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Acceptability engineering: the study of user acceptance of innovative technologies

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Abstract

The discipline of human-computer interaction (HCI) has been vital in developing understandings of users, usability, and the design of user-centered computer systems. However, it does not provide a satisfactory explanation of user perspectives on the specialized but important domain of innovative technologies, instead focusing more on mature technologies. In particular, the success of innovative technologies requires attention to be focused on early adopters of the technology and enthusiasts, rather than general end-users. Therefore, user acceptance should be considered more important than usability and convenience. At present, little is known about the ways in which innovative technologies are evaluated from the point of view of user acceptance. In this paper, we propose Acceptability Engineering as an academic discipline through which theories and methods for the design of acceptable innovative technologies can be discussed.

Keywords: Acceptability; Discipline; Early adopter; Human-computer interaction; Innovative technologies; Usability; User acceptance

1. Introduction

Innovative technologies can open up new technological markets, bring about new values and practices, and transform existing technologies. As an innovative technology emerges, however, it can be very difficult to predict how significant it will become. Innovative technologies are usually unpredictable, prone to failure, and often uneconomic. For this reason, industry and governments hesitate to invest in innovative technologies. This issue arises in part from a lack of systematic and scientific methods for assessing future technologies, as well as the intrinsic complexity that new technology often exhibits.

Evaluating the future of innovative technologies has not been considered a scientific endeavor; rather, such speculation is left to the insight and intuition of a few knowledgeable individuals. A similar approach is often seen in the human-computer interaction (HCI) community. While many technology-oriented HCI researchers have shown an interest in innovative technologies, human-oriented HCI researchers have overlooked them to a large extent. For example, wearable healthcare systems and devices have rarely been explored in terms of user perspectives (Kim et al., 2011). Here we argue that a scientific approach to the design of innovative computing technologies would be desirable to assess the design of future innovative technologies in a systematic manner from the perspective of user acceptance, and discuss the potential of a new discipline of Acceptability Engineering (AE), where concepts, theories, and methods can be generated, shared, and validated among researchers.

The remainder of this paper is organized as follows. In section 2, we discuss what are innovative technologies, describing related definitions and examples, and categorizing them into emerging technologies, disruptive technologies, and immature technologies. In section 3, we briefly introduce a technology life cycle model proposed by Moore (1991), which is the model through which AE can be best described, and explain the relationship between the early and mainstream markets, and describe the types of customers (i.e., early adopters and late adopters). In section 4, we describe the differences between AE and HCI with respect to Moore's model. Because HCI is now a well-established discipline for user-centered approaches, a comparison with AE can help readers grasp the significance of AE. In section 5, we characterize early adopters of innovative technologies as influential users, and discuss their importance for AE. In section 6, we compare two key notions of usability and acceptability, which symbolize HCI and AE, respectively. This is also useful for understanding AE and the difference between AE and HCI. We also discuss acceptability as a tradeoff between a variety of factors influencing the acceptance and use of technologies. Section 7 proposes a definition of AE and discusses the characteristics and nature of AE. Section 8 concludes the paper.

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2. Innovative technologies

The word 'innovation' is derived from the Latin word *innovates,* the noun form of *innovare* meaning 'to renew or change,' stemming from *in* ('into') and *novus* ('new'). Thus, innovative technology is technology that is changed or developed to improve products and services. Various notions that relate to such changes in technology are considered innovative technology.

2.1. Emerging technologies

Emerging technologies are technological innovations that create more competitive ideas or products (Soares et al., 1997). An example is the convergence of previously separate technologies to serve similar goals, known as technological convergence.

For example, the field of communications once consisted solely of people delivering and exchanging information using telephony, postal mail, and telegraphs. However, due to technological advances, many of these features have been combined to achieve more convenient and effective transfer of information. For example, video calling and voice telephony can be implemented using a single internet connection. Telepresence technology is widely used for business purposes, wherein two parties located in different places can conduct meetings or conferences remotely, enabling faster and more effective evaluation of information and decision-making. Current emerging technologies include nanotechnology, biotechnology, information technology, and cognitive science (NBIC).

One way to describe emerging technologies is to use Gartner's Hype Cycle (www.gartner.com), which provides a graphical representation of the maturity and adoption of emerging technologies and applications. The Cycle gives insight into how a technology or application may evolve over time, and has five key phases, from technology trigger to the plateau of productivity. Figure 1 shows Gartner's 2013 hype cycle, with a number of emerging technologies illustrated.

2.2. Disruptive technologies

Disruptive technologies are innovations that create a new method, replacing the previous technology and making it redundant. The term was coined by Clayton M. Christensen (Christensen, 1997; Christensen & Overdorf, 2000), although he later replaced the term with 'disruptive innovation' (Christensen et al., 2004). This kind of innovation originally aims to create a new market, but eventually reaches the mass market, mostly by reducing costs, thus disrupting the current market.

Take, for example, the creation of automobiles as an innovative replacement for horse-drawn vehicles. Early automobiles were made as expensive luxury items. These did not affect the market for earlier transportation methods, and it was not until the low-cost Ford Model T was introduced in 1908 that the technology became disruptive. In this respect, the mass production of an affordable automobile can be considered the disruptive innovation, rather than the automobile itself. As such, disruptive technologies are often referred to as innovations in marketing.

2.3. Immature technologies

Immature technologies are new innovations that require further development. They are usually rapid to appear, have diverse applications, and are often limited to experts and professionals in a particular field, with some remaining as theoretical concepts. For instance, wearable computing with biosensors for healthcare is not matured enough (Kim et al., 2011; Rajan & Sukanesh, 2013), but still has its huge potentiality in the future. In general, nanotechnology, quantum computers, and nuclear fusion power are a few examples of this kind of innovative technology.

3. Moore's technology adoption cycle model

3.1. Moore's model

Geoffrey Moore interpreted the technology adoption life cycle in terms of a dichotomy between early adopters and late adopters in his book *Crossing the chasm* (Moore, 1991). Moore was the first to identify a chasm between the early adopters and the early majority customers when dealing with discontinuous or disruptive innovations. Figure 2 shows a distribution of adopters of new technologies; the left part of the chasm refers to the early market, and the right refers to the mainstream market. Therefore, crossing the chasm implies moving from the early

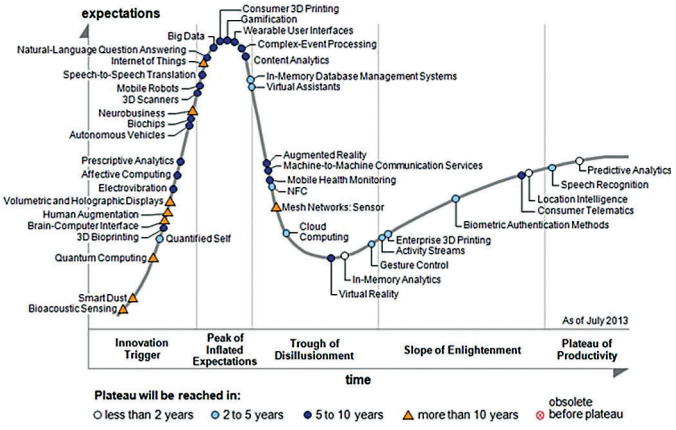

Fig. 1. Gartner's 2013 hype cycle for emerging technologies.

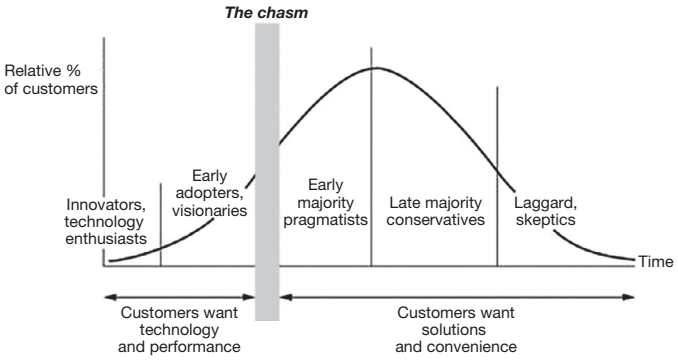

Fig. 2. Moore's model for the technology adoption life cycle.