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Acceptance and use predictors of open data technologies: Drawing upon the unified theory of acceptance and use of technology

Anneke Zuiderwijk^{a,*}, Marijn Janssen^a, Yogesh K. Dwivedi^b

^a Faculty of Technology, Policy and Management, Delft University of Technology, Jaffalaan 5, 2628 BX Delft, The Netherlands

^b School of Management, Swansea University, Swansea SA2 8PP, Wales, UK

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ABSTRACT

Policy-makers expect that open data will be accepted and used more and more, resulting in a range of benefits including transparency, participation and innovation. The ability to use open data partly depends on the availability of open data technologies. However, the actual use of open data technologies has shown mixed results, and there is a paucity of research on the predictors affecting the acceptance and use of open data technologies. A better understanding of these predictors can help policy-makers to determine which policy instruments they can use to increase the acceptance and use of open data technologies. A modified model based on the Unified Theory of Acceptance and Use of Technology (UTAUT) is used to empirically determine predictors influencing the acceptance and use of open data technologies. The results show that the predictors *performance expectancy*, *effort expectancy*, *social influence*, *facilitating conditions* and *voluntariness of use* together account for 45% of the variability in people's behavioral intention to use open data technologies. Except for *facilitating conditions*, all these predictors significantly influence behavioral intention. Our analysis of the predictors that influence the acceptance and use of open data technologies can be used to stimulate the use of open data technologies. The findings suggest that policy-makers should increase the acceptance and use of open data technologies by showing the benefits of open data use, by creating awareness of users that they already use open data, by developing social strategies to encourage people to stimulate each other to use open data, by integrating open data use in daily activities, and by decreasing the effort necessary to use open data technologies.

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1. Introduction

All sorts of open data are currently becoming available to the public as they are being published on the internet. The use of these open data can provide considerable advantages to researchers, civil servants and other stakeholders, such as increased transparency (Bertot, Jaeger, & Grimes, 2010), accountability (Parsons et al., 2011), innovation (Janssen, 2011; van Veenstra & van den Broek, 2013), and increased participation of citizens in government activities (Conradie & Choenni, 2014; McDermott, 2010). Open data use refers to the activity that a person or an organization conducts to view, understand, analyze, visualize or in other ways use a dataset that has been provided to the public by a governmental organization. For example, a citizen may use open data by analyzing quality indicators for schools in his neighborhood by using open government data from the school's inspectorate of his country.

Technologies are necessary for making use of open data. The usage process can consist of various steps and often requires the discovery, scrutiny, processing, visualization and evaluation of open data using technology. Yet, the acceptance and use of open data technologies

has shown mixed results. Data providers are encouraged to publish and link their content to generate useful information for the public (Rajabi, Sicilia, & Sanchez-Alonso, 2014), but whereas a large number of datasets is available, only a limited number of datasets is used (Bertot, McDermott, & Smith, 2012). Although encouraging data use is key for open data (Solar, Meijueiro, & Daniels, 2013), and the acceptance of open data technologies is a necessary condition for the creation of value with them, the open data debate has mainly been oriented towards data provision (Foulonneau, Martin, & Turki, 2014) rather than data use. Despite occasional initiatives to stimulate the use of open data technologies using hackathons, workshops and conferences, not much is known about which predictors actually influence people's willingness, ability and intention to use open data technologies. Open data is a relatively new field and the acceptance and use of open data technologies has barely been investigated. Systematic research with sound theoretical foundations about the possible acceptance and use of open data technologies is lacking.

If governments want citizens, entrepreneurs and researchers to use open data technologies, they need to understand under which conditions these stakeholders would adopt open data technologies. Obtaining a better understanding of the drivers of acceptance and use of open data technologies can help to better exploit the full potential of open data and realize its advantages. Insight in the factors influencing open data

* Corresponding author.

E-mail addresses: a.m.g.zuiderwijk-vaneijk@tudelft.nl (A. Zuiderwijk), m.f.w.h.a.janssen@tudelft.nl (M. Janssen), ykdwivedi@gmail.com (Y.K. Dwivedi).

technology acceptance and use can support data providing organizations in making more informed future investment decisions concerning the supply of open data (Davies, 2010). Such insights might help to create decision-making models which optimize the conditions under which data are released to increase the acceptance and use of governmental data and to stimulate the creation of public value. A better understanding of the predictors of the acceptance and use of open data technologies can help policy-makers to determine which policy instruments they can use to increase the acceptance and use of open data technologies, ultimately contributing to high level objectives including transparency, citizen participation and innovation. Furthermore, open data use can be the starting point for democratic dialogs (Davies, 2010), where open data providers and users interact to find out what can be learned from open data use and how this can help governments to improve processes, services and decision-making.

The objective of this study is to obtain insight in the predictors of the acceptance and use of open data technologies. In this paper we focus on the use of 'open data technologies' rather than open data use in general, because technologies are needed to be able to use open data. Without technologies, open data cannot be found, curated, scrutinized, processed, visualized and used. The open data use technologies that are in the scope of this study will be explained in Section 2. Moreover, open data can be used for various purposes, such as transparency, collaboration and participation (Gascó, 2014), yet using open data for the purpose of conducting research, for scrutinizing data and for obtaining new insights has not been studied much before. Therefore, this study focuses on the use of open data technologies for the purpose of research, scrutinizing data and obtaining new insights.

This paper is organized as follows. In the following section we describe the original UTAUT model and our motivation for using it in this study. In addition, we derive hypotheses from an amended UTAUT model and from the literature concerning the acceptance and use of open data technologies. In Section 3 the research approach for empirical testing the hypotheses is presented. In the fourth section we report on the findings from a questionnaire that investigates the extent to which the UTAUT constructs can explain the acceptance and use of open data technologies and test how well the refined UTAUT model explains the acceptance and use of open data technologies. Moreover, we compare the explained variance of our modified model with the original UTAUT model. Based on the findings we discuss recommendations for policy-makers to improve the use and acceptance of open data technologies, and recommendations for further research. Finally, conclusions about the predictors of open data technology acceptance and use are provided.

2. Research model and hypothesis development

UTAUT is a plausible theory for examining the acceptance and use of open data technologies, since it allows for investigating which factors influence Information Technology (IT) surrounding open data, while at the same time taking social factors into account. Martin (2014) states that technologies in the context of open data refer to working configurations "that include tangible artifacts, the skills of technologists and users, and the interfaces of artifacts with the wider technical infrastructure" (p. 225). Examples of open data technologies are linked open data vocabularies including value vocabularies and metadata element sets to assist in open data use (Pattueli, 2012), open data infrastructures and portals, software for transforming, visualizing, analyzing, linking and assessing the quality of datasets, and Application Programming Interfaces (APIs). Social factors, such as the behavior of open data users and influence from and interaction between open data users are important also for the acceptance and use of open data technologies. The significance of investigating social factors in research on technology adoption has been stressed in various articles (e.g. Gwebu & Wang, 2011).

Moreover, UTAUT allows for investigating complex and sophisticated organizational technologies of managerial concern (Venkatesh, Morris, Davis, & Davis, 2003). Open data are characterized by differing

contexts and semantics of open datasets, differences in types and characteristics of datasets, a large number of involved interdependent stakeholders with differences of interests and other contextual factors. Open data technologies are complex and sophisticated, which shows the appropriateness of this UTAUT characteristic for examining open data technology acceptance and use. Recently, UTAUT has also been used in research on factors which influence the intention to use open government (Jurisch, Kautz, Wolf, & Krcmar, 2015), and open data disclosure is often seen as one aspect of an open government.

The acceptance and use of Information Technology (IT) has been of significant importance for Information Systems (IS) research and practice for decades (Lancelot Miltgen, Popović, & Oliveira, 2013). The UTAUT is one often used model that examines Information Technology acceptance and use. Venkatesh et al. (2003) proposed the UTAUT based on a review of theoretical models and other literature about acceptance of technology and the predictors of this acceptance. The UTAUT can be viewed as a unified model for the investigation of the acceptance and use of technology. It is a well-established theory which has been tested considerably thereafter in many different contexts.

The key idea of the UTAUT is that a number of factors lead to the behavioral intention to accept and use a system or technology, while this behavioral intention in combination with facilitating conditions leads to the actual use of this system or technology (Sykes, Venkatesh, & Gosain, 2009). In the UTAUT model four constructs directly predict the behavioral intention to use Information Technologies (IT), namely Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI) and Facilitating Conditions (FC). Additionally, four key moderators are defined, including Gender (G), Age (A), Experience (E) and Voluntariness of Use (VU). The UTAUT model has been praised for its high quality compared to competing models (Shibl, Lawley, & Debuse, 2013). It explains about 70% of the variance in the behavioral intention to use a system or technology, whereas other models explain approximately 40% of the variance (Venkatesh et al., 2003). Behavioral intention is defined here as an individual's intention, prediction or plan to use a technology in the future. Several theoretical models have emphasized that behavioral intention is the best predictor of human behavior (Lee & Rao, 2009).

2.1. Hypothesis development for direct effects

The hypotheses underlying the UTAUT model are often amended to better suit the context of the study (e.g. Curtis et al., 2010; Duyck et al., 2008; Venkatesh, Thong, Chan, Hu, & Brown, 2011). We amended the original UTAUT model to better suit the context of open data, based on relevant literature concerning the acceptance and use of open data technologies. Fig. 1 shows the modified model for open data technology adoption used in this research surrounded by a dashed line. The hypotheses and the modifications are explained in the following paragraphs.

2.1.1. Performance expectancy

Performance expectancy is defined here as "the degree to which an individual believes that using the system will help him or her to attain gains in job performance" (Venkatesh et al., 2003, p. 447). Prior research shows that performance expectancy and its related constructs are the strongest predictors of behavioral intention (Duyck et al., 2008; van Dijk, Peters, & Ebbens, 2008). For instance, Davis (1989) writes that the extent to which people believe that a certain application is going to help them perform their job better influences whether or not they will use a certain application. Venkatesh and Speier (1999) also acknowledge that the achievement of valued outcomes, such as increased payment and improved job performance, are important motivations for using technologies. In the case of open data this could mean that people are more likely to use traditional ways of working if they believe that open data technologies and applications are not going to help them with performing better or making more money. This idea is supported by research of Kaasenbrood (2013), who suggest that the presence of various hindering factors, including hampered accessibility and a lack

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