NORDES 2021

EXPLORING IMPLICATIONS FOR DESIGNING FOR SOCIOTECHNICAL TRANSITIONS: TAKING REFLEXIVITY AS A MATTER OF SCALE

PENG LU

SCHOOL OF DESIGN, POLITECNICO DI MILANO

PENG.LU@MAIL.POLIMI.IT

DANIELA SANGIORGI

DEPARTMENT OF DESIGN, POLITECNICO DI MILANO

DANIELA.SANGIORGI@POLIMI.IT

ABSTRACT

There is increasing interest of design for paradigmatic and sociotechnical changes, in which the significance of actor is recognized. However, design studies that aim to connect actors at the micro level and sociotechnical systems at the macro level is limited. Based on institutional theory in sociotechnical theory, this paper proposes reflexivity as a useful concept to be associated with matters of scale in Design. Based on literature review, we explore the ways "cultivating reflexivity" has been applied in critical design, norm creative innovation and service ecosystem design. This preliminary work seems to suggest an evolution in the application of reflexivity, from a focus on individuals and their own critical attitudes, to the facilitation of a more reflexive design process to the facilitation of collective feedback loops of reflexivity and reformation of institutions and their socio-material manifestations, pointing toward a very relevant area of study for Design and sociotechnical transitions.

INTRODUCTION

The current call for a sustainable transition of our societies and economies, is motivating the increase interest of design for paradigmatic and sociotechnical changes, which redefine how we think about the state and purpose of the object, and thus, its ways of functioning, operating and managing (O'Flynn, 2007); and those changes "not only entail new technologies, but also changes in markets, user practices, policy and cultural meanings" (Geels, 2010, p.495)

In light of the complexity of this scale of change dedicated design concepts have been articulated, such as *DesignX* (Norman & Stappers, 2015), *Transition Design* (Irwin, 2015), *Systemic Design* (Jones, 2014) and *Social Innovation Design* (Manzini, 2015). While aiming to utilize design approaches to favour a sociotechnical transition for a sustainable development of the society (Norman and Stappers, 2015; Ceschin and Gaziulusoy, 2016; Irwin, 2018), the importance of engaging multiple stakeholders or actors, at the micro level of the sociotechnical systems, is recognized: Irwin argues stakeholder relations can be seen as the "connective tissue" (2018, p.970); Norman and Stappers suggest that "the most powerful knowledge for changing any system lies with its deep users and stakeholders" (2015, p.103). As a response to societal changes, design is "forced to engage more with society to gain legitimacy and support from society" (Mulder & Loorbach, 2018, p.19). Nevertheless, although those large scale design disciplines acknowledge the potential of leveraging actors and stakeholders in designing interventions (Reed et al., 2009), how and which design strategies can better connect actors operating at the micro level with the

https://doi.org/10.21606/nordes.2021.24

wider transformation of sociotechnical systems at the macro level, is still difficult to understand.

This paper will explore the potential of the concept of *reflexivity* to inform these multilevel interventions and implications. *Reflexivity* could be defined as "an *individual*'s general awareness of the constraints and opportunities created by the norms, values, beliefs and expectations of the *social structure* that surround them." (Suddaby et al., 2016, p.229). As *reflexivity* helps revealing these social norms at the micro and macro level, we assume it can be discussed as a medium to enrich current transformational design approaches.

While there is a history of work of Design research around reflective practice and reflexivity (Schön, 1984; Cross, 1999), only very recently reflexivity has been related to system changes (e.g., Sangiorgi et al., 2019; Vink et al., 2020). Furthermore, based on the strong link between reflexivity and institutional theory (Lawrence & Suddaby, 2006, p.219; Ruebottom & Auster, 2018) and the importance of institutional theory in sociotechnical theory (Fuenfschilling & Truffer, 2016), the introduction of reflexivity into design also means that institutional theory needs to be judiciously reviewed in design. Although the importance of institutional contexts have been recognized in recent design research, such as in Participatory Design (e.g. Huybrechts et al., 2017), they have been only very recently discussed in the large scale design scope as mentioned above.

For this reason, with this paper we aim to review existing design theories adopting reflexivity as a core theoretical construct, in conjunction with institutional theory, to reflect on the implications to consider reflexivity better connect micro-level actors with macro-level sociotechnical systems.

In particular this paper will review current studies into design approaches for paradigmatic and sociotechnical system transformation, to then articulate three examples of application of reflexivity in design, respectively *Critical Design*, *Norm-Creative Innovation*, and *Service Ecosystem Design*. This review will then inform the final considerations on the relationship between reflexivity and largescale design interventions to project possible future research.

DESIGN AND SCALE

SOCIOTECHNICAL SYSTEM ORIENTATION IN DESIGN

According to Buchanan's Orders of Design model, there are four broad areas explored by design practitioners, respectively *symbols (communication), things (construction), action (strategic planning) and thought (systemic integration)* (1998; 2001). Here, the thought order can be also interpreted as *complex systems* (Buchanan, 1992) which are "human systems, the integration of information, physical artifacts, and interactions in environments of living, working, playing, and learning" (Buchanan, 2001, p.12). As anticipated by Buchanan, in recent decade, Design is increasingly working on larger scale projects, lately considering the need for sociotechnical transitions, meaning the system-exceeding change that goes beyond the ordering of current system (Bergman et al., 2008); those sociotechnical sense of changes not only entail new technologies, but also markets, user practices, policy and cultural meanings (Geels, 2010), which should be allocated in the fourth order of change in Buchanan's model.

The reasons for this evolution of design connotations can be explained by both internal and external factors. From the internal point of view, the main reason lies in the changing positioning of the design and designers themselves. Design is increasingly considered and recognized to be able to contribute to complex sociotechnical arenas (Norman & Stappers, 2015; Irwin, 2015). And designers are "increasingly working with activities that mostly have societal implications" (Westerlund & Wetter-Edman, 2017, p.S886). In terms of external factors, this is mainly due to the urgent need for a sustainable development, which includes factors such as resources, climate change, equity and justice in human society (Norman & Stappers, 2015; Manzini, 2015; Irwin, 2015; Ceschin & Gaziulusoy, 2016).

Many design concepts have been proposed in response to such a trend. Norman and Stappers (2015) propose *DesignX* which focuses on complex sociotechnical systems resulting from modern issues in terms of human behaviour and cognition; social, political, and economic framework; and technologies. In the DesignX proposal, the authors suggest designers must play an active role from design to implementation stages and develop solutions through incremental steps (ibid). *Transition Design* is another design concept focusing on societal wicked problems as proposed by Irwin (2015), which advocates a circular, iterative, and error-friendly future-oriented design process. In her proposal, Irwin argues that in transition design, theories of change are a "continually co-evolving body of knowledge", and designers need to have "a new, more holistic mindset" (2015, pp.234–235). Transition design also calls for highly transdisciplinary, collaborative design approaches that are based on deep understanding of changes within complex systems (Irwin, 2015). Some more examples could be *Systemic Design* (Jones, 2014) and *Social Innovation Design* (Manzini, 2015). Besides, some established design disciplines have also expanded their scale to the sociotechnical level, including *Participatory Design* (e.g. Pilemalm et al., 2007) and *Design for Sustainability* (Ceschin & Gaziulusoy, 2016) which covering multileveled design objects ranging from products to sociotechnical systems. Despite the differences in design approaches, those design

disciplines all consider sociotechnical systems as the object of design interventions, in order to bring about sociotechnical system changes or even transitions.

However, although changes within sociotechnical systems can be catalysed by individuals such as designers, those changes "cannot be managed or controlled, nor can outcomes be accurately predicted" (Irwin, 2015, p.234). In these large scale design visions, the central position of the designer is challenged while the importance of engaging multiple stakeholders or actors, at the micro level of the sociotechnical system, is recognised, as "the most powerful knowledge for changing any system lies with its deep users and stakeholders" (Norman & Stappers, 2015, p.103).

SOCIOTECHNICAL SYSTEMS AND INSTITUTIONS

In parallel, apart from being taken as a design object, sociotechnical systems have also been connected with institutional theory (Geels, 2004), in order to conceptualize "the dynamic interplay between actors and structures" (Geels, 2004, p.897), and "influence sociotechnical systems towards more sustainable consumption and production patterns" (Fuenfschilling & Truffer, 2016, p.298). Here, *institution* is similar to the concept of norms and rules, and "comprise regulative, normative and cultural-cognitive elements that, together with associated activities and resources, provide stability and meaning to social life" (Scott, 2014, p.56). In sociotechnical theory, the core concept related to institution is *sociotechnical regime* (Dosi, 1982; Rip & Kemp, 1998; Geels, 2002; Smith et al., 2005), which investigates the coevolution of institutional and technological elements that enables the fulfillment of specific societal functions (Fuenfschilling & Truffer, 2016). As a consequence of the institutional turn in sociotechnical regime research, sociotechnical transitions "can essentially be interpreted as processes of institutional change" (Fuenfschilling & Truffer, 2016, p.298) or "regime shifts" (Geels, 2010, p.495), in which regime is "highly stable", and "has proven to be very resistant to change" (Fuenfschilling & Truffer, 2016, p.302).

Besides, in original sociotechnical theory, the *multi-level perspective* (MLP) is proposed as a framework for understanding sustainability transitions in sociotechnical systems with an overall view of multi-dimensional complexity of changes (Rip & Kemp, 1998; Geels, 2002; Geels, 2004; Geels & Schot, 2007; Geels, 2010). The MLP distinguishes three analytical levels, which refer to heterogeneous configurations of increasing stability, respectively *niches*, *sociotechnical regimes*, and *an exogenous sociotechnical landscape* (Geels, 2010). And the MLP proposes that sociotechnical transitions come from interactions within and between these levels (Geels, 2010; Ravena et al., 2012). It is also suggested that long-term changes on the landscape level is due to the regime-shifts that emerge from changes of actor practices (Ravena et al., 2012).

REFLEXIVITY AS A MATTER OF SCALE

From a micro-individual perspective, there are some disciplines that respond to the constraints or influences of the social context on the individual. For instance, Gregory Bateson's Theory of Logic Types (c.f. Bateson, 1972) "helps relate individual and social aspects of change", which highlights how individual's "learning is framed and affected by its social context." (Bredo, 1989, p.37). Another inevitable example could be Pierre Bourdieu's concept of "habitus" (e.g. Bourdieu, 1977).

On another side, according to institutional theory, actors could resort to institutional work to achieve institutional changes. Here institutional work is the "purposive action of individuals and organizations aimed at creating, maintaining and disrupting institutions" (Lawrence & Suddaby, 2006, p.215); and the importance of *reflexivity*, which is defined as "an individual's general awareness of the constraints and opportunities created by the norms, values, beliefs and expectations of the social structure that surround them" (Suddaby et al., 2016, p.229), is highlighted (Lawrence & Suddaby, 2006, p.219; Ruebottom & Auster, 2018).

So, it seems that in the process of design for sociotechnical transition, we can adopt institutional theory as theoretical basis, and *reflexivity* as a concept to connect design interventions at micro-level to macro-level of sociotechnical systems change. In fact, similar topics have already been discussed in design topics. For instance *Transition Design* has emphasized that transition design education should teach designers "to examine their own value system" and "work with the interior, invisible dimension of human experience" (Irwin, 2015, p.235), which we conclude as *"designers' reflexivity"*; however, leveraging design intervention to cultivate reflexivity of actors who are inside the sociotechnical transition is still unclear. Although the concept of reflexivity has been mentioned in design research for a long time (Schön, 1984; Cross, 1999), there is a lack of research on how to use it in the practice of sociotechnical transition.

In the next section, the paper will review existing design studies that involve "cultivating reflexivity" as a core element, to value their contribution to this discussion.

REFLEXIVITY AND DESIGN

The term reflexivity has been discussed in various disciplines to describe the "capacity to turn or bend back upon itself, to become an object to itself, and to refer to itself", and it "links self and other, subject and object" (Babcock, 1980, p.2). At the moment, reflexivity seems to be used more associated with academic research and discussed with concepts of

epistemology and construction of knowledge, especially in qualitative research (Barry et al., 1999; Mauthner & Doucet, 2003; Etherington, 2007; Berger, 2015; Alvesson & Sköldberg, 2018). However, in line with our study, we adopt the interpretation of reflexivity given by institutional theory as proposed above in this paper.

In sociotechnical systems, actors and organizations are embedded in networks interdependently, in which the sociotechnical regimes and rules provide stability by guiding actors' perceptions and actions (Geels, 2004). So, reflexivity could allow actors to recognize and reflect on those invisible rules and regimes, which may trigger further changes. Given this specific meaning, it seems to be valuable to review and discuss some emerging design research fields, respectively *Critical Design* (Dunne & Raby, 2013), *Norm-creative Design* (Öhrling et al., 2018), and *Service Ecosystem Design* (Vink et al., 2020), for their application of "cultivating reflexivity". Other design fields that relate as well with critical society transformation, such as *Design for Behaviour Change* (DfBC), are more oriented to intentionally influence individuals' behaviour and "negative social and environment issues" (Niedderer et al., 2018, p.3). Instead of aiming at changing the actors' context or the overall socio-technical system, DfBC starts from the designers' "moral responsibility" to use design interventions to influence the users (Jelsma, 2006; Niedderer et al., 2014, p.14).

CRITICAL DESIGN

The term Critical Design was first used in Anthony Dunne's book *Hertzian Tales: Electronic Products, Aesthetic Experience, and Critical Design* (1999). For critical design, critical theory is taken as an intellectual resource (Bardzell et al., 2012), although the latter is applied "strategically and sporadically" (Malpass, 2017, p.10). And critical theory argues that "our everyday values, practices, perspectives, and sense of agency and self are strongly shaped by forces and agendas of which we are normally unaware, such as the politics of race, gender, and economics" (Sengers et al., 2005, p.50). In this context, Dunne and Raby refer to "*affirmative design"* to describe most design which conforms to cultural, social, technical and economic expectation of status quo (2001, p.58). Recognizing that society is passive and people "unable to see alternatives to their current conditions of life" (Jakobsone, 2017, p.S4260), as an opposition to affirmative design, *critical design* is "a form of social research" (2006, p.147), aimed at "leveraging designs to make consumers more critical about their everyday lives, and in particular how their lives are mediated by assumptions, values, ideologies, and behavioral norms inscribed in designs" (Bardzell & Bardzell, 2013, p.3297). Critical design suggests to facilitate "a way of knowing, exploring, projecting and understanding the relationship between users, objects and the systems that they exist in" (Malpass, 2016, p.486). As a result, the primary outcome is knowledge, not a design product (Bardzell & Bardzell, 2013). Based on the review above, we believe that critical design can provide implications for cultivating reflexivity in sociotechnical transitions. And in critical design, a concept that echoes reflexivity could be *critical sensibility*.

At its most basic, critical sensibility is "simply about not taking things for granted, to question and look beneath the surface" (Dunne & Raby, 2009). To achieve that and "overcome a conditioned familiarity with design and use" (Malpass, 2016, p.484), critical design works through *relational ambiguity* (Malpass, 2013). According to Gaver and his colleagues, "ambiguity is a property of the interpretative relationship between people and artefacts", which "is an attribute of our interpretation of them" (2003, p.235). Furthermore, they propose three types of ambiguity, respectively in information, context and relationship (Gaver et al., 2003). All of them can drive users to experience a dilemma and carry a burden of interpretation, which is vital to critical design (Malpass, 2013).

When it comes to design process, critical design essentially relies on the mechanisms of narrative storytelling and allegory to visualize alternatives and allow the user to understand and engage with the design and further its satiric forms (Malpass, 2013), and design objects often play as a medium and are used to "draw attention to the matter of embedded messages and ideologies" (Jakobsone, 2019, p.15). In this process, *design fiction* is the most representative tool of critical design (Dunne & Raby, 2013). Coined by science fiction author Bruce Sterling incidentally (2005), design fiction is further refined as "the deliberate use of diegetic prototypes to suspend disbelief about change" (Bosch, 2012). Practically, design fictions utilize software development kit, 3D computer model, and other media methods to build fictional alternative worlds, where the design artefacts created by designers are making sense (Coulton & Lindley, 2017).

NORM CREATIVE INNOVATION

Norm Creative Innovation is emerging as a new design theory with special emphasis on challenging current social norms (Öhrling et al., 2018). Norm creative innovation are not only concerned with the significance of the norms in guiding our everyday life, but also with the characteristics of the actors in these norms, including their gender, abilities, etc., and the social exclusion that these characteristics entail (Nilsson & Jahnke, 2018).

For norm creative innovation, it is defined as a two-step process: the first is norm-critical design and the second is to become norm-creative (Nilsson & Jahnke, 2018). The concept of norm-critical design is proposed by

Swedish researchers Sofia Lundmark, Maria Normark and Minna Räsänen "to investigate the norms and normative assumptions that a certain object generates" (2011, p.42). They introduce the focus of a "norm-critical perspective" to "make norms that affects and dominates our beliefs and values, more visible" (2011, p.42). The term "norm-critical" comes from the Swedish term "normkritisk" that used in "normkritisk pedagogik" (norm-critical pedagogy) (c.f. Bromseth & Darj, 2010), which is a development of "queer pedagogy" (Bryson & de Castell, 1993). The term norm-creative or norm-creativity is a more recent concept coming from Swedish term "normkreativ" (c.f. Vinthagen & Zavalia, 2014), "which explores different ways of responding to non-conscious human interactions" (Nilsson & Jahnke, 2018, p.379). In norm creative innovation, norm-critical design involves gaining awareness of social norms that contribute to inequalities and social exclusion and challenging them; and then norm-creativity develops design solutions that counteract such norms through design thinking of what might be (Nilsson & Jahnke, 2018).

Norm creative innovation can be described more as a design principle than as a design discipline. Due to the fact that related theory is not yet well established, the approaches to norm creative innovation are still lacking. One of the most important sets of methods is the Nova cards toolkit developed by Swedish research and innovation agency Vinnova (c.f. Silva et al., 2016). Like a deck of cards, NOVA contains 54 cards including four tool suits, respectively *norms, tactics, role models*, and *experiments*. And it is described that the toolkit is designed as a deck for a social and interactive process and also flexible usages (Silva et al., 2016).

SERVICE ECOSYSTEM DESIGN

Service ecosystem design is a new conceptualization of service design proposed by Vink et al., aiming to cope with the "reductionist view of service design that ignores the institutional arrangements and other interdependencies" (2020, p.1).

Service design has been integrating service-dominant (S-D) logic (Vargo & Lusch, 2004; Vargo & Lusch, 2008), which has resulted in the conceptualization of "Design for Service" (Kimbell, 2011; Meroni & Sangiorgi, 2011). In S-D logic, service is the underlying basis of exchange (Vargo et al., 2008; Vargo & Lusch, 2004), and value results from the beneficial application and integration of resources for other actors (Vargo & Lusch, 2008). To better understand value cocreation among actors, Chandler and Vargo (2011) propose oscillating foci of multi-level conceptualization of context with three levels aggregation (micro, meso, and macro). Built on above theoretical foundation, service ecosystems are proposed and defined as relatively self-contained, self-adjusting systems of actors connected by shared institutions and service exchanges (Akaka et al., 2012). Here, the institutions in service ecosystems theory are also from institutional theory but focusing on guiding value cocreating interactions among actors. Service researchers also introduce institutional work to refer to the actions of creating, maintaining and disrupting institutions (Lawrence & Suddaby, 2006; Vargo et al., 2015).

Based on above new development of S-D logic, Vink et al. propose service ecosystem design to facilitate the emergence of desired forms of value cocreation (2020). Taking institutional arrangements (i.e. sets of institutions) and related physical enactments as the design materials, the embedded *feedback loop* of reflexivity and reformation is suggested as the focal stance of design process (Vink et al., 2020). Here, the reflexivity refers to the same concept in institutional theory; and the reformation involves intentionally reshaping institutional arrangements and occurs through institutional work (Lawrence & Suddaby, 2006; Vargo & Akaka, 2012; Vink et al., 2020).

Given the newness of service ecosystem design, there is a few established design methods for the feedback loop of reflexivity and reformation.

As we can see from these different design studies, cultivating reflexivity has been interpreted in different ways, with different scope and perspectives. The following discussion will compare these research works to then suggest implications that could better help design to use reflexivity as a matter of scale.

DISCUSSION

In the following text, we try to discuss their understanding of reflexivity and norms, their design processes and actors' engagement to explore implications for cultivating reflexivity in large scale design involving sociotechnical transition. Buchanan's Four Orders of Design is also introduced to integrate and broaden found implications.

UNDERSTANDING OF REFLEXIVITY AND NORMS

Critical design in itself, as the aim of the design process, is developed to stimulate people's reflexivity; a related concept is critical sensibility (Dunne & Raby, 2009). Norm creative innovation instead refers more to the phenomenon of social exclusion (Nilsson & Jahnke, 2018): here reflexivity could be taken as a starting point: with reflexivity designers and engaged actors start their journey to uncover the hidden social norms and then trigger further design activities. Whereas in service ecosystem design, reflexivity is a process in feedback loops of reflexivity and reformation.

The social norms involved in critical design and norm-creative innovation seem to be interpreted in a general

way, which "are woven into the fabric of our societies and guide our everyday actions" (Nilsson & Jahnke, 2018, p.379). Service ecosystem design, on the other side, due to its cognate origin in the introduction of institutional theory (Geels, 2004), has a natural compatibility with large scale designs for sociotechnical systems. However, it is important to note that institutions and institutional arrangements in service ecosystem design are used to explain how value cocreation is realized in a service ecosystem (Vargo & Lusch, 2016), which take into account more of the properties of value cocreation, and may ignore the moral and ethical connotations of, for example, gender or social oppression.

As such, we argue that in exploring implications on how these three design concepts understand reflexivity, there is a need to clarify their advantageous areas, and due to the complexity of the sociotechnical system itself, we may need to combine different perspectives on reflexivity in order to address different characteristics of sociotechnical regimes aiming for sociotechnical transitions.

DESIGN PROCESS

For critical design, the aim of the design process is to stimulate reflexivity, or critical sensibility (Dunne & Raby, 2009). For norm creative innovation, after providing a reflexive norm-critical process, a norm-creative phase follows to provide feedback on the previous reflective process and to try to build new norms. The service ecosystem design approach includes the feedback loop of reflexivity and reformation, firstly through reflexivity to stimulate actors' understanding and awareness of institutional arrangements, and then reformation is used to alter "physical enactments" (Vink et al., 2020, p.8) by means of institutional work, which can build up aiming for a more permanent influence on sociotechnical systems.

Based on the above discussion, it seems that critical design can be more of a communication design tool that can be used to attract people's attention and activate a critical reflection. Besides, while cultivating audiences' reflexivity, critical design focuses on single events and encounters but does not offer a solution to overcome related design problems. Norm creative innovation instead focuses on stimulating reflexive design processes. In other words, the design process combination of norm-critical design and norm-creative process could be used to stimulate reflexive practice among designers and actors. So, we suggest that norm creative innovation can be *integrated* into large scale design processes as a tool to cultivate reflexivity. While the reflexivity-reformation feedback loop allows service ecosystem design to inform a systemic and collective cycle of reflexive practice. The continuous cycle, from cultivating reflexivity to changing the institutional arrangements and their dependence on the tangible infrastructure, of service ecosystem design is inherently iterative and systemic, and as a result, its output aims for a long-term impact.

ROLE OF ACTOR OR USER

While there is a lack of specific tools and approaches as mentioned in previous part, the core differences among these three design concepts concern the nature and level of actors' engagement. In critical design, as the purpose of the design is to facilitate "a way of knowing, exploring, projecting and understanding the relationship between users, objects and the systems that they exist in" (Malpass, 2016, p.486), actors engage mostly with the outputs, reacting to the provocations to potentially change their view; in norm creative design, actors are generally engaged in the design process to affect the output and generate better solutions, that might be freer of bias. Whereas service ecosystem design requires actor's engagement, as a collective endeavour to identify existing norms and rules (i.e., institutions and institutional arrangements) that might prevent for wider and deeper aimed for transformations of their practices and the wider ecosystem.

Below we create a table to summarize the three design topics discussed in this paper to provide implications for cultivating reflexivity in large scale design processes for sociotechnical transition.

Table 1: Implications of reflexivity

	Critical Design	**Norm Creative Innovation**	**Service Ecosystem Design**
Theoretical foundation or resource	Critical theory	Norm-critical pedagogy	S-D logic; Institutional theory
How to Understand Reflexivity	Reflexivity as the aim	Reflexivity as a starting point	Reflexivity as a process in feedback loops
How to Understand Institutions or Norms	Social norms	Social norms	Value cocreation institutions
Design Process	Focus on generating reflexive encounters	Focus on stimulating reflexive design processes	Focus on stimulating reflexivity and ongoing loops of reformation
Role of Actor or User	Reacting to change their perspective	Engaging to transform the design outcome	Engaging to change their own practices

INTEGRATING WITH BUCHANAN'S FOUR ORDERS OF DESIGN MODEL

Buchanan's Four Orders of Design model (1998; 2001) is here introduced to integrate previous discussions and broaden the field of observation, understanding and application of those implications to a wider range of design contexts. According to Buchanan's definition of *products* (2001), the three design concepts discussed before can be distributed in different places of the Four Orders model, although not very precisely.

From this perspective, these three design concepts can be seen as representatives of the different design concepts based on the four orders model. And the related implications or strategies seem to have the potential to be applied to a wider range of design contexts (Figure 1).

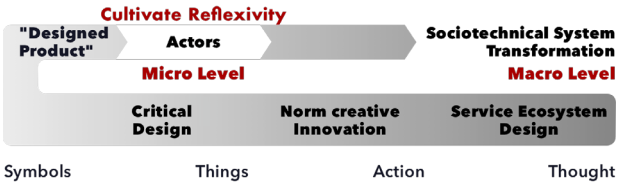

Figure 1: Integration based on Buchanan's Model.

CONCLUSION

Although large scale design such as DesignX (Norman & Stappers, 2015) and Transition Design (Irwin, 2015) recognize the value of actors, there is limited consideration on how to connect the actors to reflect on the sociotechnical transition. Given such a status quo, we have reviewed the development of sociotechnical theory with the introduction of institutional theory. Based on that, we have clarified how reflexivity can be regarded as a matter of scale in design of intervening sociotechnical transitions to connect the underlying actors at the micro level to macro level of system changes in terms of contributing to the regime shifts. Then, by reviewing the literature on critical design, norm creative innovation, and service ecosystem design, and comparing and discussing the basic findings, we discussed differences in their understanding of reflexivity and norms, their design process, and actor engagement. Furthermore, based on Buchanan's Four Orders of Design model, we suggest that those implications found in mentioned three design concepts could be useful in a wider range of design contexts.

As a first contribution, this paper has stressed the importance of reflexivity as a matter of scale. Although the concept of reflexivity has been mentioned in design theory for a long time, and Irwin has also called for designer's reflection on "invisible dimension of human experience" in transition design (Irwin, 2015, p.235), but this is still lacking when it comes to how to use design to cultivate the reflexivity of actors in large scale design interventions. To compensate this limitation, we have introduced reflexivity as defined by institutional theory, as a potential lever to connect the change at the micro level of individual actors with sociotechnical transition at the macro level.

This potential role, has been partly evidenced by reviewing how reflexivity has been used in design, moving from being a tool to stimulate individual reflexivity and critical attitude to become a collective approach that can change not only the design processes to become less biased, but also wider system change transitions, by stimulating interlinked exercises of reflexivity and reformation. We argue how the value of these three different approaches could be used in a more systematic and integrated manner in designing for sociotechnical transitions.

Although the discussion in this paper is preliminary, it points toward a valuable field of studies in Design, such as reflexivity as a matter of scale. As we intentionally selected only three recent design approaches that addressed reflexivity in an explicit manner, we would recommend future studies to conduct a more systematic review of the use of the concept of reflexive practice, critical thinking and reflexivity in design, to deepen the potential of this theoretical construct for large scale change. This future research should also support the development of practical design strategies to link micro level initiatives with wider sociotechnical systems transitions.

ACKNOWLEDGE

The authors hope to express their gratitude to the reviewers for the enlightening suggestions which allow the authors to learn a lot from revising this work.

REFERENCES

Akaka, M.A., Vargo, S.L. & Lusch, R.F. (2012) An Exploration of Networks in Value Cocreation: A Service-Ecosystems View S. L. Vargo & R. F. Lusch eds. *Special Issue – Toward a Better Understanding of the Role of Value in Markets and Marketing*, 9, pp.13–50.

Alvesson, M. & Sköldberg, K. (2018) *Reflexive methodology new vistas for qualitative research.* Los Angeles, Sage.

Babcock, B.A. (1980) Reflexivity: Definitions and discriminations. *Semiotica*, 30 (1–2), pp.1–14.

Bardzell, J. & Bardzell, S. (2013) What is 'critical' about critical design? In: *CHI '13*. New York, New York, USA, SIGCHI, ACM Special Interest Group on Computer-Human Interaction, p.3297.

Bardzell, S., Bardzell, J., Forlizzi, J., Zimmerman, J. & Antanitis, J. (2012) Critical design and critical

theory. In: *DIS '12*. New York, New York, USA,

Barry, C.A., Britten, N., Barber, N., Bradley, C. & Stevenson, F. (1999) Using Reflexivity to Optimize Teamwork in Qualitative Research. *Qualitative Health Research*, 9 (1), pp.26–44.

Bateson, G. (1972) *Steps to an ecology of mind*. New York, Ballantine.

Berger, R. (2015) Now I see it, now I don't: researcher's position and reflexivity in qualitative research. *Qualitative Research*, 15 (2), pp.219–234.

Bergman, N., Haxeltine, A., Whitmarsh, L., Köhler, J., Schilperoord, M. & Rotmans, J. (2008) Modelling socio-technical transition patterns and pathways. *Journal of Artificial Societies and Social Simulation: an inter-disciplinary journal for the exploration and understanding of social processes by means of computer simulation*, 11 (3), pp.1–32.

Bosch, T. (2012) Sci-Fi Writer Bruce Sterling Explains the Intriguing New Concept of Design Fiction [Internet]. Available from: <https://slate.com/technology/2012/03/bruce-sterling-on-design-fictions.html> [Accessed 21 January 2021].

Bourdieu, P. (1977) *Outline of a Theory of Practice*. Cambridge University Press.

Bredo, E. (1989) Bateson's Hierarchical Theory of Learning and Communication. *Educational Theory*, 39 (1), pp.27–38.

Bromseth, J. & Darj, F. (2010) *Normkritisk pedagogik : makt, lärande och strategier för förändring*. Uppsala universitet, Centrum för genusvetenskap.

Bryson, M. & de Castell, S. (1993) Queer Pedagogy: Praxis Makes Im/Perfect. *Canadian Journal of Education / Revue canadienne de l'éducation*, 18 (3), pp.285–305.

Buchanan, R. (1998) Branzi's Dilemma: Design in Contemporary Culture. *Design Issues*, 14 (1), pp.3–20.

Buchanan, R. (2001) Design Research and the New Learning. *Design Issues*, 17 (4), pp.3–23.

Buchanan, R. (1992) Wicked Problems in Design Thinking. *Design Issues*, 8 (2), pp.5–21.

Ceschin, F. & Gaziulusoy, I. (2016) Evolution of design for sustainability: From product design to design for system innovations and transitions. *Design Studies*, 47, pp.118–163.

Chandler, J.D. & Vargo, S.L. (2011) Contextualization and value-in-context: How context frames exchange. *Marketing Theory*, 11 (1), pp.35–49.

Coulton, P. & Lindley, J. (2017) Vapourworlds and Design Fiction: The Role of Intentionality. *The Design Journal*, 20 (sup1), pp.S4632–S4642.

Cross, N. (1999) Natural intelligence in design. *Design Studies*, 20 (1), pp.25–39.

Dosi, G. (1982) Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change. *Research Policy*, 11 (3), pp.147–162.

Dunne, A. (1999) *Hertzian tales: electronic products, aesthetic experience, and critical design*. Cambridge, Mass, MIT Press.

Dunne, A. (2006) *Hertzian tales: electronic products, aesthetic experience, and critical design*. Cambridge, Mass, MIT Press.

Dunne, A. & Raby, F. (2001) *Design Noir: The Secret Life of Electronic Objects*. Springer Science & Business Media.

Dunne, A. & Raby, F. (2009) INTERPRETATION, COLLABORATION, AND CRITIQUE [Internet]. Available from: <http://dunneandraby.co.uk/content/bydandr/465/0> [Accessed 21 January 2021].

Dunne, A. & Raby, F. (2013) *Speculative Everything: design, fiction, and social dreaming*. MIT Press.

Etherington, K. (2007) Ethical research in reflexive relationships. *Qualitative Inquiry*, 13 (5), pp.599–616.

Fuenfschilling, L. & Truffer, B. (2016) The interplay of institutions, actors and technologies in socio-technical systems - An analysis of transformations in the Australian urban water sector. *Technological Forecasting and Social Change*, 103, pp.298–312.

Gaver, W.W., Beaver, J. & Benford, S. (2003) Ambiguity as a resource for design. In: *CHI '03*. New York, New York, USA, SIGCHI, ACM Special Interest Group on Computer-Human Interaction, p.233.

Geels, F.W. (2004) From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. *Research Policy*, 33 (6–7), pp.897–920.

Geels, F.W. (2010) Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. *Research Policy*, 39 (4), pp.495–510.

Geels, F.W. (2002) Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research Policy*, 31 (8), pp.1257–1274.

Geels, F.W. & Schot, J. (2007) Typology of sociotechnical transition pathways. *Research Policy*, 36 (3), pp.399–417.

Huybrechts, L., Benesch, H. & Geib, J. (2017) Institutioning: Participatory Design, Co-Design and the public realm. *CoDesign*, 13 (3), pp.148–159.

Irwin, T. (2018) The Emerging Transition Design Approach. In: C. Storni, K. Leahy, M. McMahon, P. Lloyd, & E. Bohemia eds. *Design as a catalyst for change - DRS International Conference 2018*. Limerick, Ireland, pp.968–989.

Irwin, T. (2015) Transition Design: A Proposal for a New Area of Design Practice, Study, and Research. *Design and Culture*, 7 (2), pp.229–246.

Jakobsone, L. (2019) Critical Design as a Resource. Adopting the Critical Mind-Set. *Design Journal*, 22 (5), pp.561–580.

Jakobsone, L. (2017) Critical design as approach to next thinking. *Design Journal*, 20 (sup1), pp.S4253–S4262.

Jelsma, J. (2006) Designing 'moralized' products. In: P.-P. Verbeek & A. Slob eds. *User Behavior and Technology Development*. Springer Netherlands, pp.221–231.

Jones, P.H. (2014) Systemic Design Principles for Complex Social Systems. In: G. S. Metcalf ed. *Social Systems and Design*. Translational Systems Sciences. Tokyo, Springer Japan, pp.91–128.

Kimbell, L. (2011) Designing for Service as One Way of Designing Services. *International Journal of Design*, 5 (2), pp.41–52.

Lawrence, T.B. & Suddaby, R. (2006) Institutions and Institutional Work. In: *The SAGE Handbook of Organization Studies*. 1 Oliver's Yard, 55 City Road, London. United Kingdom, SAGE Publications Ltd, pp.215–254.

Lundmark, S., Normark, M. & Räsänen, M. (2011) Exploring Norm-Critical Design in Online Youth Counseling. In: *1 st International Workshop on Values in Design – Building Bridges between RE, HCI and Ethics*. pp.41–47.

Malpass, M. (2013) Between wit and reason: Defining associative, speculative, and critical design in practice. *Design and Culture*, 5 (3), pp.333–356.

Malpass, M. (2017) *Critical Design in Context: History, Theory, and Practice*. Bloomsbury Publishing.

Malpass, M. (2016) Critical Design Practice: Theoretical Perspectives and Methods of Engagement. *Design Journal*, 19 (3), pp.473–489.

Manzini, E. (2015) *Design, When Everybody Designs: An Introduction to Design for Social Innovation*. MIT Press.

Markussen, T. (2013) The disruptive aesthetics of design activism: Enacting design between art and politics. *Design Issues*, 29 (1), pp.38–50.

Mauthner, N.S. & Doucet, A. (2003) Reflexive accounts and accounts of reflexivity in qualitative data analysis. *Sociology*, 37 (3), pp.413–431.

Meroni, A. & Sangiorgi, D. (2011) *Design for services*. Burlington, VT, Gower.

Mulder, I. & Loorbach, D. (2018) Rethinking Design: a critical perspective to embrace societal challenges. In: G. Kossoff & R. Potts eds. *Can Design Catalyse the Great Transition: Papers from the Transition Design Symposium 2016*. Carnegie Mellon University., pp.16–24.

Niedderer, K., Cain, R., Clune, S., Lockton, D., Ludden, G., Mackrill, J. & Morris, A. (2014) *Creating sustainable innovation through design for behaviour change: full project report*. Loughborough University.

Niedderer, K., Clune, S. & Ludden, G. eds. (2018) *Design for behaviour change: theories and practices of designing for change*. 1 Edition. London ; New York, Routledge, Taylor & Francis Group.

Nilsson, Å.W. & Jahnke, M. (2018) Tactics for Norm-Creative Innovation. *She Ji: The Journal of Design, Economics, and Innovation*, 4 (4), pp.375–391.

Norman, D.A. & Stappers, P.J. (2015) DesignX: Complex Sociotechnical Systems. *She Ji: The Journal of Design, Economics, and Innovation*, 1 (2), pp.83–106.

O'Flynn, J. (2007) From new public management to public value: Paradigmatic change and managerial implications. *Australian Journal of Public Administration*, 66 (3), pp.353–366.

Öhrling, T., Normark, J. & Nilsson, Å.W. (2018) NORM CREATIVITY IN STUDENT DESIGN PROJECTS - ONE APPROACH TO CREATING SUSTAINABLE SOCIETIES. In: London, the UK.

Pilemalm, S., Lindell, P.-O., Hallberg, N. & Eriksson, H. (2007) Integrating the Rational Unified Process and participatory design for development of socio-technical systems: a user participative approach. *Design Studies*, 28 (3), pp.263–288.

Ravena, R., Schota, J. & Berkhoutb, F. (2012) Space and scale in socio-Technical transitions. *Environmental Innovation and Societal Transitions*, 4, pp.63–78.

Reed, M.S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C.H. & Stringer, L.C. (2009) Who's in and why? A typology of stakeholder analysis methods for natural resource management. *Journal of Environmental Management*, 90 (5), pp.1933–1949.

Rip, A. & Kemp, R. (1998) Technological change. In: S. Rayner & E. L. Malone eds. *Human choice and climate change*. Columbus, Ohio, Batelle Press, pp.327–399.

Ruebottom, T. & Auster, E.R. (2018) Reflexive dis/embedding: Personal narratives, empowerment and the emotional dynamics of interstitial events. *Organization Studies*, 39 (4), pp.467–490.

Sangiorgi, D., Carrera, M. & Lucchi, F. (2019) Co-Designing Innovation Labs for Service Ecosystem Change. In: E. Gummesson, C. Mele, & F. Polese eds. *Service Dominant Logic, Network and Systems Theory and Service Science: Integrating three Perspectives for a New Service Agenda*. p.17.

Schön, D.A. (1984) *The Reflective Practitioner: How Professionals Think In Action*. Basic Books.

Scott, W.R. (2014) *Institutions and organizations: ideas, interests, and identities*. Fourth edition. Los Angeles, SAGE.

Sengers, P., Boehner, K., David, S. & Kaye, J. 'Jofish' (2005) Reflective design. In: *Proceedings of the 4th decennial conference on Critical computing: between sense and sensibility*. CC '05. Aarhus, Denmark, Association for Computing Machinery, pp.49–58.

Silva, M.A., Ehrnberger, K., Jahnke, M. & Nilsson, Å.W. (2016) *Nova: Tools and methods for Norm-creative innovation*. Vinnova.

Smith, A., Stirling, A. & Berkhout, F. (2005) The governance of sustainable socio-technical transitions. *Research Policy*, 34 (10), pp.1491–1510.

Sterling, B. (2005) *Shaping things*. Cambridge, Mass., MIT Press.

Suddaby, R., Viale, T. & Gendron, Y. (2016) Reflexivity: The role of embedded social position and entrepreneurial social skill in processes of field level change. *Research in Organizational Behavior*, 36, pp.225–245.

Vargo, S.L. & Akaka, M.A. (2012) Value Cocreation and Service Systems (Re)Formation: A Service Ecosystems View. *Service Science*, 4 (3), pp.207–217.

Vargo, S.L. & Lusch, R.F. (2004) Evolving to a New Dominant Logic for Marketing. *Journal of Marketing*, 68 (1), pp.1–17.

Vargo, S.L. & Lusch, R.F. (2008) From goods to service(s): Divergences and convergences of logics. *Industrial Marketing Management*, 37 (3), pp.254–259.

Vargo, S.L. & Lusch, R.F. (2016) Institutions and axioms: an extension and update of service-dominant logic. *Journal of the Academy of Marketing Science*, 44 (1), pp.5–23.

Vargo, S.L., Maglio, P.P. & Akaka, M.A. (2008) On value and value co-creation: A service systems and service logic perspective. *European Management Journal*, 26 (3), pp.145–152.

Vargo, S.L., Wieland, H. & Akaka, M.A. (2015) Innovation through institutionalization: A service ecosystems perspective. *Industrial Marketing Management*, 44, pp.63–72.

Vink, J., Koskela-Huotari, K., Tronvoll, B., Edvardsson, B. & Wetter-Edman, K. (2020) Service Ecosystem Design: Propositions, Process Model, and Future Research Agenda. *Journal of Service Research*, pp.1–19.

Vinthagen, R. & Zavalia, L. (2014) *Normkreativ*. Stockholm, Premiss.

Westerlund, B. & Wetter-Edman, K. (2017) Dealing with wicked problems, in messy contexts, through prototyping. *Design Journal*, 20 (sup1), pp.S886–S899.