Chapter 6
User Acceptance of Technologies in Their Infancy:
The Case of 3D Printing Business Models

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ABSTRACT

This paper adjusts UTAUT2 to study user acceptance of an early stage technology by using the example of 3D printing for home users. The authors' findings show that UTAUT2 is capable of measuring user acceptance and that social influence and effort expectancy are good predictors for 'intention to use' for early stage technologies. Nevertheless, there seem to be significant differences in the antecedents depending on the involvement levels and the DIY mentality of the user. Moreover, this research confirms and extends the applicability of UTAUT2 to early stage technologies while improving the authors' understanding of prospective 3D printing home users.

INTRODUCTION

According to Davis (1993), most system failures are a result of lacking user acceptance rather than poor performance. This lack of user acceptance is also reflected in the status of being one of the most researched streams in information systems (e.g., Benbasat and Barki, 2007; Venkatesh, Davis, & Morris, 2007). In the last decades, literature has described dozens of approaches explaining technology acceptance and its use. In an effort to unify these approaches, Venkatesh, Morris, Davis, and Davis (2003) summarized all important technology acceptance frameworks and defined a 'unified theory of acceptance and use of technology' (UTAUT), refined later as UTAUT2 by Venkatesh, Thong, and Xu (2012). This comprehensive framework is able to explain high variances of technology acceptance and use in both organizational and voluntary user environments. While the UTAUT framework has been tested for different technologies and in different contexts (e.g., Zhou, Lu, & Wang, 2010; Cheng, Yu, Huang, Yu, &

DOI: 10.4018/978-1-5225-9624-0.ch006

Yu, 2011; Raman & Don, 2013), no research confirms its applicability in early stages of the product life cycle, i.e., in early stages of the technology diffusion process (Rogers, 1995) and when the product just started the growth stage of the product life cycle (Taylor & Taylor, 2012). While technologies in later stages of the development cycle equal already known and proven technologies, technologies in early stages can be called 'technologies in its infancy' and might be different in terms of antecedents of user acceptance. The main difference between established and recently introduced technologies is the rarity of applied usage of the latter. Hence, prospective users have little to no technology experience and knowledge. Consequently, the intention to use a technology will be dominated by users' perceptions about the technology rather than experience or deliberated opinions. Because of that, we believe that hedonic motivations and facilitating conditions might be far more important antecedents than others. In addition, we also believe that there might be differences according to involvement level. As suggested by the Elaboration Likelihood Model, technology use might influence perceptions and consequently intentions to use (Petty & Cacioppo, 1984). We will adjust the UTAUT2 framework towards technologies in the infancy stage and will test its applicability in the context of 3D printing (3DP).

3DP is a promising technology in the early stage of its user life cycle. With an annual growth of 25%, a market size of 649 million USD in service and 52 million USD and 100,000 machines sold in domestic use, respectively, 3DP in the home environment is on the rise (Wohlers, 2014). The total market projection in 2018 including the industrial application is estimated to increase by more than four times to 16.2 billion USD in comparison to 2014 (Canalys, 2014). However, there is no widespread use yet while it is seen as a revolutionary and radical technology (Campbell, Williams, Ivanova, & Garrett, 2011). 3DP technology enables the making of three-dimensional solid objects of almost any shape based upon a digital model file. Instead of traditional subtractive manufacturing methods as cutting or drilling, additive manufacturing adds raw material layer by layer without waste (Campbell et al., 2011). There are many signs that 3DP will be used in private households in the next years, creating opportunities for the development of new business models. However, current knowledge about prospective users and its propagation are still in an early stage. We hope to predict user acceptance for this new early stage technology by using the UTAUT2 framework.

Additionally, we will test whether user acceptance might be different according to the required involvement level, i.e., involvement in the design and/or production process. Moreover, this will enable us to test user acceptance for different business models of 3DP, based upon principles of (i) self-design, and/or (ii) self-production. Self-design is about users who design parts themselves. Instead of owning a printer, these people order parts via online platforms or via local 3DP (community) stores (Bradshaw, Bowyer, & Haufe, 2010; Birtchnell, Urry, Cook, & Curry, 2013; D'Aveni, 2013; Petrick & Simpson, 2013). Self-production relates to end customers that download pre-designed files to print them out on an own 3D printer without creative involvement but for utilitarian purposes (Reeves, 2009; Bradshaw et al., 2010; Campbell et al., 2011; Berman, 2012; Birtchnell et al., 2013; D'Aveni, 2013). In alignment with these different involvement stages, we test whether 'do it yourself' users (Bunshaft & Laubner, 2013; Hsu, 2013) as described by Wolf & McQuitty (2013) might be more inclined to use this technology and might be interested in a broader use of this technology.

In summary, this research will address the following gaps: First, it will test the applicability of UTAUT2 to technologies in their infancy by exploring its potential and differences to later stage technologies. Second, although 3DP is promising and revolutionary, technology perceptions of prospective home users are unclear yet. As such, insights into preferences in user involvement will be analyzed. The findings of