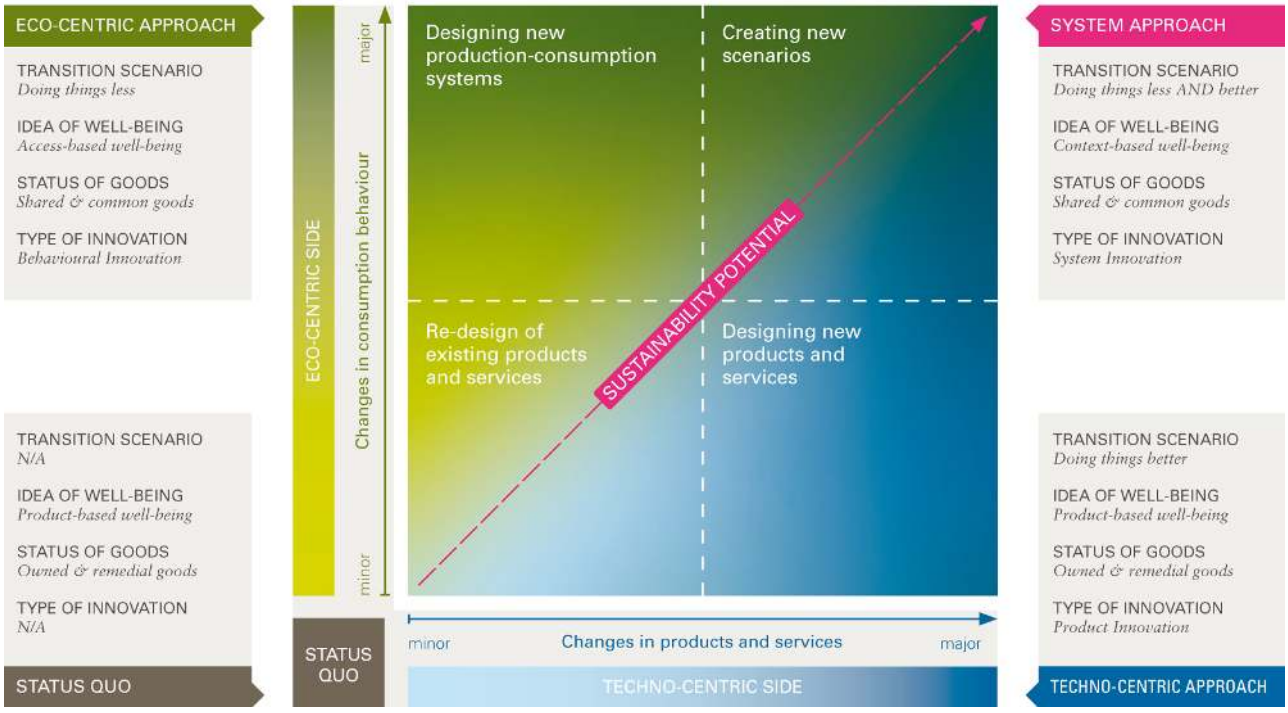
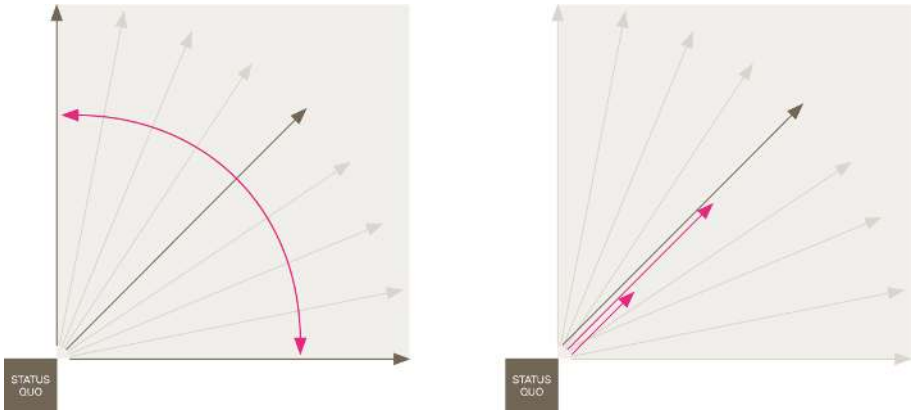


Figure 6: The compound framework – Sustainable design approaches in the context of sustainable development

In essence, the L-section of the framework (the ‘frame’) opens up a space within which the matter of sustainable design is located. Thereby this space covers two different aspects. The first aspect is concerned with the departure from status quo in the industrialised world. As already discussed, this is possible by following different directions. Yet, as illustrated in figure 7 the direction of departure does not necessarily need to follow either the eco-centric or the techno-centric approach, but may take any angle in between both extremes. Thereby the sustainability potential increases as the closer the departure’s direction gets into the centre of the spectrum (cf. 2.2.1). The second aspect describes the intensity of the departure from status quo, which would be the equivalent of an innovation’s scope in innovation theory moving from incremental to radical (cf. 1.2.3). As the framework does not work with the terms of innovation theory the departure’s scope is consequently specified with neutral terms describing a range from minor to major changes *(fig. 8)*.



Figures 7 and 8: The departure's direction and intensity

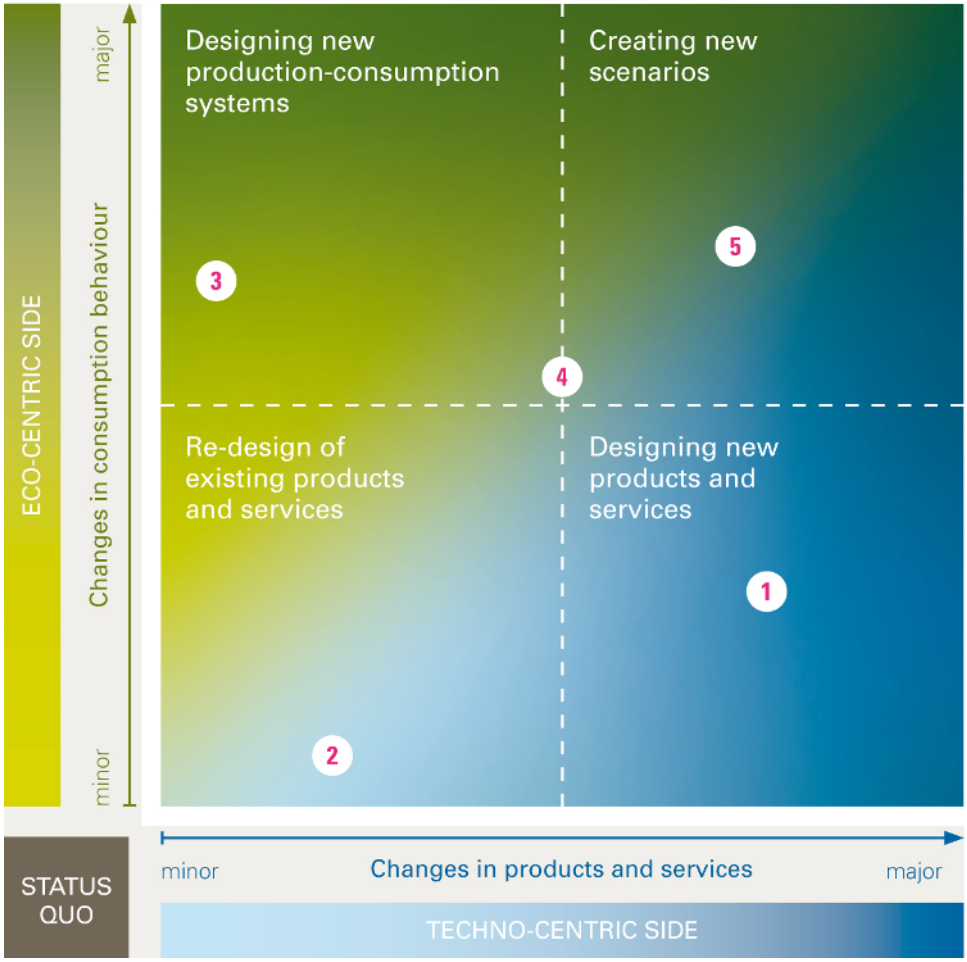
Additionally, the sustainability potential increases as a more determined departure from the status quo is performed. As a result, the framework defines the upper right corner as the area with the highest sustainability potential.

The space described above is populated and further defined by the 'picture' of the framework dealing with sustainable design. The coloured background of the matrix thereby illustrates the relationship of the eco- and the techno-centric approach. In this context the 'four modes of designing' (cf. 1.2.2) appear in a more informed way, as their relationship to the bigger picture of sustainable development becomes obvious: The bottom left corner of the matrix is closest to the status quo. Here it becomes evident that a 're-design of existing products and services' has the lowest potential to depart from the status quo towards more sustainable scenarios. However, the top left and bottom right corners illustrate that even major changes in consumption behaviour or products and services cannot achieve top levels in sustainability performance as long as they are conducted independently. Ultimately, only if both the eco-centric and the techno-centric side are united in order to perform major changes, truly sustainable development can take place. This is reflected by the top right corner and might result in the creation of new scenarios for a more sustainable life style.

As an extension to the framework four text boxes are provided which specify the corner stones of the framework with additional demarcation criteria based on Vezzoli and Manzini (2008). As already discussed in 1.1.6., when it comes to issues such as transition scenarios, ideas of well-being, or the status of goods, the boundaries between sustainable design strategy and the notion of sustainable development become blurred. As a result the text boxes are able to inform the 'frame' and 'picture' providing comparable information for both, the status quo, as well as the three main directions of departure form status quo: the 'eco-centric approach', the 'techno-centric approach', and the 'system approach'.

2.2.4 Mapping sustainable design activities

Beside its function as a visual map which describes the relationship between sustainable design and sustainable development, the framework may be also utilised as an assessment tool promoting the categorisation of further knowledge material (Choucri, 2007). In the latter case the model should be seen as "a sort of skeleton, something like an application form with many blanks or slots to be filled" (Minsky, 1986). In this case the supporting information such as the text boxes or the like is not essential anymore. In figure 9 the framework's mode of operation is illustrated by mapping the following basic strategies based on Fuad-Luke (2009). Thereby the design strategies get evaluated according to their potential to depart from the status quo as well as to their location on the eco-centric/techno-centric spectrum:



Figures 9 The compound framework utilised as an assessment tool

1. Bio-Manufacturing	–	*nature directly supports the fabrication of products (e.g. fruits become packaging)*
2. Clean Production	–	*production's impact on nature is reduced by putting appropriate systems in place*
3. Community Ownership	–	*maximises the product's efficiency through shared usage (e.g. car sharing systems)*
4. Dematerialisation	–	*products are replaced by services*
5. Downloadable Designs	–	*reduces the impact on nature and opens up entirely new scenarios*

Conclusion

Confronted with a considerable variety of different sustainable design activities such as theories, strategies or the development of tools, this study ultimately aims to establish conceptual clarity within the area of sustainable design. In order to provide a solid foundation for the area of sustainable design, it is important to define the context within the notion of sustainable development. However, due to the fundamental nature of sustainable design, it may not be entirely possible to define the field completely.

This study focuses on the relationship between sustainable design and sustainable development. The approach is based on the assumption that sustainable design may not be seen as a normal design discipline, but as an underlying notion, a philosophical approach to almost any design activity (McLennan, 2004). This notion finally responds to the same issue as the concept of sustainable development: At the centre of attention, is the departure from the status quo towards more sustainable scenarios.

To capture the fields and their relationship as described above, a visual approach is chosen. A literature review provided the basis for the conception of sustainable design in the context of sustainable development. Building on this, visual models of both spheres are introduced, classified and discussed to build a data base for the framework to be created.

As a result, a compound framework has been developed which is able to visualise the field of sustainable design in the context of sustainable development recognizing the potential to depart from the status quo as described above.

Depending on how it is used, the framework has the following implications: On a theoretical basis, the framework works as a visual map which describes the relationship of sustainable design and sustainable development. On a practical level the framework may be utilised as a visual assessment tool which promotes a better understanding and evaluation of the growing number of sustainable design activities. However, the mapping process may be debatable as many factors are not finally defined yet. This might be the starting point for future research.

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