

City Usability: A Proposal for Evaluating the Perceived Usability of a City on the Basis of the Website Quality Models

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Abstract. The assumption at the basis of this work is that people are an essential part of the city and that its different elements are adapted to the desires of citizens who live in. In order to do that it is important to apply adequate methodologies and tools that help to identify the user needs and to design solutions with people. In this paper we propose to apply the concept of “usability”, borrowed from the Human-Computer Interaction field, to the city environment in order to adopt a user perspective about the interaction with a specific territory. So, we identify the equivalences between the main features of the website quality models and those present at the city level, through a usability framework composed by a series of elements to consider for trying to create a human-centered city.

Keywords: Usability · Smart city · User perspective · Website quality model

1 Introduction

People are an essential part of the city, since they consciously or unconsciously influence the definition of its structures and services. Even into the smart city paradigm, people are a fundamental component of the smartness of the city, together with technologies and institution. Indeed, in the academic literature many approaches focus on people as the central element to realize a “smart city”, considering their needs as the most important reference for defining and implementing really effective city services. In the end, this approach allows creating cities on a human scale [1].

However, in order to obtain this outcome it is important to rethink all the touchpoints between people and the city, transforming them according to this vision. These touchpoints mainly concern public spaces and public services, and in particular the different tools that define them. In the case of spaces, we are talking for example of public infrastructures (e.g. a street, a square, etc.) and public furniture (e.g. a bench, a bus shelter, etc.), while in the case of public services we are talking for example of digital services (e.g. mobile applications, websites, etc.) or physical touchpoints (e.g. an information desk). Therefore, the human smart city vision focuses on the importance of adapting

these listed elements not only to the general user needs, but also to the specific human desires of people who live in a specific territory.

In this paper, we intend to apply the concept of “usability”, borrowed from the Human-Computer Interaction field, to the city environment. In effect, the city represents an interface between people and the different processes occurring in the urban context. The different urban places and infrastructures provide specific functions and information, inviting citizens to adopt specific behaviours. However, when the city elements do not anymore suit people’s needs and requirements, they are gradually transformed and adapted to the new requests. In fact, it might happen that the city, with whatever it has to offer, do not exactly match with the current citizens requirements. This inconsistency between what the city offers and what people really need negatively influences the modes of use the city, leading to a diffused uneasiness, ineffectiveness, and inefficiency. Then, in so far as the city is used by citizens to accomplish their needs, in this paper we draw a parallel between city and website usability. In detail, in the next section we report a general overview concerning the citizen centrality in the urban issues, then focusing on the pertinence of applying the “usability” concept for the evaluation of the city elements. In the third section we deeply analyse this concept, as applied in the Human-Computer Interaction field, and its main characteristics. In the fourth section in order to make clear the parallelism between city and websites usability we show through some examples how these characteristics can be identified in the city environment. Finally, the conclusions, with the proposal of a framework which aims to really apply the “usability” concept for the evaluation of the city environment from the citizen perspective.

2 An Overview on the Evaluation of the City from a City User Perspective

Generally, in the academic literature citizens are increasingly regarded as an important element to be considered during the design process of services and applications. In effect, Public Administration should involve people in their realization, since this involvement would produce more satisfied citizens. This process can follow different levels of people engagement. The basic level consists in the user-centered design approach, that Norman [2] defines as the design process that focus on people’s wants and needs in all its stages, while, the most engaging approach is the co-design, that lets people play an active role during all the design process [3]. Both these approaches are increasingly applied in the city context in order to foster the process of innovation of the territory [4]. However, if the involvement of the city users in the design and redesign of new services, spaces, and products has been strongly boosting, a low consideration has been given to people’s ease of use and satisfaction. So, little importance has been given to the evaluation of the actual city services, spaces, and products from a city user perspective.

Otherwise, the academic literature (and not only) has focused on the evaluation of the city from a point of view that goes beyond the people scale. In effect, a lot of frameworks and models have been elaborated in order to evaluate the cities performances. According to these models, cities can be measured through indicators and indices

concerning their different characteristics that are not related to the city user perspective, as in most cases they are extracted from statistical sources or from data collected through monitoring technologies and sensors. On this basis “smart city” rankings are elaborated. One of the most important smart city ranking is the work of Giffinger et al. [5], where the six general areas of a smart city are described (smart economy, smart mobility, smart governance, smart environment, smart living, smart people), each of them is defined by 31 factors (e.g. “Touristic attractivity”) and 74 indicators (e.g. “Overnights per year per resident”). This work focuses on the performances of the different analysed elements of the city, comparing them with those of the other cities. On the basis of the study of Giffinger et al. many other works have been conducted [6, 7]. However, a specific position in a ranking only points out the general strengths and weaknesses of a city and the areas in which it should improve through urban interventions, but no indications about the lacks of the city from the city user point of view are provided. In fact, these rankings do not let emerge how citizens live and consequently what their needs are.

On the contrary, a user perception approach to the city is necessary for evaluating the city smartness. One of the few proposal about a possible mechanism for measuring the level of citizen’s centrality in city policies and local governance, and consequently their suitability to citizen’s needs, is based on the city indicators on social sustainability elaborated by Marsal-Llacuna [8], which monitor the performance of cities in positively impacting the citizen life. Indeed, standards are suitable tools for the evaluation of the city performance from a city-user perspective, as they are fundamental parts in building evaluation models. In the case of the smart city, the first standard provided is the *ISO 37120:2014 Sustainable development of communities. Indicators for city services and quality of life*. Another standard, still under development, that is suitable to be applied to the smart city is the *ISO/DIS 37101 Sustainable development in communities. Management systems. General principles and requirements*. Both these standards highlight the importance of the human component, i.e. the community, in defining and measuring the city performance, but they still remain mostly focused on the environmental and economic aspects of sustainability, and less on the social ones [8]. The social sustainability certainly needs to undergo in wider standardization process.

However, in evaluating the capacity of the city in meeting the citizens’ needs from a user perspective, we believe that it is adequate to also consider the concept of quality of use applied to the city, since it can be seen as an interactive system “used” by people. The concept of quality of use is strictly connected to the design and evaluation of interactive digital systems, assuming the human experience as the central element of the process. In this regard, the main reference standards are *ISO 9241 Ergonomics of human-system interaction* (especially *Part 210:2010 Human-centred design for interactive systems*, *Part 110:2006 Dialogue principles*, and *Part 11:1998 Guidance on usability*), *ISO/TR 16982:2002 Ergonomics of human-system interaction. Usability methods supporting human-centred design*, and *ISO/IEC 25010:2011 Systems and software engineering. Systems and software Quality Requirements and Evaluation (SQuaRE). System and software quality models*. All these standards provide requirements, recommendations, models, and methodologies to design and evaluate interactive and human-computer systems. They also show the centrality of the ease of use of these systems by a user-centered perspective. The concept of quality of use is a key point of

this work. In fact, in this paper we apply to the city the concept of usability, derived from the Human-Computer Interaction field, creating a parallelism between the structure and organization of cities and websites. In effect, some websites evolve during the time as cities do, with a continuous change and overlap of elements that produces the peculiar structure of the sites. This process of transformation risks to not be consistent with what people need, consequently making websites and cities unusable. So, it is necessary to safeguard their quality of use. In general, the evaluation of the quality of use of a certain website is determined from its usability as the capacity to let a certain target of user to satisfy a certain objective or need into a certain context. In our work the target is represented by the city users, the context by the city, and the objective by the quality of life. The concept of usability as a qualitative research method applied to the city can be connected to the Lynch' work [9], and in detail to his book "The image of the city" [10], where he identified the key elements of cognitive maps as being landmarks, nodes, paths, districts, and edges, and looked at how people build a mental representations of environmental spaces, then elaborating the concept of wayfinding. This work has been of inspiration for several authors [11–14] in supporting the design and evaluation of virtual environments and websites. On this basis, in this paper we adopt a website quality model to support interventions on the urban environment assuming the parallelism between cities and websites as a useful instrument to meet the city user's needs.

3 The Website Quality Models

As stated above, the approach we have adopted for the evaluation of the quality of use of the urban environment derives from the principles of the *ISO 9241-11:1998 Guidance on usability*, where the concept of usability is defined as: "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".

On the basis of this standard, a lot of practical models for the evaluation of the website's usability (i.e. the website quality models) have been elaborated. In general, it has been approached from three perspective: machine, experts, and users. About machine perspective, the quality evaluation of a website is generally made through a specific software that tests a set of established parameters [15]. For the experts' side, there are different techniques applied to predict usability problems, such as the heuristic evaluation or the cognitive walkthrough. The first is a usability inspection technique in which experts apply their knowledge of typical users, on the basis of a set of broad rules known as "heuristics", to evaluate user-interface elements (e.g. the ten heuristics of Nielsen [16]). Cognitive walkthrough technique consists in simulating the user interaction with the system, checking if the user's goals and actions can lead to a successful interaction in completing the tasks [17]. The evaluations executed by machine or experts have several benefits, as the possibility to focus on technical aspects, but they do not reveal the user perception on the quality of the website. Since the websites are designed for the end-user and their success is determined only by the end-user, it is a contradiction that their perception of quality and usability is not measured. Lastly, concerning the user perspective, a lot of website quality evaluation models have been elaborated. To name

a few: the QUIS (Questionnaire for User Interaction Satisfaction) [18] is one of the most used questionnaire for evaluating the user interfaces; the Website Quality Model of Polillo [19] based on seven macro-features, useful not only for the evaluation, but also to adequately manage the website design process; the Framework for a Global Quality Evaluation [20], based on a website quality concept made up of three main dimensions (i.e. content, service, and technical quality). In addition, several quality models are designed for a specific kind of website, e.g. the e-commerce site. In this case, the user quality perception influences the customer satisfaction, encouraging the purchase.

Considering the above-cited ISO and several website quality models, we opt for the seven macro-features identified by Polillo's model for evaluating the usability of the city. In effect, this model constitutes a clear and well-organized framework for a general and complete evaluation of the website quality of use. Moreover, it highlights the importance of the user needs satisfactions in determining the success of a website. Following, we describe the macro-features highlighting the main issues to consider in the evaluation and detailing the related sub-features.

1. *Architecture*. It identifies the general information architecture of the website with its surfing paths, evaluating if it is suitable for the website content. In fact, a website has a good architecture if its organization in pages is content-coherent and allows an easy to understand navigation. The sub-features of architecture are: structure, site map, navigation.
2. *Communication*. It concerns how clearly and coherently the website communicates its aim through its visual identity. Referring to the sub-features (i.e. home page, brand identity, graphic design), they allow to evaluate how and if the website reached its communication aims through the brand identity hallmarks and the choice of graphic design (from layout, colours, fonts, etc.).
3. *Features*. It examines in detail the set of functionalities offered by the website and how the users could perform them. From this point of view, a good site must: have appropriate features supporting the user in finding information; prevent and help to reduce errors or malfunctioning; ensure the security of data entered. Indeed, the sub-features are: suitability, reliability, privacy, security.
4. *Content*. It identifies the reliability, the adequacy, the level of update, and the understanding of the information present on the website. The sub-features are: taxonomy/labelling, content style, information, translation, localization.
5. *Management*. It concerns the workability of the website and measures the overall quality of the website management. It is essential a continuous work to ensure proper workability for the whole time: technical supervision, software upgrade and data update, aids and supports to users. In fact the sub-features are: availability, monitoring, update and upgrade, relations with the users.
6. *Accessibility*. It deals with the aspects that allow everyone to quickly and easily access to the website. This feature examines fundamentally if the website is easy to access for all, regardless of the age and the ability and the hardware and the software (e.g. browser, search engine). The sub-features are: time's access, easy to find, browser independence, accessibility for all.

The Polillo's model includes another feature to evaluate, i.e. usability. We choose to leave it out from our city evaluation framework as it concerns everything making the website easy and pleasant to use and it does not arise from a specific aspect, but from all the above-illustrated features. In fact, usability can be intended as the result of the evaluation of all of them.

4 Discussion

As we said, the focus of this work is the application of a usability evaluation model to the urban environment. In order to do that, in this section we intend to investigate the matching points between the main features of the Polillo's website quality model and the main characteristics of the city environment. In detail, we specify how the peculiar aspects of the six features emerged in the previous section find some equivalences at the city level. For each feature some examples related to the city of Rome are provided. The human perspective at the basis of this approach should guarantee that in this case it is measured and evaluated how the city is perceived by the city users.

4.1 Architecture

In the urban environment, this level might correspond to the physical level, that is to say the organization of the city, the relationship between the different elements that constitute it (for example the urban and the mobility infrastructures), and the correspondence of the city composition (and elements) to the main city users' needs. The architecture also includes the tools useful for travelling within the city (e.g. road signs and directions) and the elements for the representation of the city structure (e.g. maps).

In order to evaluate the suitability of the city architecture to the user needs, it is mainly important to identify the general structure and composition of the city and the main objectives of its users, by pointing out the variance between these two elements. It is also important to evaluate the efficacy and the effectiveness of the tools that help people moving within the city, identifying both the real correspondence between the real structures of the city and how it is represented, and if these tools really help people during their travel. An important element to focus on is the user understanding of the city structure and of the different levels of the city. In this sense, just think how a traditional tool to "navigate a city", the map, can communicate several aspects of the city, such as the touristic one, the administrative one and so on. As an example, many different maps illustrate the city of Rome mostly referring to a single aspect (especially the touristic points of interest and the government buildings) and without integrating each other. These redundancy might contribute to create information fragmentation and to add confusion to the city user mind, impeding him/her to find the right information when needed. So the current tools may not adequately communicate the different aspects of Rome, as they represent a disjointed structure. This way to communicate the city of Rome might influence the way Rome is lived by its users, i.e. enjoying a single aspect at a time (as tourists, residents, workers, etc.).

4.2 Communication

In the urban context, this level might refer to the entire identity of the city (official and not) concerning its values and visual elements. In fact, different cities have different messages and give different suggestions. So, evaluating the communication of a city means focusing on how it communicates these contents towards the outside and on how it emphasizes their distinctive characteristics. In detail, it is important to identify how the city matches its visual identity with its real identity aspects, as well as if these characteristics are consistently present in the different city elements. It is also important to focus on the evaluation of the effectiveness of the communication system in helping people to use the city for reaching their goals.

Regarding that, we can focus on a specific similarity between the banners of the websites and the advertising signs of the city. In fact, as well as the banners cannot be perfectly integrated with the graphic elements of a website, by disturbing the user, also the billboards can clash with the general city elements and they can distract the city user, as shown in Fig. 1.



Fig. 1. Advertising panels of the city of Rome that can distract people, also impeding a clear visibility.

In order to avoid this negative citizen experience, in 2014 the Municipality of Rome prepared a plan that regulates the advertising panels of the city, both protecting its cultural heritage (that is a strong point of the city of Rome) and bringing the user to focus only on his/her activity, with no elements that could distract him/her.

4.3 Features

In the urban environment, this level might regard the delivery of public utility services and spaces offered by the Public Administration. So, the evaluation of the city features

focuses on how services and spaces adequately meet the city users' needs and how they work. In detail, it is important to evaluate if these services (with their specific sub-functions) or spaces (with their specific characteristics) are consistent with what people want and with their objectives, if people always have the correct and necessary contextual information when he/she accesses to them, and if people can access to services and spaces and to the related information in an easy way. Moreover, the concrete performances of the different services and spaces should be evaluated.

As an example, in 2012 the citizens of Rome complained about the low quality of the public transport service by doing "ticket crossing" actions that consist in giving the unexpired bus ticket to the next bus passenger. This is an example that shows what a service that does not meet the people needs can produce. Considering the high number of protest by the city users, nowadays the public transport service of Rome is providing them with many value-added services, in order to improve their experience within the city, such as: promotion and discount for accessing to the services offered by the affiliated museums, theatres, restaurants, shops, and other kind of entertainments.

About the city spaces, we observe how human behaviours has been continually changing and influencing the urban structures. However, in general, the physical aspect of the city is mostly shaped on the basis of well-defined plans that take time to be effectively implemented, while behaviours change in a more quick and liquid way. So it is very probable that the city spaces often show some elements that do not adequately meet the current needs of citizens. This is made evident in the transformation of urban furniture in respect of the effective use made of them by the citizens. Figure 2 shows an example of a bottom up process of adjustment of the features offered by a public space in accordance with the real needs of people.



Fig. 2. Seats added by citizens in a square of the city of Rome to supply to the shortage and unsuitable arrangement of public benches.

4.4 Content

In the urban environment, this level might correspond to the information of the city, concerning both the physical and the digital environment. In detail, in this case it is important to evaluate how the information is “grouped” and organized. For example, we could evaluate how the different levels of the city (e.g. the political structures, the shopping streets, etc.) are present within the urban environment (if they create different areas, each dedicated to a specific level of the city, or if these levels are disseminated into different areas) and how people consider the related configuration. Moreover, we should evaluate the “labelling” of places and services (e.g. if the name of a specific space is appropriate and clear), if the used language (not only the verbal language) is suitable for the people aims, and if the provided information is appropriate and reliable. One of the important elements to focus on nowadays is also the direction of the information, since it is produced not only by the Public Administration that addresses it to the city users (top-down processes), but more and more by the city users themselves that address it to the Public Administration (bottom-up processes) or to other city users (peer-to-peer processes). Figure 3 shows an example related to the suitability of the label to the people aims and to the reliability of the information. In the city of Rome digital screens “as that illustrated into the picture below” give information concerning the limited traffic zones, and in particular if in a specific moment drivers can go in or not. If drivers can go in the message on the screen is “Active gate” (tr. “Varco attivo”); if not, the message is “Inactive gate” (tr. “Varco non attivo”), as reported in the picture below. These labels are generally considered not clear and people are confused when they read these messages. The reason is that usually people associate the adjective “active” to something that they



Fig. 3. The message “Varco non attivo” (“Inactive gate”) confuses people. It communicates that drivers can access to a limited traffic zone by using an adjective (“inactive”) usually associated to the impossibility to do something.

can do, and the “inactive” with something that they cannot do. In the given example, this association is inverted, inducing many users to make mistakes.

4.5 Management

In the urban environment, this characteristic might concern the management of the city by the Public Administration. The evaluation of the management focuses on: the availability of the city services and spaces; the city user perception of the duration of the possible services suspensions and the way in which they are communicated; who are the city users that use the different spaces and services of the city and how they enjoy them; how people see the possible maintenances of the city.

An example: the city of Rome had different problems related to the public works, mainly concerning the road maintenance. The most important problems have been: the lack of transparency regarding the duration of public works; the overlapping of the public interventions on the same urban area; the security of citizens; etc. In 2015 specific measures were adopted in order to facilitate the life of the city users, even in this sense. Among them: the use of electronic signage providing real-time updates for the work in progress the sharing of a map of the work on the road surface through which the city users can be informed and decide how moving; and the preparation of a plan which defines the different interventions avoiding the overlapping of works in the same urban area.

4.6 Accessibility

In the urban context, this feature (truthfully already applied in the city context) might mainly be referred to the accessibility to the physical and digital infrastructures of the



Fig. 4. One of the architectural barriers of the city of Rome

city. In detail, this characteristic evaluates if all the people categories can access, in any way, to the city services and structures. Moreover, this level of usability also focuses on the times of access to the different services or structures (e.g. public buses) and on the findability of the different places of the city (also through different means of transportation and not only through one mean).

One of the main problems related to this feature is the presence of the architectural barriers that impede to people with physical impairments the movement or the use of services. Figure 4 is an example of this issue related to the city of Rome.

5 Conclusion and Future Work

This work focuses on the application of the usability concept to the urban environment as a possible way to understand and evaluate the city from a user-centered perspective. In effect, the assumption is that as the application of the usability concept in evaluating interactive systems allows users to interact with them with efficiency, effectiveness, and satisfaction, as the application of the same concept in evaluating a city allows the city users to interact with the different elements of the urban environment in an effective (i.e. assuring the achievement of city users objectives), efficient (i.e. assuring the appropriate use of resources in achieving city users objectives), and satisfactory (i.e. assuring the comfort in “using” the city) way.

Moreover, the concept of usability has been made arise from the interaction among six specific features: architecture, communication, features, contents, management, and accessibility. In fact, each of them should be considered as linked to the others.

Lastly, this work does not intend to provide specific solutions to the city issues, but only to focus on the citizen perception and satisfaction of the city, an aim that the concept of usability can contribute to better explore. However, both for website and city environments, the usability concept is not only based on the point of view of the real final users, but also on some general solutions applicable in different contexts. In this paper we apply these characteristics to the city of Rome with the aim to better illustrate them. However this work aims to create a usability framework that can be used by different cities. Moreover, it does not intend to overlook the peculiarities of a single city, since it only provides general elements for investigating the city from the user point of view. Indeed, the identified problems and needs should be solved by each city in a context-based and specific way. In the future work, we intend to test it with different Italian cities.

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