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A Multilevel Design Model: the mutual relationship between product-service system development and societal change processes

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ABSTRACT

Change actors like designers play a strategic role in innovation and transition processes towards a sustainable society. They act at all levels of society and need help to find their way through increasingly interrelated innovation systems. To support their efforts, there is a need for a design supportive model that (1) can provide insight into the development of new products and product-service systems, as well as in developments that occur in society as a whole; (2) can provide insight into the relationship between functional problems on the one hand, and more abstract societal problems on the other; (3) describe design processes, change processes and transition processes in a consistent, mutually comparable manner that can potentially be used to structure future design-based initiatives. In this paper a Multilevel Design Model (MDM) is discussed, combining two specific functionalities: First a cyclic iterative design approach that may be generic enough to describe both the design of physical artefacts and the design of product-service systems, as well as the way that complex societal change processes may occur. Second a hierarchical systems approach, where on each aggregation level a similar description of the design, change or transition process is applied. The MDM is discussed by means of a simulated case example in the area sustainable transportation and electric transport, explaining the model may indeed be useful to describe and potentially explain some of the dilemmas that occur during the course of complex design processes.

1. Introduction

1.1. The widening scope of design and the changing role of the designer

In 1959, the International Council of Societies of Industrial Design defined an industrial designer as ‘one who is qualified by training, technical knowledge, experience and visual sensibility to determine the materials, mechanisms, shape, colour, surface finishes and decoration of objects which are reproduced in quantity by industrial processes’ (ICSID, 1959). The current definition describes design as ‘a creative activity whose aim is to establish the multi-faceted qualities of objects, processes, services and their systems in whole life cycles. Therefore, design is the central factor of innovative humanization of technologies and the crucial factor of cultural and economic exchange’ (ICSID, 2010). It further explains that the aim of design is to enhance global sustainability and environmental protection, give benefits and freedom to the entire human community, individual and collective, and to support cultural diversity despite the globalization of the world. Today, the important role designers can have in innovation processes towards a sustainable society is fully endorsed at the political level as well, such as in the report ‘Design for Growth & Prosperity’ of the European Design Leadership Board (Thomson and Koskinen, 2012).

When comparing both ICSID definitions, it shows that the working area of the designer has changed considerably during the last 50 years, shifting from tangible objects to combined product-service systems to the development of complex systems. The role of the designer is becoming more and more entangled with the roles of other actors (where an ‘actor’ can be defined as either a person, a company or an organization). That means that designers are evolving from being the individual authors of objects or buildings, to being the facilitators of change among large groups of people (Thackara, 2006). The design arena is getting more and more diffuse, and designers are more and more becoming ‘solution providers’, utilizing their specific qualities, like their capacity to

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produce visions of what is possible, and to imagine and visualize things that do not exist but could potentially exist (Meroni, 2007).

One could say this broadening perspective on the role of the designers is nothing new indeed. In 1969 Nobel Prize winner Herbert Simon already concluded that 'everyone designs who devises courses of action aimed at changing existing situations into preferred ones. The intellectual activity that produces material artefacts is no different fundamentally from the one that prescribes remedies for a sick patient or the one that devises a new sales plan for a company or a social welfare for a state' (Simon, 1969, 111). Victor Papanek, one of the forerunners of the sustainable design movement, made a similar statement when he emphasized that 'all men are designers. All that we do, almost all the time, is design, for design is basic to all human activity. The planning and patterning of any act toward a desired, foreseeable end constitutes a design process' (Papanek, 1985).

However, although all men may be designers, it is important to realize that each kind of design requires a specific expertise. A graphic designer is different than a fashion designer, and a landscape designer needs different skills compared to a game designer. For instance industrial design is a specialism in itself, where specialists are trained to develop new products or physical artefacts that originate from a human action or a machine process. Likewise, the design of product-service systems – defined as a mix of products and services that have been designed and combined so that they are jointly capable of fulfilling final customer needs (Halen et al., 2005) – is a specific design specialism with its own unique tools, methods and necessary expertise. The process of designing a product, for instance a new vehicle, is something rather different than designing a transport service. Let alone the development of a completely new regional transport system including innovative infrastructure and adapted government regulations. The new vehicle may be part of the transport service and be included in the regional transport system, but the system boundary of each of these designs varies considerably.

1.2. The need for a suitable design supportive model

Jørgensen (2012) demonstrates that change actors like designers act at all levels of society and need help – in terms of mapping – in their navigation through the innovation systems, full of conflicting visions, institutions and competing innovations. The question is how designers can take these mutual and complex relationships into account during their design activities. And what systematic approach – in terms of a first categorization of multiple design cycles at different levels of societal activity – could potentially help designers to effectively handle this complex process, in terms of their position and role with respect to the different design phases and activity levels? To answer this question, there is a need for a design supportive model with specific features. First, the model should provide insight into the development of a new physical product or a new product-service system, as well as in developments that occur in society as a whole. Second, the model should provide insight into the relationship between functional and operational problems and objectives on the one hand, and more abstract socio-technical and societal problems and objectives on the other. Third, the model should offer insight into these change processes in such a way that the design processes, change processes or transition processes are described in a consistent, mutually comparable manner that can potentially be used to structure future design-based initiatives.

To find out if current models can offer these specific features, a broad range of existing design or innovation models, in various fields of expertise, have been taken into account. The first group of models originates from the field of Industrial Design Engineering, among others: the Basic Design Cycle (Roozenburg and Eekels, 1998), the Innovation Cycle (Buijs and Valkenburg, 2005), the Double Diamond approach (Design Council, 2007), the VIP approach (Hekkert and Van Dijk, 2011), and several other methods and models (Cross, 2008; Curedale, 2012; Curedale, 2013). Here it is mainly about prescriptive models, especially targeting the development of one new tangible product or a new product-service system that solves a specific functional or operational problem. Even when the wider societal context is taken into account, this is mainly restricted to determine the influence that this context may have on the single product that is being developed, and not to pursue actual changes in the context itself.

The second group of models originates from the field of sustainable product-service system development, among others other the Kathalys method (Brezet et al., 2001b), the Solution Oriented Partnership approach (Manzini et al., 2004; Jegou and Joore, 2004), the Method for System Design for Sustainability (Vezzoli et al., 2014) and several other methods and models (Halen et al., 2005; Tukker and Tischner, 2006; Jegou and Manzini, 2008; Crul et al., 2009; Diehl, 2010; Ceschin, 2012; Vezzoli and Manzini, 2008; Meroni and Sangiorgi, 2011; Reinders et al., 2012), These models are often aimed at the development of one new product-service system, within the context of the broader socio-technical or societal environment, but without the aim of actually changing this broader context. Compared to the previous group of models, the design scope of these models is extended to include the development of product-service systems, which is combined with a strong focus on the issue of sustainability.

The third group of models originates from the field of Systems Engineering, among others the Waterfall Model (Royce, 1970), the Spiral Model (Boehm, 1988), the V-Model (KBST, 2004; Cadle and Yeates, 2008), the Work Breakdown Structure approach (Haugan, 2001) and several methods and models (VDI, 1985; NASA, 1995; Hitchins, 2008; Van Hinte and Van Tooren, 2008). Models in this field of expertise are targeted at the realization of strictly defined, technical objectives. They are prescriptive models that work toward the development of one new technical system, including the underlying subsystems. To separate systems, subsystems and elements, a hierarchical structure based on various aggregation or system levels is used (Haugan, 2001).

The fourth group of models comes from the field of Sustainable System Innovation. These models focus on societal change processes, which are about gradual, continuous alterations, during which the character of society undergoes a certain level of change. During this process, the way that societal functions are being fulfilled change, and a shift is made from one socio-technical system to another. Some of the models used in this field are the Dynamic Multilevel Model (Geels, 2005), the Transition Management Cycle (Loorbach, 2010), the Backcasting approach (Quist et al., 2008) and the concept of Strategic Niche Management (Kemp et al., 1998; Raven et al., 2010). These are mainly descriptive models aimed at understanding socio-technical or societal developments, mostly from studying developments afterwards ('ex post') instead of influencing them in a certain direction ahead of time ('ex ante'). In this field of expertise, physical products and product-service systems are considered as limited building blocks of the whole system. Several models in this field of expertise apply a multilevel perspective, where developments take place on various system or aggregation levels.

Based on the study of existing models (Table 1), the conclusion can be drawn that no existing design or innovation model is