Usability Evaluation of an Open Data Platform

Edobor Osagie
Insight Centre for Data Analytics
National University of Ireland, Galway
Ireland
edobor.osagie@insight-centre.org

Mohammad Waqar
Insight Centre for Data Analytics
National University of Ireland, Galway
Ireland
mohammad.waqar@insight-centre.org

Samuel Adebayo
Insight Centre for Data Analytics
National University of Ireland, Galway
Ireland
samuel.adebayo@insight-centre.org

Arkadiusz Stasiewicz
Insight Centre for Data Analytics
National University of Ireland, Galway
Ireland
arkadiusz.stasiewicz@insight-centre.org

Lukasz Porwol
Insight Centre for Data Analytics
National University of Ireland, Galway
Ireland
lukasz.porwol@insight-centre.org

Adegboyega Ojo
Insight Centre for Data Analytics
National University of Ireland, Galway
Ireland
adegboyega.ojo@insight-centre.org

ABSTRACT

[1] Despite the rapid proliferation of open data platforms, the accessibility and ease of use of data portals is low. This factor prevents citizens and civil society organizations from exploiting open data for their goals. The poor usability of current generation of open data platforms could be attributed to the fact that these platforms were not designed for non-technical users. They are typically software products developed "by programmers for programmers or technical users". Consequently, while reports about innovative use of open data by software developers and start-ups are common, there are very few reports about successful public use of open data to tackle concrete societal challenges. This paper provides the results and lessons learnt from the usability evaluation of the second alpha release of a next generation open data platform designed explicitly to support non-technical users. A scenario involving a transportation challenge in Dublin City was employed as the context for the evaluation of the platform. Findings provide some empirical basis for identifying important user interface design considerations, patterns for highly usable open data platforms and considerations for open data policy.

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CCS CONCEPTS

• Information systems → Data management systems engines • Information systems → Collaborative and social computing systems and tools.

KEYWORDS

Usable Open Data Platform, Route-To-PA Platform, Open Data,

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1 INTRODUCTION

Despite the proliferation and diversity of Open Data platforms, the low usability of these platforms remains a challenge [19]. This barrier is preventing wider exploitation of increasingly available Open Data by citizens and civil society actors with modest technical and data literacy skills.

There have been several explicit attempts at investigating the challenges of open data platforms and aiming at evaluating contemporary open data platforms such as work by Kapoor et al. [12]. Nevertheless, these studies, in fact, focused more on the on the properties of open data itself (such us quality, provenance, trust, open data usability) rather than identifying specific affordances for open data platforms to deliver better user experience, which we believe is pivotal for improving open data consumption. Moreover, the work by Kapoor, like many other in the domain, misses the actual empirical proof for the recommendations presented. Other works, involving user evaluation, like the study by [20] investigated some specific aspects of the open data platforms nevertheless the concepts elaborated include mostly very specific features or functions

delivered by open data platforms rather than investigating any specific processes and methodologies behind those platforms. Moreover, there are few studies that involved the open data platform stakeholders such as public administration (open data producers), ordinary citizens, businesses and common open data users, in contrast to widely involved researchers, students and engineers with advanced technical skills. Therefore, while current generation of Open Data platforms still does not provide good support for non-technical users and face challenges with user engagement, we note that there has been an explosion of custom portals based on traditional web-frameworks and content management systems to offer user-friendly interfaces.

The literature provides several hints on why some platforms experience better user engagement than other. Any product including open data platforms is only accepted as a successful only if it carries the characteristics desirable by those that need the product (Seddon & Kiew, 1994 in DeLone & Mclean, 2003). In general "*unfriendly*" user interfaces are common cause for systems to fail in actual use [22]. Product characteristics are essentially the qualities that define the capability of the product to meet the needs of the end users. A product may not meet the intended goal due to the different perspectives from which both the product designer and the user are looking at the product in relation to the intended goal [18]: In most cases, the product designer is unable to place himself in the position of the product user while designing the product largely because of a gap in communication between user and designer and/or difference in levels of emotional attachment to the product. The designer-user differences in perspectives arise from the existence of the points of focus of both parties. Whereas the designer focuses on the product *Appearance* and *Utility*, the user's focus is on the empathy caused by *emotionally* induced reactions, that come from three sources [18]: *Behavioural* – which comes from – expectation-induced reactions; *Visceral* – which comes from – perceptually-induced reactions, and *Reflective* – which comes from – intellectually-induced reactions. *Specifically, in the context of open data and DeLone & McLean (2003), we argue that open data platform's qualities and the quality of the open data it maintains will significantly impact end-user satisfaction.*

Agile methodology, which comes as a solution to the problems mentioned, recommends that the end user of a software product should play key roles in the product development process through consultation [7]. To realise the above argument, this paper reports the user consultation survey, based on applicable theoretical principles and concepts [22] for gaining the insight into the user experience and satisfaction which can be used to update the quality of the product. In this particular case the study product is named *Raising Open User-friendly Transparency-Enabling Technologies fOr Public Administration* (ROUTE-TO-PA). The ROUTE-TO-PA system is a web-based system made up of two components: the Transparency Enhancing Toolset (TET) and the Social Platform for Open Data (SPOD). The TET component provides data search and analytical tools for searching and analysing datasets while the SPOD component provides mainly the data visualisation and social discussion but also has searching tools. The technology foundation section below examines the general usability evaluation principles and concepts but narrows down to our choice of a specific concept as a basis for explaining usability, and a complementing scale for measuring the usability of our case study.

2 CONCEPTUAL FOUNDATION

2.1 Defining Usability

The most widely cited definition of usability (ISO/IEC 9126 (1998)) states that "usability refers to 'the capability of the (software) product to be understood, learned, used and be attractive to the user, when used under specified conditions" [11]. Based on this definition, the aim of measuring the usability of a web application, for example, should not just be to provide a general rating for the website, but should ideally point to the strengths and weaknesses associated with the site design [1]. Due to fast pace at which technology changes, standards quickly become out of date and thus make it more appropriate for standards to focus less on precise specifications rather, more on applicable principles to produce an interface that meets both the user needs and the task needs [4]. Therefore, ISO 9241-11, which treats usability as a high level quality objective, defines Usability as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use [4]. The quality objective reference in ISO 9241-11 is linked to the Quality in use as regards the specific context of use and as such the MUSiC[2] method favours measuring usability through the measurement of the quality in use, by which it means, measuring the components of usability such as effectiveness, efficiency and productive period [2].

Usability has been argued to have two views in which one is a product-oriented "bottom-up" view and associates usability with ease of use, while the other is a broader "top-down" approach which interprets usability as the ability to use a product for its intended purpose [5]. A number of authors consider product usability to be derivable from the qualities in use and the capabilities of the product to support goal achievement with efficiency, effectiveness and learnability as some of the qualities most considered (Alva & López, 2003; Macleod & Rengger, 1993; Claridge & Kirakowski, n.d.). Other authors introduce the notion of dimension to describe the perspectives from which usability can be considered – such as User view, Interaction view, Dynamic view, Product view and Execution view [11]. A different perspective from which researchers have considered usability is the environment or context for which the product is designed to be used – for example as a web application or suitability for a specific task [6, 23]. The five-view framework [11] which considers usability from user view and product view, interaction view and dynamic view as well as from the task execution injects arguably

[2] Metric for Usability Standard in Computing (MUSiC) was originally designed to evaluate usability through the measurement of the quality-in-use by measuring three components: **performance**-, **value**- and **perception**-oriented components of usability [2]

appropriate perspectives from which usability can be measured. However, the method it suggests for measuring usability which is based on evaluator's Yes/No response scale (without midway between the Yes and No) to a set of usability questions makes this method unsuitable for our case study. Specifically, the complexity involved in linking the impact (usability) factors to the various views is and added disadvantage.

The study of Usability Measurement in Context [6] explains the benefits of measuring usability. To end users, it increases productivity and reduces costs; it increases satisfaction and improves ease of use. On the other hand, good software usability can increase a supplier's market share while at the same time helps reduce international standards requirements or legislative and user demand pressures. Even though this paper considers measuring usability through the measurement of features (effectiveness, efficiency and satisfaction), it generally considers doing so in the context of use that includes – the user, task, equipment and environment [6]. What makes this framework not ideal for our case study is our decision not to test usability in the context of environment and equipment at the second Alpha release. Furthermore, the measurement of efficiency usability is all encompassing and therefore is better measured at the project completion stage at which phase all aspects of the product would have been developed. The Quality in Use Integrated Measurement (QUIM) model [22] assembles ideas from a couple of studies and identifies ten usability factors to which it links a number of usability criteria that are used in measuring the factors. The linkage between the criteria and the factors enabled us to decide which factors of usability to measure through the measurement of associated criteria. Moreover, the QUIM model is suitable for ROUTE-TO-PA usability evaluation due to the fact that there exists a complementary usability scale which is easy to use and designed for use with the QUIM.

2.2 The QUIM Model

The Quality in Use Integrated Measurement (QUIM) model [22] is of specific relevance to the ROUTE-TO-PA case study. By consolidating the features of many research outcomes on usability models, measurements, factors and criteria, Seffah and colleagues proposed the QUIM which is based on the product qualities in use. The model considers the usability factors as the perceivable features of product usability and tries to link the characteristic features (that a product may exhibit during use) to the usability factors. The authors explain the relationships between usability factors (or indicators) and the related measurement criteria. They show which criteria relate to (or impacts on) which indicator(s) and opine that by measuring a particular criterion, that in effect are measuring the related usability indicator (s) either partially or wholly. The usability factors considered in QUIM are more than those shown in Table 1, however, in our case study, only factors relevant to ROUTE-TO-PA usability were considered (it was a project decision not to measure the context of environment and equipment for the second alpha release evaluation presented in this document. Therefore, for the purpose of evaluation of a mid-product (for which factors like efficiency or universality are not pivotal), the selection included only: effectiveness, satisfaction, learnability and accessibility. It is important to note that a lot of other researchers consider these usability factors as the major features or attributes that explain the user happiness with the product in use [2, 14, 22]. Nevertheless, other authors introduced the quality of customisation to usability [11] and that the measurements of usability has to be done with respect to specific context [6, 15] for reasonability. Each of the usability factors is linked to one or more of the product criteria in such a way that the exhibition of those criteria by the product will cause the user to perceive the usability qualities. There are 23 product criteria considered by the authors of the QUIM Model, however, Table 1, shows the criteria that are relevant to our case study (due to nature of our software) and it also shows the relationship between the criteria and the usability factors.

Table 1: QUIM usability factors and criteria (excerpt)

Usability Criteria	Usability Factors			
	Effec-tiveness	Satis-faction	Learn a-bility	Acce ssi-bility
Attractiveness		●		
Minimal action		●	●	●
Consistency	●		●	●
Self-descriptiveness			●	●
Accuracy	●			
Readability				●
Simplicity			●	●
Familiarity			●	

In the domain of usability, different researchers maintain their specific list of usability factors and criteria. Using the term usability attributes Bratati et al. (2014) maintain a list of usability factors that include learnability, efficiency, memorability, errors and satisfaction. Compared with the QUIM model, the usability attributes in the study above are much fewer; however, the study provides the reasons why usability evaluation is important. For example, usability evaluation provides support for solution acceptance and adoption, user support cost reduction, influences on usability engineering and avoidance of unnecessary redesign cost [2] all of which improve return on investment [8]. Due to the fact that the QUIM model does not offer any specific instrument for measuring usability, we therefore, decided to adopt a usability measurement form adapted from the System Usability Scale (SUS). The SUS model [9] provides a simple scale for users to rate a product across usability criteria employing a set of usability statements. The usability scale is a range of scores from 1 to 5 in which: number 1 corresponds to *very bad,* 3 is neither bad nor good (*Undecided*) while number 5 corresponds to *very good.*

2.3 Agile Development

The evaluation presented in this paper is part of agile development process proposed to address the major challenges with open data platforms design. In particular the results presented in this paper inform the consequent (beta) development cycle of the ROUTE-TO-PA platform.

Agile methodology introduces continuous, iterative development and testing software development lifecycle (with communication and evaluation loops with stakeholders) [3]. Therefore, the software evolves through continuous dialog between self-organizing teams with cross-functional expertise. Design science and software engineering communities introduced agile methods in form of flexible techniques that can be easily adapted specific user requirements [17]. The adaptiveness and agility in development is pivotal for better responsiveness to fast changing user requirements (e.g., Byrd and Turner 2000, Duncan 1995, Gefen and Keil 1998, Lee and Xia 2005, MacCormack et al. 2001) resulting in positive end-user satisfaction with developed system (Lee and Xia (2005)). However, the flexibility comes at the additional cost in a form of structural and communication overheads [17].

3 THE CASE STUDY

3.1 Context

The study was carried out as part of a European Commission Horizon 2020 - funded innovation action project (ROUTE-TO-PA) aiming at improving government's transparency through better uptake of Open Data. The work presented is related to activities in the project dealing with testing the user response to the product usability and satisfaction levels in anticipation of the technology acceptance and adoption by citizens of the European Union. Specifically, the ROUTE-TO-PA project aims to design and develop models, tools, technology artefacts that will simplify and increase access to datasets published on Open Data portals and also enables citizens to engage on different societal issues by drawing on insights provided from analysis and exploration of available open datasets in different forms. To achieve these objective, the project delivers three major outputs in collaboration with five Public Administration (PA) partners as pilots: 1) *SPOD* – a Social Platform for Open Data enabling social interactions among end-users drawing on different visualisations of Open Data, 2) *TET* – a set of Transparency Enhancing Toolset designed to extend existing Open Data platforms by a set of features that simplifies access to and analysis of datasets as well as export of different representations of datasets to external platforms including SPOD; and 3) *GUIDE* - a set of recommendations on good practices and strategy for Public Administrations to publish high quality datasets and effectively engage citizens to use available dataset for addressing societal issues of interest.

3.2 User Scenario

In this section, we present a user scenario that was leveraged as a major data collection instrument in the platform evaluation. The scenario enables users to relate to the platform in a more personal way, by making the activity applied to the users' local context. In this way users can better understand the challenges and better articulate their needs in consuming required Open Data. The scenario goes as follows: *A small group of students living in Dublin is interested in ways of reducing overall traffic flow challenges in Dublin while also thinking about ways to get senior citizens, elderly and disabled people more mobile in the city life. The group has been looking at relatively cheap and efficient three-wheeled waterproof scooters that occupy small parking spaces like bicycles. The group is investigating whether making the scooter available in addition to the Dublin Bikes might be an improvement to mobilizing more of the population and reducing overall traffic problems. A member of the group was inspired by seeing thousands of mopeds in the city streets of Taipei and was seeking for enterprise ideas in this space for Dublin. The group has chosen to review available datasets in Dublinked data portal (a major local data portal in Ireland) to determine how feasible the idea of introducing the three-wheeled moped into Dublin traffic system might seem.*

As a help material in the task of executing the scenario, we provided Table 2 showing the names of the datasets the group was to use to help in developing solutions to address the issues presented in the user scenario.

Table 2: Datasets used in the usability evaluation

Dataset name	Usage in Scenario	Social Discussions
Dublin City Council Spending and Revenue budgets 2014 (CSV)	To understand the amount of money allocated & spent on Dublin traffic improvement measures for the year	Discuss why zero allocation/spending for Dublin traffic improvement.
Modes of Travel in Dublin Region	To understand the major modes and manners of commuting in Dublin city so as to know how improvement changes can be made to Dublin traffic	Discuss views on modes of commuting – high & low modes
Population	To understand population density – high and low areas, where the need of traffic congestion reduction, improvement is most needed	Discuss options – Mopeds, parks: new & existing parks, colocation of parks.
Luas Network 2012 Stops ITM	To understand networks of Luas, Luas stations where users will likely stop their mopeds and get into Luas – potential locations of moped parks	Discuss Luas stops and how they may be used as places for mopeds parks
Dublinbikes	To view distribution of Dublinbikes location around the city. These are possible places for moped parks as well.	Discuss possible colocation of Moped parks with existing Bike parks

4 METHODOLOGY

The approach adopted in the usability evaluation exercise enables measuring a set of product qualities by simply measuring the various components of those qualities. In this section, first, we explain how we effectively linked ROUTE-TO-PA usability criteria with the QUIM criteria and then to the usability factors of interest to our study. The methodology was designed to measure the usability status of the product as well as to obtain user comments that can be used not only to estimate the level of technology usability and user satisfaction but also to use their comments and suggestions to inform the product design improvements. The following sections will deal with how we aligned QUIM usability criteria with ROUTE-TO-PA criteria; the basis and how we constructed the usability rating statements; stakeholder composition and surveys conducted as well as the compilation and analysis of usability evaluation results.

4.1 Linking Usability Criteria to Usability Factors

Evaluating usability can be achieved by measuring a set of product criteria (properties or qualities) that have relationships with usability factors [22] or indicators (Table 1). Among other methods of measuring usability e.g. by using video-assisted DRUM tools [16]; questionnaire-based SUMI method [13] and the WAMMI questionnaire [21]; we adopted the simple method of asking users to perform some tasks on the system and to respond afterwards to a set of usability statements [22]. This simple method of task and interview is recommended as good practice to study how users use a system and what features they particularly like [14]. In this paper, we focus on the TET usability report only. Based on this decision, the list of the usability factors of relevance in the current release of TET include Effectiveness, Satisfaction, Learnability and Accessibility. The QUIM criteria are in turn linked to the appropriate ROUTE-TO-PA criteria applicable to and testable in TET interface (Table 3). It also provides explanations of the aspects of the platform tools they are used to measure in the usability exercise and which usability factor they affect.

Table 3: ROUTE-TO-PA criteria aligned with QUIM Criteria

QUIM criteria	Equivalent ROUTE-TO-PA criteria	Explanations of features / factors measured by the criteria	Measured Usability factors
Attractive-ness	Structure	The presentation and layout of the data charts and tables on the screen and in pdf formats	Satisfac-tion
Mnimal action	Number of clicks, effort, Speed,	The rigor or the effort required to use the tools to achieve a goal	SatisfactionLearnability Accessibility[3]
Self-descriptiveness	Help, Self-descriptiveness	The level of user help in form information, guide, tool-tips available on platform	Learnability Accessibility[3]
Accuracy	Relevance, Accuracy, Appropriateness	The accuracy and relevance / appropriateness of search results to the search keywords. The accuracy of meeting the information need of the user	Effectiveness
Readability	Structure, Simplicity, understandability	The readability or interpreta-bility of datasets (i.e., variables and table headings, etc.) and data visualisations created from a selected subset of variables or data are readable.	Accessibility[3] Learnability
Simplicity	Simplicity, understandability	How simple the analysis task is, understandability of data analysis outputs, and the simplicity of presentation of analysis outputs.	Learnability Accessibility[3]
Consistenc, Familiarity	Consissten cy, Familiarity	How close the terminologies and icons are to existing portals and infrastructures	Learnability

4.2 Usability Measurement Statements

The usability statements were constructed around the selected criteria (Table 1) to measure the usability factors based on users' experiences on interaction with the system tools, functions and other features made possible by technology designs. To measure the usability factors (effectiveness, satisfaction, learnability and accessibility); we selected the criteria in Table 1 that have direct link with the factors. Furthermore, we aligned the QUIM criteria with the equivalent criteria of ROUTE-TO-PA system Table 3. Based on the above arrangements, we developed the user manual as instructions for users to carry out the scenario-based usability task by considering the need to test user perceptions on the selected system criteria (or qualities). The identified problem in the scenario was the Dublin traffic congestion situation and the task was to analyse Dublin commuting networks and infrastructure using available datasets in order to understand possible solution options that support the introduction of scooters to de-congest Dublin traffic network. We also used the idea of the usability criteria and factors to construct the usability measurement statements that we believed would measure ROUTE-TO-PA usability perceptions accurately (Table 3 and Table 4). These statements were featured in the survey that users were to respond to after the scenario-based usability exercise was completed. Table 4 shows the functional areas of ROUTE-TO-PA (TET) interface that we evaluated and it also shows the features in these areas that were considered. The feature that, in particular, is case-specific for TET evaluation is Informativeness. That feature corresponds here with functional areas around datasets (like data description and social discussions around datasets). That specific feature, pivotal for data-driven solution

[3] ***Accessibility*** in this context refers to being able to have the technology tool for the user's use

like Open Data platform, as we show further, does not have a generic equivalent in QUIM model.

4.3 The Usability Exercise and Survey

The usability exercise was conducted in form of a workshop in which we had a cross-section of stakeholders representing different sectors of interest to ROUTE-TO-PA system. The age groups represented by the 19 users (10 males and 8 females, 1 unknown) who participated in this evaluation workshop were from 18 to 54 years old and the most represented of these age brackets was the group of 35 – 44 years old (i.e. 7 or 38.9%) followed by the group of 25-34 years old (i.e. 6 or 33.3%). Evaluators who had no significant experience in the use of Open Data were highest in number (5 or 27.8%) followed by those with 2-3 years of experience (4 or 22.2%). In terms of functions, student evaluators were more in number (8 or 44.4%), followed by researchers (5 or 27.8%) and then public servants (4 or 22.2%). Software developers were the least represented in number (1 out of 19 or 5.6%). The sample of users who participated in evaluating the ROUTE-TO-PA platform in the workshop and survey was a good representation of a typical Open Data community with representatives from sectors such as education, public services, IT research and the software applications development. During the workshop, users were shown a demonstration of the web-based ROUTE-TO-PA system to get familiar with the system after which they were handed over the user manual to be used in executing the scenario described in section **Error! Reference source not found.**. While working on the system, users were guided through the processes of problem identification, discussions on issues arising or matters of interest such as the suggested moped bikes and finally attempting the co-creation of a solution to the identified Dublin City traffic congestion problem. As they worked with ROUTE-TO-PA tools, users were asked to note down their experiences with the system functionalities and the perceptions they felt. At the end of the workshop, users were asked to complete the Google survey containing the usability statements (Table 4). This gave them the opportunity to rate their levels of satisfaction on the various aspects of the system they used.

Table 4: ROUTE-TO-PA Tech Evaluation Survey – System Features and Usability statements

Functions	Features	Usability Statements (used for survey)
Search for datasets	1)Relevance (Keyword search)	The result list of datasets returned is relevant to the search keywords entered
	2) Accuracy (search result refinement)	The filters options enhance the data search accuracy
	3) Clarity	The presentation of search results is clear and easy to read
Data resource views	4) Simplicity (Data charts and tables)	The data tables and charts are simple and easy to read
	5) Understandability (charts and tables)	The dataset presented as data tables are understandable
	6) Structure of pdf output (charts/tables)	The datasets presented as charts are understandable.
Data resource description	8) Understandability	I understand the description of the dataset.
	9) Informativeness	Data description provides sufficient information about the content and meaning of the dataset I viewed.
Social discussions on data resource	10) Relevance	I find the discussions from SPOD on my dataset relevant to my need about the dataset
	11) Informativeness	The discussions provide some sense about the content of the dataset
	12) Understandability	The discussions about data on SPOD are clear and understandable to me

Table 5: Computation of average score from usability rating

Features Tested	Criteria Tested (ROUTE-TO-PA)	Equivalent QUIM Criteria	1.) Very Bad	2) Bad	3) Can't Say	4) Good	5) Very Good	Av Score	QUIM usability Factors (ref. Table 1)
Search dataset	Relevance	Accuracy	3	2	2	4	8	**3.6**	Effectiveness
	Accuracy	Accuracy	2	3	3	8	3	**3.4**	Effectiveness
	Clarity	Readability	2	3	4	6	4	**3.4**	Accessibility
Data resource views	Simplicity	Simplicity	2	2	5	6	4	**3.4**	Learnability, Accessibility
	Understandability	Simplicity	2	1	4	10	2	**3.5**	Learnability, Accessibility
	Structure	Attractiveness, Readability	2	2	0	6	7	**3.8**	Satisfaction, Accessibility
Description of data resource	Understandability	Simplicity	4	2	1	9	3	**3.3**	Learnability, Accessibility
	Informativeness	-	4	1	4	5	5	**3.3**	-
Social discussions on data resource	Relevance	Accuracy	3	3	2	10	1	**3.2**	Effectiveness
	Informativeness	-	3	3	4	7	2	**3.1**	-
	Understandability	Simplicity	3	1	3	8	4	**3.5**	Learnability, Accessibility

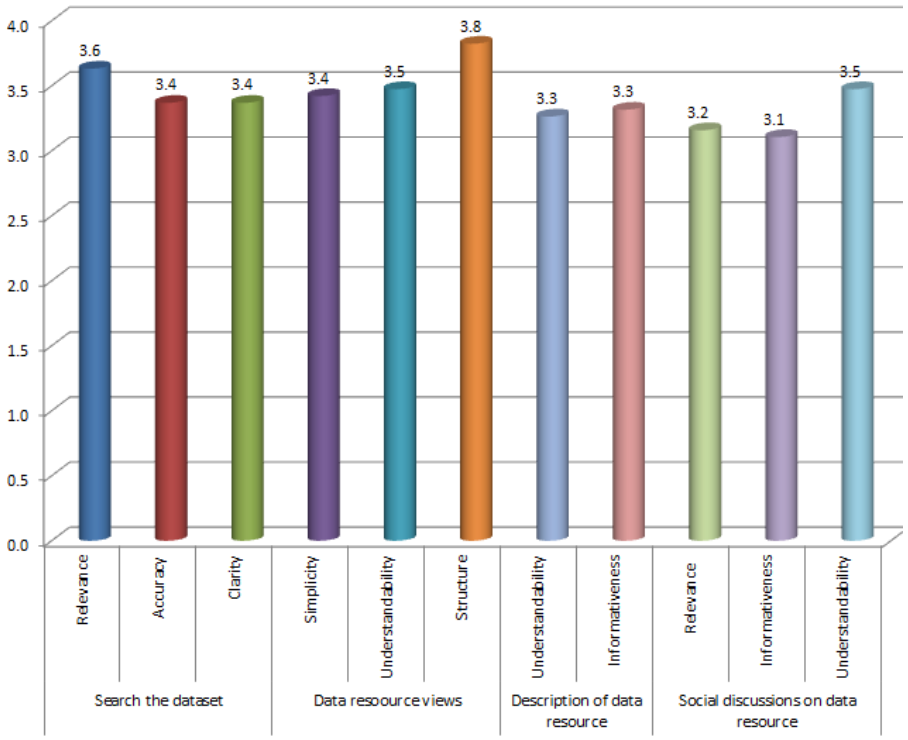

Figure 1: Evaluators' rating across functional areas of ROUTE-TO-PA system

5 RESULTS

Table 5 provides the results of the usability survey conducted as part of the workshop showing the various scores users gave to the criteria that were evaluated in the scenario-based exercise. In the table, we associate QUIM criteria with the equivalent ROUTE-TO-PA-specific usability criteria and related factors as prescribed by the QUIM model in Table 1. As indicated in section 4.3, here we can observe that the ROUTE-TO-PA-specific criteria related to data-handling properties (data description and social networking around data) the QUIM model has no equivalent generic criteria. Nevertheless, informativeness, in the context of data, is an important factor considering the open data-driven architecture of the software evaluated.

Users rated each usability criterion on a scale of 1 to 5. The rating score of a usability feature is computed as the average score for that feature over all users. A mean value of *1.0* indicates that the feature has been rated *very poorly or bad* and unfit for use while a mean value of *5.0* indicates that the feature is *very good* and fit for use. Mean scores of *3.0* is interpreted as a design feature that is *reasonably good* for use by platform end-users.

5.2 Quantitative Aspects

An overview of the average scores of each of the evaluated features in each functional area of ROUTE-TO-PA system is provided in Figure 1. We observed that the majority of the features have mean values above the 3.0 mark, that is, they are considered to be fairly usable in the context of this case study.

5.1 Interpreting results

The result reveals that the *structure* of the data resource views – in terms of presentation and layout on screen has the best rating (3.8) while *informativeness (3.1)* and *Relevance features (3.2)* under '*Social discussions on open data'* (as seen within TET interface) received the poorest scores. However, these discussions were previous users' inputs and had nothing much to do with the functionality of ROUTE-TO-PA system tools other than viewing purpose. Other features with significant positive score include *relevance of search results* and *clarity* as well as *understandability* of dataset views and discussions (both, 3.5).

5.1 Qualitative Aspects

The major problem with the first generation of Open Data platforms such as CKAN-based platforms is the complexity of the system that makes it difficult to use for non-technology savvy citizen users. This is a significant obstacle to users in consuming the data resources available on data portals. ROUTE-TO-PA major aim was to provide tools to augment the standard approach so that ordinary citizens with little computing skills could consume Open Data resources with relative ease. In the usability evaluation workshop, evaluators provided both positive and negative comments regarding the usability of the technology and improvements delivered by ROUTE-TO-PA and some of the comments show how the system is addressing the main objectives of the project.

The Positive Comments

Improved User Interface: On overall, users believed that ROUTE-TO-PA system has simple user interfaces especially the dataset search and analysis interface. Moreover, there has been a big improvement on the user-friendliness of the data analysis tools from the first alpha release which was a simple extension of the CKAN platform, to the second version (beta) that implemented significantly altered design. In this version, we adopted a simplified, clear, Google-style landing page (Figure 2) whereby users are given a search bar to type in their query to search a topic of interest to them.

Figure 2: ROUTE-TO-PA - TET Interface

The simplicity which also comes with the opportunity for users to enhance their search result using filtering tools made a lot of difference in usability improvement (Figure 3). On-screen presentation structure which affects satisfaction has also improved tremendously along with clarity as well as familiarity because of better consistency with other platforms to which users are already used to. All these usability criteria were rated above average – the 3.0 threshold as seen on column chart.

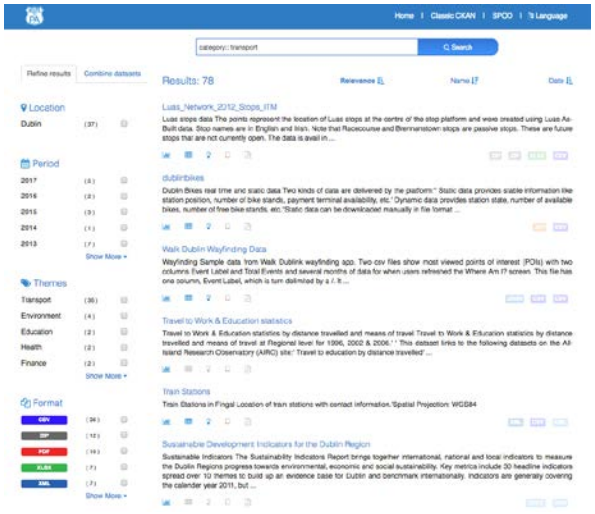

Figure 3: ROUTE-TO-PA - TET Search Results

Improved User Experience: The improved user experience perceived by evaluators comes as a combination of the improved data processing and presentation tools in data search and analysis interface that enabled users to understand more about the dataset they were viewing and that helped them to decide whether such datasets were of sufficient quality and relevance.

First generation Open Data platforms are more difficult to use because a certain mid-level of computing skills is needed to make sense of datasets available on portal. So, unlike earlier Open Data platforms, in ROUTE-TO-PA users were not just able to view simple data tables but they were able to create visualisations of the datasets by following on-screen simple processes (Figure 4).

Figure 4: ROUTE-TO-PA TET Visualisations

User comments support the fact that usability criteria such as understandability, relevance of search results, informativeness of textual material on platform, minimal action, simplicity, accuracy, clarity, structure (attractiveness) are above the mean threshold of 3.0 (Figure 1). The availability of tools on ROUTE-TO-PA made it possible for better and easier consumption of datasets because they enabled users to make better sense of the datasets of interest through simple table presentation, geo maps and other visualisation charts. These possibilities informed user comments that the system is more data usage centric than, not only compared to the first version of ROUTE-TO-PA platform, but perhaps than other traditional Open Data portals.

The Shortcomings

Interface integration problem: On the negative side, users perceived integration problem between the data search and analytics interface, and data visualisation and social discussions interface. That is largely due to fact that in the version that was evaluated, these two interfaces had not been integrated completely. During evaluation process, users were made to copy dataset API links from analytic interface to data visualisation interface in order to study the datasets information further through the use of the advanced visualisation tools.

Using the pivot table: A few users had problems creating graphs and using the pivot table and conclusively, the lack of user help documentation features such as tooltips coupled with the technical demand to actually plot a graph or use the PV tools correctly affected user satisfaction negatively. Furthermore, many users commented on the problem of self-descriptiveness especially about not having enough user help documentation such tooltips and pop-up notes on platform to explain unfamiliar terms and guide users on what do at certain points.

6 DISCUSSION AND POLICY IMPLICATIONS

In this work, we elaborated presented current Open Data platforms challenges and possible improvements based on the outcome of a user-evaluation exercise involving different categories of stakeholders. Our scenario-based approach enabled users to have more ownership of the evaluation process and enabled users to better identify their standing on open data issues and needs in their local context (Dublin traffic congestion issues).

We argue that the QUIM model, with some extensions, can be applied to evaluate the open data platforms usability. The major limitation of the QUIM model, in the context of open data platform evaluation, is the lack of coverage for informativeness, which is a feature of great importance when considering data-driven software. Therefore we claim better alignment of ROUTE-TO-PA criteria selection for open data platform evaluation.

From the user feedbacks and evaluation results from our study, we outline a set of general recommendations for future open data platform and portals:

- Users do not only want to be able to analyse and use datasets; they also wish to engage other members of the community for clarifications and to discuss issues around the datasets;
- User wish to perform search, data analysis, and social discussions with the same level of simplicity they experience when using popular search engines (e.g. Google) and social media platforms (Such as Facebook)
- Users are not ready to spend significant time or effort on learning the new interfaces nor interested in carrying out data analytics paradigms and prefer fully automated data analysis and visualisations

In short, common Open Data users would like the new Open Data platforms to mimic the principles that guide the popular commercial online portals that they already incorporated in their daily routine. Platforms such as Google that offer simple and seamless searching experience without content overload or Facebook that offers picture sharing and social discussions with so much ease engage significant participation. Both platforms are so simplified that users do not need any special computing skills to use them. In the light of the above argument, the first generation of Open Data platforms such as CKAN, the demand for technical capability to use them is beyond the knowhow of many of the intended citizen users. This is perhaps one of the main reasons why first generation open data platforms are of little or no interest to the ordinary citizens.

Evaluators' specific comments demanding specific system qualities such as simplicity, user help, consistency and intuitiveness were collected in the case study. Perhaps, what is most important is the fact that users want a system that is intuitive but is also well supplied with help facilities in form of pop-up tooltips and notes that explain use of buttons, terms and icons on the system interface. As usability criteria, these facilities support usability factors such as learnability and understandability of the interface and thus enable users to use the tools to achieve their goals more easily. *Also users do have concern about poor quality datasets:* those that contain errors and/or omissions that cannot be analysed or may lead to wrong results of analysis. Users are in fact advocating a situation whereby the future Open Data platforms will support quality dataset upload right from source by means of system restrictions or tools that enhances upload of only quality datasets. This findings are in line (and expand the research) with the work by other authors [12, 20] .

The major limitation of this study is that it has been conducted in specific context, with a relatively small group of participants (19) and was based on specific Open Data platform evaluation. Nevertheless, we claim good representation of the Open Data stakeholders in our study (good distribution of stakeholder types in the group) and as our platform has been built upon most propagated and most-used Open Data platform implementation – CKAN, we claim high applicability of our findings to major Open Data platforms available worldwide.

Our study has major implications for Open data policy across levels of governments; whether at regional, national or city levels. First, to address users' concerns about poor data accessibility, data understandability and data quality, ***there is a need for governments to allocate adequate human and financial resources for publishing high quality datasets.*** Poor quality datasets is one of the most frustrating experience for users. One of the biggest frustrations for government officials involved in open data programs is lack of resources[4]. Second, our findings indicate a need for providing simple, intuitive interfaces for the public to access available open datasets. Specifically, governments need to ***focus on simplicity in Open data portal design strategy***. A major obstacle to the use and exploitation of open data is the complexity of platform from citizen end-user perspective. Existing open government data portals do not offer a service-centric interface to the public. Rather available data are presented as simple "catalogues". Lessons acquired over the decade with respect to the delivery of online seamless services are yet to be applied in the provision of open data to the public. Third, citizens expect some means of technical support and help in accessing and using open data (whether automated, semi-automated or through peer-

[4] Edobor Osagie, Waqar Mohammad, Arkadiusz Stasiewicz, Islam Ahmed Hassan, Lukasz Porwol, Adegboyega Ojo, "D2.1 State-of-the-art Report and Evaluation of Existing Open Data Platforms", Route-To-PA Project, available at: http://routetopa.eu/wp-content/uploads/2015/06/D2.1-State-of-the-art_Report_and_Evaluation_of_Existing_Open_Data_Platforms-v1.1.pdf

interaction) with a standard of service similar to popular e-commerce and social media platforms. The social features and service support ubiquitous at commercial platforms (that would enable social interaction around open data) are considered an essential component.

7 CONCLUSION

The usability of IT products demands them to be easy to use so that users achieve their intended goals at minimal possible effort. This simply means that new IT solutions must have low learning curve so that users can understand how to apply the tools in their tasks and interact with it intuitively, without frustration or major errors. Most applications and platforms are increasingly designed to provide these qualities, however, as our study confirms, traditional Open Data platforms (largely CKAN-based) fail to meet the simplicity and understandability by most intended users. These platforms were originally designed by "professionals for professionals", and often fail to meet the need of ordinary citizens. Our case study revealed that in addition to all other usability factors desirable of an IT products, Open Data platforms should adopt the technology design of popular search and social media platforms. Results show that users are calling for platforms that provide user-friendly clutter-free interface such as Google landing page whereby users can easily search for data contents. Furthermore, users seek the Open Data platforms to behave in similar manners and offer easy communication features like Facebook or other popular social media platforms. This means that they favor consistency and familiarity with not only the design, feel and simplicity of existing platforms, but also, they wish to see a consistency in relation to terminologies, icons and logical flow of the interfaces. Users show great interest in simplicity of data analysis through automated systems of data visualization, unwilling to engage in statistical terms and methodologies involved in professional data analysis. Results also point to the fact that users favor discussions with other users over the lone exploration of information, however, they are interested in doing so in a manner that allows simplicity of data sharing, commentary, 'liking', etc., again, similar to Facebook activities. The summary of lesson learnt is that, to improve on the current level of adoption and use of Open Data platforms, future platforms have to improve on the state of the art of existing base-platforms such as CKAN. Based on the results, we claim better alignment of the augmented platform delivered by ROUTE-TO-PA to non-technical user needs. Moreover, we believe our improved platform can already serve as a successful template for other CKAN-based Open Data platforms improvements. Future work should bring further improvements to the platform and second major evaluation (across project pilots) that will inform directly one of the key project outputs - Open Data guide for Public Administration.

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