# Understanding the adoption dynamics of medical innovations: Affordances of the da Vinci robot in the Netherlands

Payam Abrishami [a,b,*], Albert Boer [b,c], Klasien Horstman [a]

[a] Research School CAPHRI, Department of Health, Ethics and Society, Maastricht University, P.O. Box 616, 6200 MD Maastricht, The Netherlands
[b] National Health Care Institute, P.O. Box 320, 1110 AH Diemen, The Netherlands
[c] Institute of Health Policy and Management, Erasmus University Rotterdam, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands

## ABSTRACT

This study explored the rather rapid adoption of a new surgical device — the da Vinci robot — in the Netherlands despite the high costs and its controversial clinical benefits. We used the concept 'affordances' as a conceptual-analytic tool to refer to the perceived promises, symbolic meanings, and utility values of an innovation constructed in the wider social context of use. This concept helps us empirically understand robot adoption. Data from 28 in-depth interviews with diverse purposively-sampled stakeholders, and from medical literature, policy documents, Health Technology Assessment reports, congress websites and patients' weblogs/forums between April 2009 and February 2014 were systematically analysed from the perspective of affordances. We distinguished five interrelated affordances of the robot that accounted for shaping and fulfilling its rapid adoption: 'characteristics-related' affordances such as smart nomenclature and novelty, symbolising high-tech clinical excellence; 'research-related' affordances offering medical-technical scientific excellence; 'entrepreneurship-related' affordances for performing better-than-the-competition; 'policy-related' affordances indicating the robot's liberalised provision and its reduced financial risks; and 'communication-related' affordances of the robot in shaping patients' choices and the public's expectations by resonating promising discourses while pushing uncertainties into the background. These affordances make the take-up and use of the da Vinci robot sound perfectly rational and inevitable. This Dutch case study demonstrates the fruitfulness of the affordances approach to empirically capturing the contextual dynamics of technology adoption in health care: exploring in-depth actors' interaction with the technology while considering the interpretative spaces created in situations of use. This approach can best elicit *real-life* value of innovations, values as defined through the eyes of (potential) users.

© 2014 Elsevier Ltd. All rights reserved.

## 1. Introduction

The da Vinci robot is a new surgical device. Worldwide, it has been used most commonly for the surgical removal of cancerous prostate (Camberlin et al., 2009) and more recently also for uterine cancers (ECRI, 2013). It is a remotely-controlled laparoscopic device for the surgical excision of cancerous (and surrounding) tissues. The da Vinci robot is to date the only robotic surgical system available on the market (Gleitsmann et al., 2012). Despite uncertainties in clinical added benefits and high costs (see below), it has been widely adopted in most Western countries and demand for it continues to rise (Gleitsmann et al., 2012). How should one understand the rather rapid adoption of this innovative technology?

Many well-developed health care systems, particularly market-oriented systems, permit a more decentralised provision of health care innovations. Providers, patients and payers are frequently engaged in situations of choice on whether to adopt (i.e., whether to purchase and use), request, or reimburse new forms of care. As a result the take-up of innovations is a dynamic *process* involving multiple formal/informal decisions by a multitude of interactive actors (Greenhalgh et al., 2005). Since the technology is embedded in the "wider social body" of the setting of use (Webster, 2007), adoption decisions are not bounded merely by the technical advantages of the innovation as a solo artefact. Adoption takes place at the interface of stakeholders, technology, and the stage (i.e., socio-organisational structures, assemblages, and networks). This way of conceptualising adoption processes draws on a

constructivist perspective on technology, as developed in Science, Technology and Society Studies (STS). It entails that technology and society co-evolve and shape each other (Rip, 2001). It is oriented toward exploring both the material and rhetoric 'identities' of the technology in practice (Ulucanlar et al., 2013). As a 'sociotechnical' process (Bijker and Pinch, 2012; Ulucanlar et al., 2013), adoption represents a wider set of benefits within the 'social matrix' of use (Webster, 2007): what priorities are served by the technology, what actors can achieve by using it, and which symbolic meanings are attributed to those activities.

The aim of this article is to gain an understanding of the adoption dynamics of health care innovations by examining one specific case, namely, the da Vinci robot in the Netherlands. To grasp the contextual dynamics of robot adoption, we placed the concept 'affordance' centre stage. The article starts by introducing this concept after which we explain the case and the methodology. In presenting the results we show how five kinds of affordances play a role in the adoption dynamics. Analysing the case of the da Vinci robot in terms of affordances also serves to explore the fruitfulness of this concept as a conceptual-analytic tool for understanding the adoption of technological innovations in health care. In the conclusion, we reflect on the case study as well as on cross-applicability of the concept affordances in understanding real-life adoption practices.

## 2. Understanding adoption dynamics by means of affordances

The concept 'affordance' is originally developed in ecological psychology by James Gibson in 1979 in an attempt to capture behavioural responses that can emerge in the interaction between an organism and its environment (Scarantino, 2003). The edge of a cliff, for instance, can be fall-off-able or jumpable depending on the circumstance (Scarantino, 2003). More recently, the concept has been used to study human–technology interaction in computer science and technology design. In these fields, affordances are described as capacities for action offered by technology and signified by actors within the context of use. For example, a jacket is *wearable* or a touchscreen display is *tappable*. It makes the actor opt to wear the one or tap the other. Similarly, a piece of paper is writable but also foldable (as in origami). In STS, affordances refer to the different meanings, promissory visions, and utility values that can be assigned to a technology according to the ways it is implemented in its context of use (Webster, 2004).

We argue that the affordances approach is a fruitful conceptual-analytic tool to understand adoption dynamics. Central to such an understanding is an exploration of the 'adoption space' and technology–actor–setting interrelations therein (Ulucanlar et al., 2013). As a sociotechnical process and subject of a sociological investigation, adoption processes encompass *both* the material characteristics of a device (identified by pre-existing technical properties and initial promises) and the rhetorical practices/expectations of actors constructed within a particular socio-organisational setting of use. Affordances comply with this fluidity in capturing the technology–actor–setting interrelations. Firstly, they comprise 'perception–action couplings' (Scarantino, 2003). Affordances represent perceived promises (benefits) of an innovation. However, they are not isolated mental abstractions. They provide grounds for individual decisions, architect situations of choice, and 'suggest' the choice (action) that should be made. Affordances are, therefore, 'performative' as they stimulate and frame agentic adoption decisions (pro-)actively (Hutchby, 2001). Secondly, affordances can frame stakeholders towards specific *collective* sociotechnical practices. When shared within a network of stakeholders, perceived promises of a new technology — once

internal to some individuals' intentions — are externalised and objectified (Garud and Rappa, 1994). They are recognised and available to 'convince' other actors even though the details necessary to warrant the promises being fulfilled in practice are missing (Van Lente, 2012). This can create a 'consensual validation' (Garud and Rappa, 1994) of perceived promises, thereby making affordances performative at a collective level too. Third, the concept affordance enables us to capture the implicit drivers of (non-)adoption, which cannot be sharply demarcated from the knowledge-based conception of the value of the technology. This may reveal a symbolic/interpretative dimension of adoption, which often remains unarticulated and unapprehended within a formal evidence-based rationalisation (Ulucanlar et al., 2013). The affordances approach, therefore, enables us to understand the 'socio-cognitive roots' of adoption processes (Garud and Rappa, 1994), their 'generative forces' among users and potential adopters (Borup et al., 2006), and the *semantic utilities* of the technology as recognised by individual users within the context of use.

As a conceptual-analytic tool, affordances draw closely on the insight gained from the sociology of expectations (Borup et al., 2006). They are both capable of describing technology dynamics by linking technical and social issues. They attend to the importance of developing a conceptual–analytical vocabulary to better understand a 'strategic turn' in the technological innovations and investments of recent decades (Borup et al., 2006). Affordances approach, we argue, can complement expectations studies by zooming-in on strategic adoption behaviours at the interface of actor, technology, and the setting of use. This approach responds to the call for 're-connecting' the promises with the practices constituting them (Borup et al., 2006). In this regard, the affordances approach is more utilisation-focused in exploring sociotechnical (i.e., technology–actor–setting) interlinkages. The expectations approach is more appropriate for exploring the adoption of major generic technological innovations with wide varieties of application (e.g., nanotechnology), whereas the affordances approach might better explain technology adoption in a particular application field — where expectations may be more fragile (Borup et al., 2006) — e.g., a surgical device (such as the da Vinci robot) or an implantable device (such as deep brain stimulation). The affordances approach can therefore be regarded as an *ecological* (situated) version of expectations studies capable of capturing local patterns of adoption and utilisation.

Understanding the technology–actor–setting dynamics of medical innovations is particularly important during the early diffusion phase. At this stage, the promises of the innovation are salient and the inquiry of impact (in the face of contingencies of effect) is pressing. Exploring affordances of the innovation at this phase provides insight into an array of processes that account for *both* shaping and fulfilling the adoption. However, this has remained an under-studied subject in studying the diffusion of health care innovations and in health technology assessment (HTA). In both research areas, little attention has been devoted to the social dynamics of adoption (Ulucanlar et al., 2013; Webster, 2007; Lehoux and Blume, 2000; Blume, 2009; Ashcroft, 2012). In fact very often, the unit of analysis has been the artefact as separated from the context of its use, or the individual adopters detached from their social networks and their agentic roles therein. On the other hand, empirical research to capture the adoption dynamics is scarce (Greenhalgh et al., 2005), particularly with a constructivist enquiry (Reuzel and van der Wilt, 2000) and more specifically for non-pharmaceutical innovations (Ulucanlar et al., 2013). This can be added to an overall generic paucity of descriptive research in health care practice and policy (Gagliardi and Dobrow, 2011). Such research would nevertheless provide valuable insight to (national) policy-makers involved in procurement