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PERSPECTIVE

Responsible innovation as an endorsement of public values: the need for interdisciplinary research

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This article has a theoretical and a practical objective. The theoretical objective is to conceptualize responsible innovation as the adequate and timely inclusion of public values relevant to technological development. Technological innovations always occur in a specific institutional context, closely connected to stakeholder dynamics. Hence, an ideal approach to responsible innovation requires interdisciplinary research that incorporates: (i) the ethics of technology, to investigate the role of values in design; (ii) institutional theory, to understand the parts played by institutions in realizing values; and (iii) policy, planning and science, technology and society literature, to focus on stakeholder engagement. The practical objective is to explain how this approach can be operationalized. Since values emerge and evolve during the development and implementation of technologies, we take public debate to be the empirical source for extracting public values. Several salient questions need to be addressed such as: which and whose opinion should count, and how should value trade-offs be facilitated?

Keywords: public value; stakeholder engagement; value-sensitive design; institutional theory; shale gas

1. Introduction

The world of policy-making is giving increasing attention to "responsible innovation". While the academic discussion of responsible innovation is fairly recent, various studies have highlighted some of the key features of responsible innovation (Hellström 2003; Guston 2004; Owen and Goldberg 2010; Von Schomberg 2011; Van den Hoven 2013). One should, for instance, consider the need for interaction between innovators and other stakeholders in conjunction with the early assessment of ethical and societal desirability. The rationale is that since innovations should primarily serve societal needs, the various societal complexities and associated ethical problems should be anticipated by involving stakeholders[1] – along with scientists and engineers – at the earliest possible stage.

Adhering to this line of reasoning, we shall argue that in an ideal situation, responsible innovation can best be conceptualized as an endorsement of the relevant *public values* during the innovation process. We shall stake out the boundaries of responsible innovation by drawing upon the value-sensitive design (VSD) approach, discussing examples related to the controversial development of shale gas exploitation. In Section 2, we discuss how incorporating public values could

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facilitate the inclusion of societal issues in technological developments. In Section 3, we focus on how these public values could be incorporated into the design, not only of technological systems, but also of the societal context. Finally, in Section 4, we examine four important challenges to this approach.

2. Responsible innovation as an accommodation of public values

Values are things worth striving for. The public values referred to here represent those values that will serve the public good. In other words, public value has to do with the public view of what may be considered valuable (Talbot 2011, 7). We do not claim that public values are objective or objectively determined (Pesch 2005). Our aim is rather to identify "intersubjective" sets of values that are relevant, given specific technological developments. This approach is in sympathy with Rawls' "overlapping consensus" that assumes that citizens support the same basic ideas for different reasons (Rawls 1971). Consequently, a stakeholder's position toward acceptance of a technology relates more to the way values are prioritized and traded off than to how one single value is conceived (Taebi and Kadak 2010, 1343).

Technological design has value implications because new technologies can shape our practices, thereby promoting or undermining certain values (Van de Poel 2009). If innovation is to be responsible, public values have to be appropriately incorporated during the design process. The first step is to identify the public values at stake, so that they can be accommodated in the design process. In actual practice, this task proves challenging.

We follow Meynhardt (2009, 212) in seeing public value as "a result of evaluations about how the basic needs of individuals, groups and society as a whole are influenced in relationships involving the public", while holding that such values must be drawn "from the experience of the public", that is, by deriving or extracting them from public debate. There are of course other methods for identifying public values. One could posit public values (e.g. Antonsen and Jørgensen 1997), distill them from the academic literature (e.g. Bozeman and Sarewitz 2011), or extract them from mission statements, strategic plans, statutes or other documents of government agencies (Bozeman 2007). However, none of these methods would sufficiently capture the public values that *emerge* during the process of innovation, development and implementation of a technology. Indeed, innovative technologies could give rise to effects and consequences that have not yet been discussed in such sources.[2]

3. Reconciling public values in design: the need for interdisciplinary research

Responsible innovation requires the identification of the relevant public values. This mandate does not imply that we can always reconcile all these values. We speak of *value conflicts* when "considered in isolation, they evaluate different options as best" (Van de Poel 2009, 977). In such situations, two scenarios are conceivable: (i) changing the design in such a way that it accommodates these conflicting values or (ii) making a value trade-off that decides which value should take priority in the design.

In responsible innovation, the analysis of potential value conflicts and their solution should form an integral part of the design process. Ideally, such an analysis is an ongoing activity that starts *ex ante*. This is the aim of the VSD framework. Primarily introduced to incorporate public values into human computer interaction (Friedman, Kahn, and Borning 2002; Van den Hoven 2007), VSD was later elaborated to address the inclusion of values in other domains of technological design (e.g. Nissenbaum 2005; Taebi and Kloosterman, forthcoming; Van den Hoven, Van den Poel, and Vermaas, forthcoming).

VSD aims to create a technological design that adequately incorporates the relevant public values, seeking solutions through technological *adjustment*, i.e. design changes. An interesting historical example is the Oosterschelde barrier in the Netherlands, which was originally designed with only flood risk prevention in mind and *safety* as the leading value. However, completely barricading the Oosterschelde estuary proved to have major *ecological* repercussions. This conflict was resolved by means of ingenious technological design in the form of the storm surge barrier that is only closed during storm floods (Correljé and Broekhans, forthcoming).

In the case of shale gas, we can investigate whether seemingly conflicting values can be reconciled through technological modification. For example, since water is scarce in many places, using it in large quantities may raise concern. The chemicals in fracking fluids may also evoke concern, since their seepage into drinking water may constitute a health and safety risk. Inquiry into technological modification, therefore, needs to focus on finding ways to accommodate *health and safety* values as well as *resource durability* of both energy and water.

Technological development takes place in specific institutional contexts, involving particular stakeholder dynamics. The institutional context incorporates two main categories: (i) formal institutions such as laws, standards, regulations and contracts; and (ii) informal institutions such as customs, traditions and routines. These institutions embody values that have important ramifications for the distribution of the real or perceived burdens and gains of a specific project. Many of these institutions, especially the formal ones, may be subjected to redesign to accommodate divergent values (Correljé and Groenewegen 2009).

Indeed, public values are not static entities frozen by technologies and institutions. They emerge or may turn *fluid* under the pressure of dynamic social processes. Their fluidity suggests that if we are to incorporate public values into VSD, we need to carefully design decision-making procedures that facilitate constructive forms of stakeholder interaction. Hence, an ideal approach of responsible innovation should build upon extensive research and experience with participatory procedures in policy and planning (Rowe and Frewer 2005; Hisschemöller and Cuppen, forthcoming), as well as the literature on participatory and constructive assessment (e.g. Schot 1992; Joss and Bellucci 2002).

In short, responsible innovation requires interdisciplinary research. We suggest that responsible innovation can be realized by involving, alongside science and engineering: (i) the ethics of technology, to investigate the role of values in technological design; (ii) institutional theory, to understand the role of institutions in the realization of values; and (iii) the policy, planning and STS literature, to focus on stakeholder engagement.

4. Concluding remarks and future research

We have argued that an ideal approach to responsible innovation requires a timely and continuous inclusion of stakeholders' values in the process of technological design. The relevant public values can be extracted from the always-rich public debate, and the potential value conflicts need to be identified. The insights of this interdisciplinary research should then inform technological design, the associated institutions and the decision-making process.

There are at least four challenging questions that need to be answered before a framework for responsible innovation can be applied in real-life practical contexts. We provide initial responses, but future research is needed for complete responses.

(i) How should interdisciplinary research be performed?

Philosophers, social scientists and policy-makers have recommended interdisciplinary research "to attune research and innovation processes to societal needs" (Schuurbiers et al. 2014, 4).

Empirical studies show how interdisciplinary research can address societal and ethical aspects at the R&D stage (e.g. Gorman, Groves, and Shrager 2004; Zwart et al. 2006; Fisher 2007; Schuurbiers 2011; Flipse, van der Sanden, and Osseweijer 2014), contributing to an increased reflexivity among scientists. These studies have not yet induced any significant modifications in design practices, however (Rip 2009). Moreover, others have argued appropriately that the ethical issues raised during R&D sometimes "cannot be tackled within the laboratory [and] should be put on the agenda of groups outside the laboratory" (Boenink 2013, 75). Our approach proposes to fill this gap by broadening the perspective of design to include the analysis of relevant institutions and processes of stakeholders' participation. Indeed, we need to seek methods to increase the effectiveness of such interdisciplinary research. An ideal approach to responsible innovation should address the challenge of modifying the design of not only technology, but also of associated institutions and stakeholders' involvement.

(ii) How and when to extract public values?
Our approach reveals a tension between the need for *ex ante* assessment of stakeholder values on the one hand, and the emergent nature through which values and opinions are specified during the development and implementation of technology on the other. Ideally, *ex ante* assessment would enable a "VSD" that accommodates (conflicting) values. Yet, new technologies may give rise to unforeseen effects and emergent consequences, which makes such assessment incomplete or even impossible. Also other approaches such as participatory technology assessment are not well equipped to deal with the values that emerge in the ongoing process of technology development and during implementation. The difficulty is that the dynamics of public debates cannot easily be managed, which means that it is often only possible in hindsight to state when and why a debate has escalated. Responsible innovation should thus be an ongoing, iterative process that starts during innovation and continues during implementation.

(iii) Which opinions should count?
The public arena presents a great diversity of opinions. In the shale gas debate, for example, one of the arguments involves the "homeopathic quality" of water. Water mixed with chemicals is, so the argument goes, less "vital", supposedly making it less suitable for alternative healing practices. While in a pluralist society, even deviant minority opinions cannot simply be dismissed, one may legitimately wonder whether such arguments merit seriously consideration. Yet even such minority viewpoints can be valuable for policy-making, as they have more probative value than viewpoints on which there is substantial consensus (Dunn 2001). The complexity of technological design is also sometimes underestimated, exemplified by demands for absolute safety in design (Doorn and Hansson 2011). While absolute safety is a useless concept in technological design, it nevertheless reflects the high relevance of safety in the public eye. Translating such a *public sentiment* into a design criterion – where the thorny question of how safe is safe enough still needs to be addressed – remains unanswered. Similarly, when opinions are attached to minority groups, it is unreasonable to "brush aside the views of those objecting to a development as not reflecting the majority community opinion", since such a minority might represent those directly affected by the technology in question (Walker 1995, 56). Therefore, the challenge includes how to give weight to such varying opinions.

(iv) How should trade-offs be facilitated?
Our approach aims at a timely and proactive identification of potentially conflicting values. However, are value conflicts in the development of innovative technology any different from

those that usually occur? It is commonly known that public values may conflict in many real-world situations (Bozeman and Sarewitz 2011). However, potential value conflicts in technological innovations often need to be made more explicit. Subjecting potential trade-offs to public discourse and participation could inspire and facilitate technological and institutional (re)design to accommodate a variety of values. However, who decides which values take precedence, and by what methods? Facilitating such trade-offs is an important challenge, particularly in the case of emerging or fluid public values, and it is also one of the important issues that VSD methodology is currently grappling with (Van den Hoven 2010; Manders-Huits 2011). VSD as a methodology, and thus our account of responsible innovation, remains in need of an ethical theory that can reflect on moral arguments and considerations.

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Notes

1. "Stakeholder" should be a term inclusive of both the parties than can normally influence the decision-making process (e.g. municipal, regional and national governments and industries involved in the innovations) as well as any other parties whose interests could be affected (e.g. citizens and civil society organizations).
2. Discussing precisely how to identify public values remains beyond the scope of this contribution. Elsewhere, we have elaborated a methodology for analyzing public debate and extracting the relevant public values (Correljé et al., forthcoming).

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