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Open Data Platforms and their Usability: Proposing a Framework for Evaluating Citizen Intentions

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Abstract. Governments across the world are releasing public data in an effort to increase transparency of how public services are managed whilst also enticing citizens to participate in the policy decision-making processes. The channel for making open data available to citizens in the UK is the data.gov.uk platform, which brings together data relating to various public services in one searchable website. The data.gov.uk platform currently offers access to 25,500 datasets that are organized across key public service themes including health, transport, education, environment, and public spending in towns and cities. While the website reports 5,438,159 site visits as of June 2015, the average time spent on the site has been recorded at just 02:12 minutes per visitor. This raises questions regarding the actual use and usability of open data platforms and the extent to which they fulfill the stated outcomes of open data. In this paper, the authors examine usability issues surrounding open data platforms and propose a framework that can be used to evaluate their usability.

Keywords: Open data, Citizen, Usability, Evaluation, Public Services

1 Introduction

The push for making public services data available to the community started around mid 2000's with the European Union directive encouraging greater realisation of the economic value of public data through its reuse in 2003. This directive, combined with the advancement of Internet and associated ICT tools facilitating data analytics [29], has paved way for governments to open up data to the community. Conventionally, government departments retained public service data within their systems, with limited information being released to citizens and other stakeholders (businesses, charitable organizations, and NGO communities). However, since the last decade, the spread of digital governance and associated norms such as responsiveness, accessibility and efficiency of public services, transparency and accountability, have motivated governments to exploit the potential of wider distribution and use of such data [28]. One of the first countries to mandate the use of open data was the United States. The Presidential Open Government Directive in December 2009 required the

use of open formats by all federal US agencies. Six months later, the UK followed with their own plans for open public data, with the Prime Minister announcing the setting up of the data.gov.uk website. Subsequently, the European Commission published a Communication on Open Data in 2011, and in the same year, USA, UK, and initially six other countries were signatories to the Open Government Declaration.

The UK is considered as one of the leading countries in Europe for open data. The data.gov.uk is one of the most comprehensive open data repositories making available non-personal UK government data about public services, ranging from health, social services, education, transport to crime and other geo-environmental data. It was launched in closed-beta in September 2009 and publicly launched in January 2010 (data.gov.uk/blog/the-new-datagovuk). When the data.gov.uk website was officially launched in January 2010, Ordnance Survey data which provides information on geographical locations was one of the key datasets that was opened up as part of the project [3]. Subsequently, in June 2010, the Treasury released the Combined Online Information System (COINS), which operates as the UK Government's central accounting system detailing the spending of all government departments and their major spending programmes [38]. As of June 2015, the data.gov.uk website contains over 25500 datasets. The data can be used by individuals, businesses and other stakeholders under the conditions that the copyright and the source of the data is acknowledged by including an attribution statement specified by data.gov.uk.

One of the motivations of the open data movement has been to make more data easily accessible to diverse stakeholders with a view of enticing them to participate and contribute to the public policy-making space. For example, it is anticipated that researchers, think-tanks, entrepreneurs, businesses leaders, representatives of public services, NGOs, charities, community groups and citizens, at large, will use the open data to contribute to the policy decision making process, particularly across local governments. Indeed, this has encouraged these stakeholders to take an active interest in the way services are currently being delivered, and has stimulated thinking around how to improve services. Although countries such as the UK and US have taken proactive steps to improve the availability and ease of use (through machine-readability and technical standards), there still remain several barriers to accessibility and usability of open data. Moreover, the actual use of open data is cumbersome and stakeholders have to do it themselves. In order to fully exploit the potential of open data, users will usually require a certain level of applied skills. The fact that there is no existing easy-to-use, proven solution which can help citizens exploit the open data for decision making regarding their own lives, or contribute to the wider public policy making debate, does not help. Such issues are further compounded by the generic nature of open data repositories such as www.data.gov.uk and www.epsiplatform.eu, and thus their relevance and direct interest to citizens, in particular.

The motivation for this paper lies in the reasoning that although the availability of open data offers many opportunities for citizens, no research exists that questions the usability of open data platforms, particularly from a citizen's perspective. In this pa-

per, we set out to examine and discuss some of the salient factors that influence the usability of open data by citizens and propose a conceptual framework to encapsulate these factors. In order to do this, we first review the benefits and challenges of open data followed by examining the role of open data platforms, and motivations for using such platforms. Thereafter, we identify potential measures for evaluating the usability of open data platforms and propose a framework to capture these. We conclude the paper by offering a discussion to synthesise the main arguments presented in the paper, identifying the main limitation, and pointing at future research directions.

2 Open Data: An Overview

The goal of Open Data initiatives has been to open all non-personal and non-commercial data, especially data collected and processed by government organizations [1]. It can be seen as a movement very similar to the Open Source or Open Access phenomenon. In the course of this trend, public sector organisations have started making governmental data available on web portals, as web services so that the public have access to these data at a single point of access to official datasets. The increase in availability of open data initiatives has been seen as mainly due to the growing pressure imposed by governments on all kinds of public organisations to release their raw data [18]. The key motivators to encourage public organisations for publishing data revolves around government's perception that the open access to publicly-funded data provides: (a) greater economic returns from public investment [11], (b) provides policy-makers with data needed to address complex problems [7], (c) generate wealth through the downstream use of outputs [18], and (d) help involve citizens in analysing large quantities of datasets [30]. In general, the overarching arguments for stimulating open data are highlighted as the increase in political economic growth and the contribution to public values (i.e. transparency and accountability).

2.1 Benefits and Challenges in using and accessing of Open Data

Many scholars believe that Open data can be a valuable resource of information if published in a useful manner (e.g. [1]). Some of the key benefits and challenges identified in the extant literature (e.g. [10, 11, 19, 32]) are synthesised and presented in Tables 1 and 2, respectively. These tables do not provide an extensive list of benefits and challenges of open data use, but highlight the prominent opportunities and concerns discussed in the literature.

Table 1. Benefits of Open Data

Benefits	Description	References
Increased Transparency and Accountability	Making government data transparent should increase public trust in government and civil servants and also allow citizens to hold the government officials accountable.	[11, 19, 32]
Economic Growth	Opening government data is believed to bring a range of economic benefits such as encouraging the marketplace to develop products and services, which increase productivity, offer employment, and bring revenue back to government in the form of taxation revenue.	[1, 19]
Societal benefits	Potential to allow citizens to interact with government in a more informed and interactive manner.	[32]
Cost reduction and efficiencies	Sourcing data is often significantly costly in both time and money for organisations. Opening government data can significantly reduce the costs associated with acquiring data.	[33]
Improved data quality	Leads to improved data quality via crowdsourcing of corrections or by filling gaps in data.	[11]
Simulating Innovation	Opening government data encourages developers and the general public to explore and play with new data that might lead to development of innovative solutions.	[19, 32]

Although open data can potentially provide many benefits, its use also comes with a number of challenges. Some of the key challenges identified in the extant literature are presented in the following table.

Table 2. Challenges of Open Data

Challenges	Description	References
Increasing public interest	Challenge of raising the capacity and awareness of civil servants, citizens and the private sector on their rights to access and re-use public data initiatives.	[32, 40]
Cost of opening up data	Time and resource costs are seen as obstacles for government departments in opening their data, especially as they were often experienced as upfront costs.	[11, 32]

Data ownership risks and legality concerns	In the past, if councils or government departments contracted a third party to gather data for them, or purchased data directly from the third party, they often licensed the data and did not own the intellectual property rights, and thus could not directly release it under open copyright.	[18, 41]
Uncertainty about data stream continuity	If a user is not positive that a data stream will be maintained in the future, this creates uncertainty around any project using that data stream. This reduces the chances that an organisation or individual will be willing to invest the time and resources into a product or application that uses this data.	[18, 32]
Data quality concerns	Government departments may be reluctant to release data that they see as low quality. Some agencies are worried about the potential liabilities of releasing their data concerning information accuracy, up-to-dateness etc.	[10, 39]
Privacy violation	Data that includes private or potentially sensitive information on citizens; there can be concerns over whether and how the data can be anonymised, what can be released, to whom and under what copyright.	[11, 9]

2.2 Use of Open Data Platforms

The main purpose of open data platforms has been to promote access to government data and encourage development of creative tools and applications to engage and serve the wider community [22]. In doing so, enabling civic engagement by providing opportunity for citizens, public sector organisations, businesses and independent developers to use systematically-updated stream of open data is being encouraged. The governments perceive that making this data available on the web would lead to more transparency, participation, and innovation throughout society [10, 19]. Often open data platforms publish datasets covering a wide range of domains, from environmental data over employment statistics to the budgets of municipalities. Publishers of these datasets can be individual government agencies or providers of larger repositories that collect public datasets and make them available in a centralized and possibly standardized way. Governments and publishers of open data expect the users to exploit these data in many ways as possible for the benefit of the society [12]. For example, general public (non-technical users) may use it simply to analyse trends over time from one policy area, or to compare how different parts of government go about their work. On the other hand, technical users such as software

developers are encouraged to create useful applications out of the raw data files, which can then be used by everyone benefitting the wider society.

In terms of the process to find the available open data, end-users of these platforms (i.e. citizens, businesses) who wish to access and use Open Data need to first identify relevant datasets manually or by visiting a central repository/platform (e.g. data.gov.uk). In the case of finding datasets manually, this includes finding organizations or agencies that publish open datasets on platforms that provide a central and responsive entry point where users can search for data. If a single dataset can be found, that contains all the relevant data, the user can directly extract the required information. However, it is rather unlikely to find all relevant data in a single file. The way people access and use Open Data is greatly influenced by the way the data is published [1]. Many government agencies or organizations collect large amounts of data. In its original, raw form, this data is often not very useful for end users. Therefore, many datasets are cleaned and customized before being published. While some publishers prefer the data to be in a human-readable format, others prefer a machine-readable format. Apart from accessing data from these platforms, users (e.g. organisations) are also encouraged to submit useful data that can be published to the general public. Government open data initiatives are also encouraging users in a number of ways to be involved as part of these projects dependent on their background or interest. For example, one of the challenges is making existing data come to life, and users are encouraged to combine and reorganise existing data to offer new insights resulting in useful visualisations of these data [12].

3 Developing Measures for evaluating the acceptance of Open Data Platforms

Websites such as data.gov.uk make it easy for citizens to access governmental data and other offered services whilst increasing citizens' potential of contributing to democratic processes [14]. According to Wangpipatwong et al [37], citizen use of such websites substantially reduces the management and operational costs for the government. This study aims to empirically investigate the use of the aforementioned open data website from a citizen's perspective. A suitable mix of measures will be borrowed from the available innovation adoption models to evaluate the citizens' continued use intentions of such websites. This will be undertaken by gathering the opinions of those who already have the experience of using data.gov.uk along a set of measures identified from the literature.

Available literature shows that very few studies have attempted to empirically evaluate the performance of open data websites. There are, however, evidences of other studies using different measures of innovation adoption to investigate the performance of different websites. For instance, Wangpipatwong et al [37] use the Technology Acceptance Model (TAM) alongside self-efficacy as an added measure, to evaluate the use of an e-government website. Fang and Holsapple [14] focus on the

navigation structure of a website and their impact on the usability of that website by using factors defining its usability. Wang and Senecal [36] used ease of use, speed, and interactivity to measure the usability of a website and its subsequent impact on user attitudes and intentions.

The literature is rich with theoretical models, mostly developed from the psychology and sociology theories, which assist in analysing the acceptance of a service or a product [34, 35]. Some of the most used models come from the following theories: Diffusion of Innovations theory (DOI) by Rogers [25], Theory of Reasoned action (TRA) by Fishbein and Ajzen [16], Theory of Planned Behaviour (TPB) by Ajzen [4] and Ajzen and Fishbein [5], Technology Acceptance Model (TAM) by Davis [13], Decomposed Theory of Planned Behavior, Extended Technology Acceptance Model, and Unified Theory of Acceptance and Use of Technology by Venkatesh et al [35]. The DOI theory is regarded as a principal theoretical perspective on technology adoption offering a conceptual framework for discussing adoption at a global level. Rogers [27] has synthesized sixty years of innovation-adoption research in developing this theory. His DOI model has been well received in the world of innovative solutions, and it is one of the most used theories in the field of innovation diffusion [20, 31].

Rogers [27] identified the following five attributes as the perceived attributes of innovations within DOI – relative advantage, compatibility, complexity, trialability, and observability. It can be easily observed from the attributes used in the aforementioned models that the TPB model is an extension of the TRA model, and the decomposed TPB model shares similarities with TAM. Fishbein and Ajzen [16] incorporated attitudes, subjective norms and behavioural intention in their TRA model. TAM is also regarded as an adaptation of the TRA model and the TAM model also shares two attributes with the DOI model (relative advantage/perceived usefulness and complexity). Davis [13] identified perceived usefulness and ease of use alongside the effects of attitude on intention in their TAM model, as the factors influencing the acceptance of a technology. Giving due consideration to all of these innovation adoption models, the following attributes were shortlisted depending upon their relevance to the case of open data website being covered within this study (figure 1): perceived usefulness, compatibility, ease of use, result demonstrability, trust, risk, social approval, visibility, and behavioural intentions.

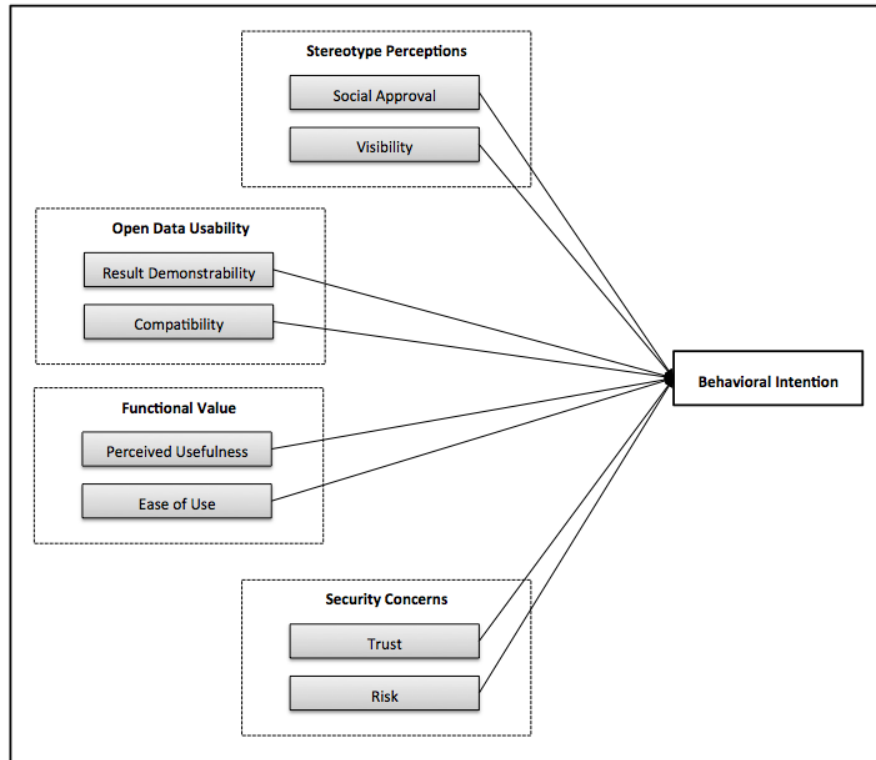


Fig. 1. Proposed Framework for Open Data Websites

Perceived usefulness, also referred to as the relative advantage, will help assess if the information available on the website is relatively better across multiple aspects in comparison to the same data that a citizen can access via other physical offices and platforms. In measuring the advantages of a new service, users tend to evaluate the pluses and minuses of using that service. This characteristic is known to determine the ultimate rate of most innovation adoptions in the long run [24]. In terms of compatibility, the website will be assessed for the type of information it offers to the citizens with respect to the type of information the citizens are interested in, or are expecting to, access using such open data platforms. Rogers [27] describes compatibility to be the degree with which the introduced innovation manifests itself as being consistent with users' past experiences, present values, and their future needs.

Users' knowhow of a service tends to dictate their perception of the level of effort involved in using that service. The less complex a service is to use/operate, the more easily it is accepted. The ease of using the data.gov.uk website will be evaluated from a perspective of optimizing user experience; the design of the interface, time required to look up for the desired information, understandability of different features/tabs offered within the website, and any other navigation complexities will be explored using this attribute (page layout, scrolling and paging, text appearances, links, search

and so on). Result demonstrability will be measured along users' satisfaction of the quality of information that they can retrieve using the open data website. The trust factor will be used to measure the extent to which the users trust the validity of the information that they are accessing using such open data websites. A user's uncertainty about the quality of information being gathered can potentially lead to anxiety, which can come in the way of their adoption decision. The expected social or economic loss caused from using a new system constitutes perceived risk [21, 26]. In this context, the risk factor will be used to measure users' apprehensions of inputting personal information onto such websites, and also their confidence in using the information available on such websites.

The members of a social system generally tend to display a sense of belonging by being a part of the activities that are regarded as a norm within their social system [23]. Social interaction and information exchange can play critical roles in promoting the use of a new system, in effect, motivating individuals to accept that system [6]. Social approval is a construct that will help measure approval from a user's social circle (friends, families, and peers) regarding the use of open data platforms and their authenticity. Visibility of a system encourages peer discussions of that system, which collectively contributes towards achieving a better acceptance rate for that system [27]. Thus, the visibility construct will be used in this study to help identify the awareness that the citizens have about the existence of such open data platforms that they can utilize to their benefit on a daily basis.

The effects/influences of perceived usefulness, compatibility, ease of use, result demonstrability, trust, risk, social approval, and visibility will then be individually measured across users' behavioural intentions. Behavioural intention is perceived as an instinctive probability that a user relates directly with the possibility of a particular behavioural option being chosen [8]. Some models of innovation adoption and diffusion (TRA and TPB) acknowledge this attribute to be the best immediate predictor of the acceptance of a given service/product [23]. These eight characteristics are expected to positively and significantly impact users' intentions towards the usage of open data platforms. The positive or negative correlations that will surface post the empirical evaluations will then be logically reasoned and analysed for their significance in influencing users' intentions towards using the data.gov.uk website.

4 Discussion and Conclusions

This paper focuses specific interest on open data platforms to establish an understanding of its usability from a citizen perspective. In the UK, data.gov.uk is the functional open data website available to be accessed by the public. The UK government has introduced an action plan for a smarter and more efficient government to open the government and promote transparency in empowering citizens and their roles in the civic society; their focus is on redefining the relationship between the frontline and the centre to better manage finances via efficient delivery [33].

In terms of theoretical implications, this study broadly touches upon the streams of open government, ICT literature, and digital governance. The framework presented in this paper has been developed from well-established and most used theories in innovation adoption. This framework can be applied across different open data domains to assess the impact of transparent governance on empowering and encouraging citizen engagement in open government data initiatives. Other researchers can use this framework to build upon, as required, to run in-depth analyses of specific aspects (such as trust in available information, level of risk involved in utilizing that information, and so on) of open data and its usability across different contexts.

In terms of practical implications, a significant milestone of this research is the development of a framework that would enable a reliable assessment of the open data platforms. A 2015 report from a four million project funded by the European commission revealed that one of the issues of such open data platforms is that most data owners in the public sector hold a poor understanding of the relative benefits of different data formats [17]. Most owners tend to adopt a path of least resistance and publish the data in its original format, ignoring the potential of making the data available in more reader-friendly capable formats. Nevertheless, such open data holds numerous practical implications for international data standard forums [17]. The framework will assist policymakers, publishers of open data, IT practitioners (application developers), and other proactive citizens in analyzing the usability of open data platforms. This framework will help evaluate the perceived usefulness of readily available open data, whilst measuring its compatibility with user needs. The stakeholders will also be able to assess the quality of information available in these websites across the risk and trust perceptions of the involved users. Other issues such as user friendliness and usefulness will also be measurable across the aspects of ease of use and result demonstrability. Overall, the constructs put together in the framework will help practitioners to summarize the effectiveness of the specific open data platforms being evaluated, to be eventually bettered for future use by the citizens.

This study suffers from the limitation of no empirical evidence supporting the validity of the proposed framework. This is an ongoing research, and having established a framework for evaluating open data, our future research will be focused on empirically assessing the validity of this framework in the context of a UK open data website: data.gov.uk. Exclusive scenarios will be defined prior to the empirical evaluations; for instance, the users will be directed to explore specific categories (housing, environment, taxes, health, and so on) in the targeted website to assess the retrieved results against the framework proposed within this study. This will help analyze and identify problem areas, if any, to be marked for improvement by the publishers of such open data.

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