Public design of digital commons in urban places: a case study

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Abstract

There has been a growing interest in the relation between the design of urban computing technologies and the construction of publics. However, there has been only a weak connection between such topics and recent debates on digital commons. In this paper, we present our perspective on the public design of urban computing technologies drawing upon the concept of digital commons. In order to do so, we define what we mean with digital commons, how public design can be grounded in matters of concern, and how public design can stimulate the formation of recursive publics. To engage in a reflection on our design approach, we focus on the empirical case of ViaggiaTrento, a mobility app part of the wider project Smart Campus, a case of design of a digital commons.

Keywords: digital commons, public design, urban computing, mobile applications

1. Introduction

The debate on the design of digital technologies has seen a growing attention for the public dimension of design, that is the ability of designers to engage with issues that are relevant for the society they are living in: this

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aspect is almost taken for granted in the field of urban computing, as many research projects deal with the localities where designers operate.

In this paper, we propose a perspective on the relation between public design and urban computing that is mediated by the background perspective on digital commons and the common: after articulating our theoretical tenets in detail, we discuss our point of view in the light of our experience in the design of a mobile application for mobility.

Our argument is located in the problem space of the current changes in the design of digital technologies, which has shifted from focusing on individual experiences to problematizing the social and collective dimensions of technological production and use. The collective we focus on is the city, and more specifically the university campus: the starting point of our argument is therefore the understanding of urban places as characterized by social relations and by the emergence of subjective practices. The complexity of such scenario is in our opinion incompletely framed within the concept of smart city, one of the dominant narratives in the industry and governments' take on the relation between digital technologies and the urban landscape: therefore, we think that the academic discourse on urban computing, focusing contemporaneously on people, technologies and places, is a promising field for framing the relationship between the city and the practices occurring in it.

Once established that, however, two main questions emerge: what to design? and how to do that? In order to answer to the first question, we articulate a general vision in which the common is a political perspective of societal transformation supporting practices of mutual sharing and collaboration that can leverage the institutional gains and peculiarities of the commons. For designers, this implies engaging in the construction of digital commons, such as free and open source software, that can be taken over and self-governed by the concerned people. Moreover, in an urban computing context, that means to conceptualize technologies as the mundane elements supporting active human agents in the shaping of their urban environment, their subjectivities, and their collective life.

We answer the second question about how to design starting from the relevance of people's concerns and more specifically through the emerging references to "public design" and "matters of concern". The first concept has been recently revamped to indicate a shift from a solution-oriented perspective in design to the articulation of issues and problems.

A corollary of public design is its ability to support the strengthening of social groups concerned with particular issues. Here, the concept of matters of concern allows to see how the technology itself is not neutral but can rather concern people, i.e. publics, and that it is the designers' duty to start from such concerns, articulate them, and support their emergence and solution with the direct takeover of the concerned people; in this way, design becomes "public". Once identified matters of concern and their relative publics, one of the key aspects for designers is to stimulate people's engagement through the social practices entailed by the designed artefacts. In particular, we will discuss how, the characteristics of publicly designed digital commons should stimulate recursivity: recursive publics, in fact, engage with the technological and institutional elements that allow their existence as a public, deepening their knowledge and domains of action.

In conclusion, we discuss the case of a mobile application for mobility that has been designed as a digital commons, as free and open source software and with the aim of stimulating the takeover by the users, following a process of public design that moved from the identification of a concern to the stimulation of engagement and to the takeover of the design itself by the publics.

2. Designing in urban places

As urban computing has mainly focused on the relation between people, technology, and places, we should first locate the design of urban computing technologies in the wider picture of design transformations and of the general discourses on the city-technology relation. To do that, we firstly discuss how the debate on the design of digital technologies has testified a shift from a personal-oriented, individualized, perspective of design, to a more publicly oriented one. Secondly, we stress how urban computing has correctly focused on urban places as the object of intervention, underlining how places are where the subjectivities of people emerge. Thirdly, we introduce the narrative on the smart city, socially widespread but characterized by a technology push orientation that hides the centrality of people as subjects in the construction of the urban places they live in. Finally, we discuss how urban computing, discussing technology with awareness of subjectivities of people, is a promising field to articulate a perspective on design that is able to connect specific projects to wider social issues.

2.1. Design: from personal to public dimension

Over the years, the methods for design and evaluation of communication and information systems have been adapting to the needs and activities of the context in which technology was used. During the 80s, the work of several academics including (Shneiderman, 1980) and (Gould and Lewis, 1985) helped to establish the importance of human factors in computing systems. Their work proposed methods for designing systems which were "useful and easy to use" (Gould and Lewis, 1985). Experts in Engineering, Computer Science and Psychology worked together in the design and evaluation of systems giving rise to the field of Human Computer Interaction (HCI) (Card et al., 1983). Efficacy and efficiency were relevant performance metrics. Artifacts as interfaces between the technology and the task were the main objects of study. In this period, Computer Supported Collaborative Work (CSCW) emerged as research field which investigated computers as support for "cooperative work arrangements" (Schmidt and Bannon, 1992). CSCW mainly focused in workplace settings, such as offices and industrial factories.

In the 90s, the focus of design moved from the workplace to the personal life of users. Context, setting and individual characteristics, such as motivation, became relevant aspects in the design. As Bannon argued (Bannon, 1991), people should not longer be considered as "factors", but rather as "human actors" in a context and with individual characteristics and values. In parallel, research in HCI moved from design for performance towards design for experience. User eXperience (UX) became a fundamental metric for user requirements and evaluation. Within this shift, fun, aesthetics, enjoyment and pleasure became relevant performance metrics. Artifacts as mediators for personal experiences, and individual well-being were the main objects of study. In the last few years we are experiencing a move from designing for personal contexts towards designing in the public dimension. Some researchers have explored the challenges posed by this move and elaborated on the "third wave" in HCI (Bødker, 2006) or "design in the wild" (Rogers, 2011; Chamberlain et al., 2012). While defining UX dimensions and reproducing ecological settings were some of the challenges faced when designing in personal contexts (Hassenzahl and Tractinsky, 2006), large and diverse groups of stakeholders, undefined context boundaries and dynamic requirements are some of the identified issues in the public dimension (Bødker, 2006). In spite of the raise of design projects declaring to act in the public domain, the understanding of methods for design and evaluation adapted to this context is still limited. Answering questions such as what are we designing for and how

can we do it might constitute the initial steps towards the strengthening of public design.

Designing in the public dimension might entail not only designing in for everyday life and but also for urban life. Brynskov et al. (2009) discuss that HCI researchers have mainly focused on spreading digital technologies as essential part of everyday life; in connection to the house, school and entertainment. However, urban life cannot be considered as completely overlapping with everyday life because urban life is characterized by specific social and cultural practices and because it is connoted by spatial and material situations which pose new challenges for interaction designers (Brynskov et al., 2009; Dalsgaard and Halskov, 2010). The uniqueness of the urban context lies in the fact that it is both a research context, and the context in which urban computing is created and analyzed (Memarovic et al., 2012). The next paragraph deals with the characteristics of urban life, as life in urban places.

2.2. Urban Places

Place and space are two different concepts which converge in the public dimension. Space is a concept related to the structure and geometrical features of physical context; while place relates to a more experiential dimension which includes interactional dynamics and the use of the space (Harrison and Dourish, 1996; Dourish, 2006). Existing studies on urban computing claim that the city cannot be analyzed as a mere spatial container, but rather as an action setting place where infrastructures and practices are intimately related (Williams and Dourish, 2006; Brynskov et al., 2009; Dalsgaard and Halskov, 2010; Memarovic et al., 2012).

In 1982, Ondelburg and Brissett defined the urban place as the most important element of social life and the base of democracy. The urban place, also referred as the "third place" (Oldenburg and Brissett, 1982), is the intermediate space situated between the first (i.e. housing place) and the second place (i.e. working place). The urban place is open to its inhabitants and it is where some of the most important social activities take place such as fortuitous encounters, public discussions, etc.The special character of the urban place lies on the opportunities for experiences and relations that it offers, such as serendipity (Hannerz, 1980) and pure sociality (Simmel and Hughes, 1949).

Urban life can be understood as life which happens in the urban place. In computing studies, urban life can be investigated in terms of urban contexts.

Urban contexts are unique and complex social ecosystems which are product of practices and flows culturally situated (Williams and Dourish, 2006). People interact in place-time relations with and within the urban context. These interactions might influence in a recursive process the construction of the first and the second place (Oldenburg and Brissett, 1982).

Thinking about the urban context means considering the unique and complex ways in which place and time are interrelated and how this interrelation contributes to the construction of the urban context itself. To grasp this complexity, we leverage on Carr's conceptualization of personal interactions and roles as influenced by five human needs (Carr, 1992): comfort, relaxation, passive engagement, active engagement and discovery. Comfort refers to a request of food, drink and places in which to rest. Relaxation refers to the need to put at own ease body and mind (e.g. sitting on a bench in the park). Passive engagement relates to people?s relaxation and it allows them to see what other people do; while active engagement represents the need to meet or create intellectual and physical challenges in a space (e.g. to undertake a conversation with friends or unknown people). Discovery is the desire of stimulation that appears through new meetings, values or ideas that can emerge in places already known. These needs could be interpreted as the building blocks of the orientation to the common of the subjects living in the city.

2.3. Smart City

Smart City has become a very popular label for referring to an approach to city renewal. In the technological age, Smart City seems to refer to technology-pushed, corporation-driven orientation towards urban computing, supported by the efforts of some public administration (e.g. the European Commission). This vision confronts with the original human-centered and situation-oriented conceptualization of the introduction of computing in the urban texture (Greenfield and Kim, 2013). To exemplify differences between Smart City and the academic discourse on urban computing, we performed a simple search, on Google and on the academic database Scopus. This search retrieved interesting results. On Google, the search [1] for the three keywords provided the following results: Smart City, 1700000 pages; Urban

[1]The search was done on June 3rd, 2014, with an anonymous instance of the web browser Firefox and through the keywords included between inverted commas.

Computing, 39000 pages. On Scopus, the search [2] provided the following result: Smart City, 925 documents; Urban Computing, 184 documents. It appears clear that, if urban computing is still a small and growing academic discourse, the Smart City appears as an industry and administration phenomenon followed by a widespread social adoption. We want to contribute to urban computing using the Smart Campus project, which is a meeting point with the concept of smart city, as a case study for the forms of public design that we have already introduced. This is a trial to stage an encounter, through design, among the narrative on the city and the tools and methods of urban computing, seen as a derivative of ubiquitous computing more open to consider the subjectivity of citizens as a relevant starting point in the design process.

An example of how this encounter can work is provided by one of the issues at stake in urban computing, that is the ability to optimize place and time for people: this means not only to optimize mobility in general, but also to find the faster solution in the faster way. Such narrative is not far from, but in some way opposite to, the one of the smart city as oriented toward organizing mobility from a planning perspective. The same technological tools could be purposed equally to the control of people or to their empowerment, a topic already discussed in Norbert Wiener's work (Wiener, 1950). In this sense, the apps that we will use as a running example throughout this paper is a crucial example. If everyday life is understood in terms of spatialization and temporalization, urban computing can offer the possibility to evaluate the relational aspect as a flow, as a dynamic.

2.4. Urban Computing

Urban computing can be defined as the integration and activation of information technologies in lifestyles and in the urban context of everyday life (Paulos and Jenkins, 2005). Urban computing poses its research questions on people, places, and technologies (Foth, 2011) and builds on theories and methods from social sciences and design disciplines. Under this understanding, the field of urban computing appears as a promising approach to transdisciplinary contributions. In particular, the claim of Foth (2011) on Urban Computing (or, as they call it, Urban Informatics) being able to

[2] The search was conducted under the same conditions as the one on Google and on the same day.

address issues and opportunities that go beyond the urban dimension. This claim points to the fact that Urban Computing research is particularly apt to investigate the possibility to develop a public design perspective supportive of alternative social practices, oriented to the common, enlarging the scope learning from the urban landscape. Before describing how we think that possible, we refer to scholars who have framed a similar concern.

Notably, Paul Dourish and colleagues (Dourish et al., 2007; Bassoli et al., 2007) have framed the field of urban computing applications as organized among two different generations: in the first generation, the mobility of people was seen as a problem to be addressed through technologies, with the problem being in turn the disconnection of workers from a stable situation, the dislocation with the need for guidance, or the disruption mobile technologies could bring into different social situations; in the second generation, technologies are designed both to leverage the wealth of potential social interactions emerging through mobility and to be able to situate themselves in the different contexts of the city, being sensitive to the different locations. Dourish et al. (2007)'s point is particularly interesting for two main reasons: on the one side, they stress the need for an ethnographic-based interdisciplinary research, for example drawing directly upon sociological concepts (e.g. civil inattention by Goffman (1963)) in order to include them as a design objective and research object; on the other side, they stress the need for urban computing to accommodate the diversity of urban experiences in relation to different social groups and the actual agency of people in producing the urban life they are diving in.

In such a perspective, design, intended as a deliberate intervention in the world through the construction of technological artefacts, finds itself in the position of supporting dense experiences, the continuous innovation of the practices of living together typical of the common, the everyday interactions of the commoners, and the engagement of people with their sociality and urban life. Basically, focusing on mobility as a resource, the design of urban computing could support recursive dynamics through engagement. The next section will clarify the meanings we attribute to the concepts of commons, public design, and recursive engagement.

3. Design Framework

As urban computing designers find themselves in the position of trying to understand what to design in their research projects, we think that one of the criteria of choice stands in the ethical and public implications of intellectual activities. We articulate such conception starting from the history of computing as an academic and social practice. Questions on the public responsibility of technology designers were already present in Wiener's *The Human Use of Human Beings* (1950), where the author stressed how technology could liberate human beings or subjugate them. This trend has been emerging from time to time: for example, (Zuboff, 1988) focused on the dichotomy automating/informating in organization and management studies, while the recent sociological debate between Fuchs (2012) and Arvidsson and Colleoni (2012) has discussed the economic transformative power of digital technologies. In all these cases, technologies appear as double faced: on the one hand they can potentially sustain social practices oriented to liberating the subjects, in other cases they can be used to sustain the reproduction of hierarchies.

In order to understand how we can locate our publicly informed design choices in contemporary debates on society and design, we refer to three main aspects: the focus on digital commons as a way to link design activities to wider societal possibilities, such as the "commons paradigm" (Bollier, 2007), which can suggest a third way of organizing the economy apart from the market or the state; the introduction of "matters of concern" as what to be looked for as a design issue (DiSalvo et al., 2014); recursivity as the ability of people of taking care of what allows their existence as a group and, through that, to widen their perspective on what they are concerned about (Kelty, 2008). In this section, we discuss these three aspects more in detail.

3.1. Digital Commons

As technologies affect the practices through which people make the city as a common place, the way technologies are designed and the way they translate visions of the city are key points in a design process. To build our own vision of urban practices, we draw upon the recent debate on commons-based projects taking place among the observers of the digitalization of society. Deriving from the work of the Nobel prize Elinor Ostrom, many scholars, either more critically oriented like David Bollier (Bollier and Pavlovich, 2008; Bollier and Helfrich, 2014), or more liberal as Yochai Benkler (Benkler, 2006),

have referred to the commons as a possibility to promote a renewed form of distributed and social wealth. In such a reading, the commons is a third-way institutional arrangement to manage specific resources, be they natural or digital, that is neither the state or the market, but rather a collective effort of the people directly interested in managing the resources through means that are based on democracy more than on hierarchies (Ostrom, 1990; Elinor and Charlotte, 2006).

Typical examples of commons related to natural resources are water, pastures, or fishery seas, while typical examples of commons related to digital resources are Wikipedia and the various incarnations of Free and Open Source Software. As we try to describe the relation between the different commons, that is pieces of good managed collectively, and society at large, we come to see how a more general concept, the common (singular), emerges as the ensemble of the material and symbolic resources shared among humankind and that sustains the possibility of humankind to live together, including natural resources and digital wealth (Hardt and Negri, 2009). If the commons are the articulation of particular (and fruitful) institutional arrangements, the common is a political perspective of societal transformation supporting practices of mutual sharing and collaboration that can leverage the institutional gains and peculiarities of the commons. As any ensemble of resources and the element supporting our living together, the common can be either nourished or exploited: therefore, designers acting in a common-oriented perspective can face the issue of understanding the complexity of common-related phenomena and of positioning themselves in the frame of nourishing the common. The study of Free and Open Source software has identified some of the practices that can participate to nourishing the common, notably the interpretation of the people engaged with free software as a recursive public (Kelty, 2008): this expression indicates the capability of a public of being able to take care of the infrastructure that allows its existence as a public and to its capacity to deepen their level of engagement outside the limited preoccupation for the technology at stake, including institutional, legal, and social elements. From a public design perspective, that means to design not only useful technological tools but also the means for discussion, improvement, and future autonomy of the public engaged. In the urban context, a common-oriented approach means primarily to focus on the agency of people, on their ability to connect one to the other, on their possibility to collectively manage the environmental aspects of their collective life.

The common is not an abstract perspective: it is first of all the ability to recognize, as Haraway (1988) pointed out in the feminist debate, that having a situated, local perspective, provides an epistemological privilege in understanding the world. To put it differently, it is a matter of understanding design as coming from somewhere and not from the detached perspective of nowhere (Suchman, 2002). The city is the place where subjects take shape, their ability to live together is continuously reinforced, and the possibilities for diversity and social interactions multiply. Technologies, in such a perspective, are common devices, the mundane elements supporting active human agents in the shaping of their urban environment, their subjectivities, and their collective life.

3.2. Public design

The perspective on the common and digital commons can suitably accommodate the design of urban computing, yet it is still too broad to specify a design problem and engage into a specific project: to this end, we believe that the "public design" (DiSalvo et al., 2014) approach should be followed. In this frame, it is important to differentiate between designing for publics and designing in the public dimension: in Dewey (1927)'s terms, publics refer to groups of people who come together in order to trigger an action to deal with a common issue. However, when designing for the public domain, the group of people who we are designing for and related stakeholders might not recognize the immediate relevance of their involvement (Dalsgaard and Halskov, 2010): therefore, engagement becomes a crucial element to promote participation and proactiveness, sometimes turning people into a public.

If technology design traditionally entailed deciding how artefacts should work or the experience they should enable, public design starts from the premise that the boundaries of what to be designed become blurred and designs are susceptible to interpretation (Sengers and Gaver, 2006): designers might lose control over the object of design, as there can be diverse understandings about what artefacts are for and how they should be used (Sengers and Gaver, 2006). However, designing artefacts which are susceptible to interpretation can also open up opportunities for enabling reflection on what Latour (2005) defined as "matters of concern": technology and knowledge are seen as something people is concerned about rather than something established on "matters of fact" , the declaration of absolute reality. The focus on matters of concern also helps to see technology as uncertain and as able to relate to people on the basis of their stake into the technological development

(Latour, 2005). As DiSalvo et al. (2014) clarified, the role of the designers within such perspective moves from "providing solutions or initiating change" to articulating "issues and giving form to problematic situations".

Several examples of how this "matter of concern" approach might trigger different interpretations and positions towards a technological artefact based on personal, contextual or social elements are currently emerging. For example, real-time ridesharing platforms (e.g. Uber [3]) have recently become very popular as an alternative solution to public and private transportation. Non professional drivers, who are paid for this service, and passengers, who enjoy higher flexibility and lower prices than with existing transportation services, have received the platforms with enthusiasm; differently, European taxi drivers associations see these platforms as an unfair threat to their business and have organized several protests to request their cease [4]. Some governments [5] are supporting the protests, as this kind of activity carried out by non-professional drivers can be prosecuted according to laws written at the end of the last century; however, the European Commissioner for the European Agenda has highlighted the innovation aspect of these platforms and called for collaboration between taxi drivers and the platforms to reach an agreement.

Therefore, identifying matters of concern as potential design themes is not a trivial task. In a digital commons perspective, the key aspects become to initiate and expand the practices of positive engagement toward the commons at stake, potentially promoting the construction of a recursive public that can question the wider context in which they are situated.

3.3. Recursive Engagement

The topic of engagement is not new in urban computing and it has covered a variety of social, professional, and technical practices (Foth et al., 2011). In this paragraph, we focus on a situated notion of engagement that is useful either as analytic instrument for the study of interactive systems or as a reflection element for designers to plan new tools. We follow Dalsgaard and Halskov (2010), who have discussed three different cases of urban computing technologies: Aarhus by Light, an urban installation of a interactive

[3] www.uber.com

[4] http://online.wsj.com/news/article_email/taxi-drivers-plan-big-protests-against-uber-technologies-across-europe-1402432899-lMyQjAxMTA0MDEwMDExNDAyWj

[5] http://elpais.com/elpais/2014/06/12/inenglish/1402567397_216162.html

faade; Hydroscopes, an interactive installation that explores new experiences potentially involving a museum and a scientific centre; the LEGO Table, an interactive installation that explores the potential for digital marketing into a department store. These cases present public engagement as a highly relational phenomenon, characterized by the interaction among four different elements: cultural practices, physical conditions, content of the installation and social practices (Dalsgaard and Halskov, 2010), which we describe in the following:

- *cultural practices*: they influence the interactions between public and digital installations. Elaborating this concept, we propose to refer to the concept of "performing perception", elaborated by Dalsgaard and Hansen (2008), that is the possibility that people are aware to be observed and therefore modify their behaviour and their way to use the installation;

- *physical conditions*: Dourish (2004) says that embodiment has become a central core in the most recent studies about HCI: our presence in the world becomes essential for the way in which we give meaning to the world and thus becomes important for the analysis of engagement of people with technologies. Fritsch, analyzing the concept of physical conditions, elaborated the notion of affective engagement (Fritsch, 2009), through which he tries to emphasize how, since we fit in a context, we are affected by the physical space even before entering consciously (and perhaps actively) in the sensemaking process;

- *content of the technology*: it does not concern the engagement with the content itself, but how a person invests herself entering in relation with the content. This aspect is still more relational than static or technical, because it regards the dynamic relation between content and public and not only the content itself (Dalsgaard and Halskov, 2010);

- *social aspect*: it regards the interaction between users and potential users of the installation (Dalsgaard and Halskov, 2010). It is impossible to establish a priori the effects that urban computing has on citizens, but this aspect seems to help to define the way in which real and potential users can interact with the content of the installation, the physical condition and the cultural practices.

Due to the complexity of the way people can be engaged, Rogers advocates for designing "bounded" rather than "pervasive" technologies which allow people to take the initiative to construct, improve and control their interactions with the world (Rogers, 2006). Although in different terms, Rogers is pointing to the possibility of stimulating a recursive process among people using technology, providing them with the means to affect their surroundings more than subjugating them to the surrounding themselves. We refer to the contribution on recursivity by anthropologist Kelty (2008), who studied free and open source software (which is by the way the main example of digital commons) and argued that "a recursive public is a public that is constituted by a shared concern for maintaining the means of association through which they come together as a public" (Kelty, 2008). This is the distinguishing feature of engagement in public design, as recursive engagement is the ability to let people maintain the means through which they are associated, becoming a public. In the following section, we discuss the Smart Campus project, an example of public design of digital commons in urban places, and we show how our experience suggests that such approach is a promising one.

4. Smart Campus: toward recursive engagement

The case study we reflect upon is the Smart Campus project, which started two years ago with the short-term goal of creating an ecosystem that may foster students' active participation in the design and development of services for their own campus; on the longer run, the project was meant to act as a sandbox for an experiment of fostering active participation of people in social innovation (Björgvinsson et al., 2010). In one sentence, Smart Campus is an experience of public design trying to stimulate the emergence of recursive practices among its users. Smart Campus configures itself as a digital commons for three main reason: firstly, the software produced is released with an open source license, making it legally a digital commons; secondly, the design and development of the first technological artefact was based on a specific concern of students; finally, it looks for stimulating forms of self-governance by concerned people, making them take charge of the project itself. In particular, the mobility application we focus on is interesting as it implies the same technological base but two different local instances. The two instances not only refer to two cities different in size but belonging to the same cultural context, the Province of Trento, but, more importantly, they differ in the strategies of engagement of users and potential users.

In our research, we attempted to document, analyse and reflect on antecedents and consequences of specific design interventions during the project, unfolding on techniques of interaction and participatory design. Our activities consist of the facilitation of new relationships between human actors as well as the public place and lead to our objective of participatory development: we interpret the latter in the literal sense, as leaving the design and development of new technological artifacts to the people taking part to the Smart Campus who, in such a way, translate into the Smart Campus public, taking care of the means of its existence.

Together, the social and technical dimensions of the project are meant to facilitate the formation of a public and, through it and its attention to the needs of the people part of it, forms of recursive engagement. They meet in a process of collective association around the concerns on the design of artefacts (mainly smartphone apps); and such infrastructure had the narrative purpose of acting as a living lab, serving the local Province through the smart city way of talking.

Summarising, Smart Campus was meant to be a sort of playground where smartphone apps were developed based on people requirements in order to showcase the capabilities of the technical platform developed and to facilitate the establishment of recursive social practices: such effort was meant to set the conditions for transferring the activities from the circumscribed environment of the campus to the "wilder" context of the city. In this paper, we will focus on the case study of ViaggiaTrento, the first app developed on top of the Smart Campus socio-technical platform to progress through the incubation within the project lab, the opening to the urban population with the publication on the Google Play Store and the appropriation by a different place with the creation of a customised version in Rovereto, a nearby municipality.

The differences among the original and customised version of the app can be traced to the different paths of construction of users engagement in the two cities: in Trento, the engagement has been a constant activity, e.g. involving students since the beginning in a sustained way through their university courses, without any particular promotion through traditional media; in Rovereto instead, the launch of the application was celebrated by a press conference of the mayor, with all the local newspaper talking about it. We will see later how users' engagement with the apps has had different trends, supporting the thesis that a continuing work is more fruitful in the mid to long-term than a strategy based exclusively on the press and broadcasting

communication.

In order to discuss ViaggiaTrento as a case of public design of digital commons in urban places, the following paragraphs are organized as follows: first, we will show how we have identified matters of concern for the student population; secondly, we will describe the functionalities and interface of the application; thirdly, we will present the different engagement strategies enacted in Trento and in Rovereto; fourthly, we will compare the trends of downloads of the two apps; finally, we will discuss two forms of direct users engagement, one that is not recursive and one that seems to be recursive.

4.1. Identifying matters of concern

[6] At the beginning of the Smart Campus project, we needed to identify matters of concern able to promote of the emergence of a public oriented to the common urban living. To achieve this result, we applied several user-centred design techniques to investigate and collect the needs of stakeholders and particularly of the students of the local University campus. In order to make a meaningful contribution to their daily lives, we focused on identifying what issues were negatively affecting their daily experience of academic life. In practices, our activities focused on what concerned students, that are their "matters of concern", the basis of public design as we defined it here. Several activities such as focus groups, diaries and workshops were put in place, involving 60 bachelor and master students overall. Commuting resulted to be one of the less pleasant moments in a student's day: in fact, the location of scientific departments in a suburb forces students to reach them typically by bus. Moreover, most of the students live beyond walking distance from the city centre and the departments, due to economic factors and to the location of the main student houses. Issues reported by students were also related to travelling around the urban area: Trento is in fact a medium-sized city (115,000 inhabitants approximately), composed of an historical centre and of several suburbs spread over the surrounding hills and along the river Adige, thus covering a rather large territory (158 kmq approximately).

Students reported the unreliability of transport, as local buses are often late. Moreover, a generalised lack of knowledge about timetables, location of bus stops and routes of each line often hampers the usage of public transport,

[6] An earlier version of this section has been presented at the Urban Sustainable, CollaboratIve, and Adaptive MObility Workshop as part of the 11th International Conference on the Design of Cooperative Systems (COOP 2014).

Figure 1: Homepage of the ViaggiaTrento app

even though students expressed their intention to use it; a related limitation consisted in the absence of a unique point where to find this information altogether. Referring to the five needs mentioned before (Carr, 1992), the transit system did not look comfortable or relaxing and, therefore, it constituted a good starting point to engage people in our design activities. We also performed a benchmarking phase, in order to relate the needs to limitations and strengths of existing mobility apps available in other urban environments; after that phase, we tried to address these concerns by making relevant transit information easily accessible through the ViaggiaTrento mobility smartphone application. The project team designed its concept in spring 2012, with the involvement of the Municipality and of the local transport company as additional stakeholders. ViaggiaTrento, whose homepage is represented in Figure 1, provides several functionalities, which will be described in the following paragraph.

4.1.1. Functionalities and Interface

ViaggiaTrento allows planning of trips over different means of transport (Figure 2 and Figure 3): entering the departure and arrival addresses and the intended departure time, the system will suggest different travelling

options, automatically combining different means of transportation (local trains, buses, car sharing, but also personal car and walking). The system is able to take into account user preferences, such as the most frequently used means; and characteristics of the preferred travel, such as shortest walking distance, least number of changes, and fastest route.

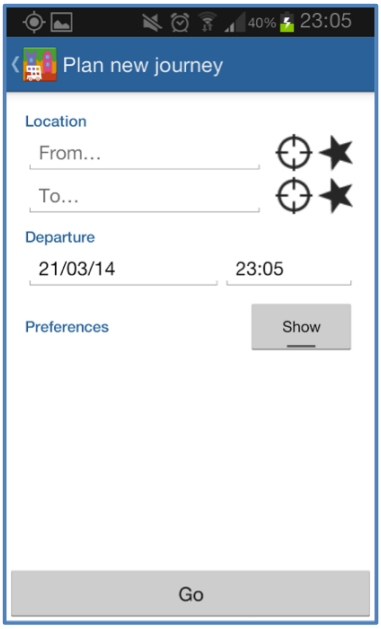

Figure 2: Journey planning functionality

Figure 3: Details of a proposed route

Users can also save their recurrent routes (Figure 4), such as the path followed while commuting: by specifying a limited time span, they can then receive push notifications on their smartphone in the case a delay or service interruption affects their route. Moreover, the app can provide real-time information about the availability of slots in the public parking lots of the urban area (Figure 5), which are equipped with sensors. Parking lots are listed by increasing distance from the detected position of the user for easier consultation.

The app relies on the active participation of travellers in order to provide real-time, accurate information on delays. Users standing at a bus stop or train station can broadcast a delay notification through a quick form (Figure 6), specifying which ride they are waiting for and how late it is; the notification is then propagated to all users monitoring the same ride,

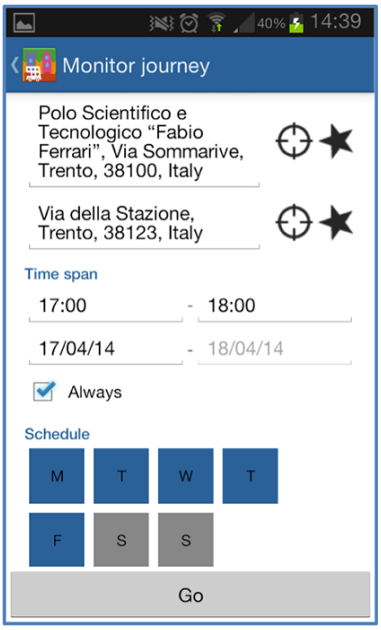

Figure 4: Monitoring of a recurrent route

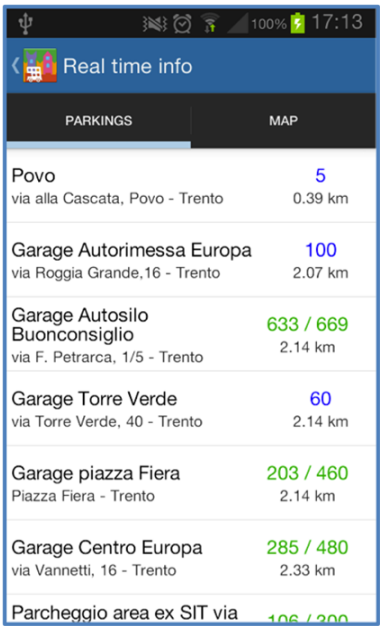

Figure 5: Availability of parking slots

or whose journey would be affected by the delay. This information is also shown on the timetables for urban and extra-urban buses and local trains, which the app gathers all in the same place (Figure 7). This collaborative practice among travellers allows ViaggiaTrento to provide information that is not even available to the local transport company itself.

4.1.2. Fostering Public Engagement

ViaggiaTrento was first released to the students attending the HCI class at the Department of Information Engineering and Computer Science (N = 90) in October 2012. In this way, our seed base of users was introduced to the Smart Campus project as a real-world application of the methodologies and techniques taught in class; furthermore, their particular area of learning allowed them not only to provide feedback on existing artefacts, but also to generate, design, and code new services for their own needs. This activity resulted in a large amount of qualitative feedback, which was analysed by the Smart Campus team in order to derive suggestions for improvement which were then integrated into the app; proposed functionalities included, for instance, timetable checking, which had not been foreseen in the original design of the app.

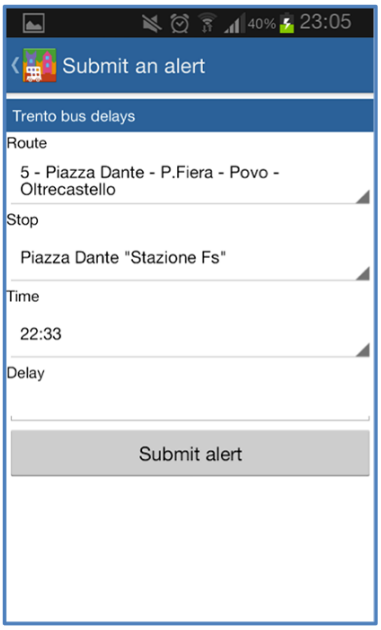

Figure 6: Form for delay notifications

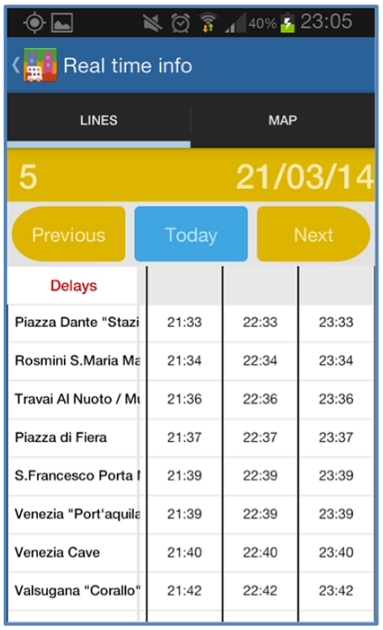

Figure 7: Timetables of the local buses

We underline once more that, during this phase of evaluation of the existing apps and participatory design of new concepts, the activities were ongoing. In particular, for what concerns the social component, we focused our efforts on seeding a group of users starting from the HCI students: to this end, several communication channels were set up to decrease the gap between designers, developers and users (Pipek and Wulf, 2009) and to allow students to directly provide their feedback to the Smart Campus staff. These channels ranged from forum, social networks and a bug tracking system to personal diaries, face-to-face meetings and questionnaires. Through these communication channels, students communicated with the Smart Campus staff, reporting technical and usability bugs, but also giving their opinion on possible improvements and new functionalities. All these suggestions were collected and used to progressively refine the apps, accommodating the suggestions coming from the forming Smart Campus public.

A similar study was performed again one year later, in fall 2013, involving the new computer science students attending the HCI class (N = 117): ViaggiaTrento was at that point much more mature, hence the activities performed with the class were more geared towards boosting the engagement of

other students into the collective and applying participatory design methodologies rather than on applying HCI knowledge to improve the design of the apps. Nevertheless, we obtained further qualitative and quantitative feedbacks from the students, which were once more analysed and implemented.

The students have now been using ViaggiaTrento for almost two years. However, after a few months of users testing, we realised that the app seemed to be stable and usable enough for it to expand its user base beyond the initially seeded group of people. Therefore, in collaboration with the Municipality of Trento, we released ViaggiaTrento on the Google Play Store in October 2013, thus making it available to all the inhabitants and not only to students. In the same period, the nearby Municipality of Rovereto expressed interest in the Smart Campus project. The territory of this city is smaller, covering only 50 kmq, and counts a population of less than 40 thousand people. Leveraging on the now available technical infrastructure, we created a customized version of the app called ViaggiaRovereto and released it on the Google Play Store. In this case, the Municipality was available to provide us with more data: therefore, ViaggiaRovereto also informs people about public notices regarding mobility issued by the Municipality and concerning, for instance, detours or roadwork.

Given this favourable context, we once more adopted a participatory design approach in order to try to fit the app even more to people needs: this time, however, we involved a different group, thanks to the collaboration with a technical high school in Rovereto. Many pupils commute to this high-quality institute from all over the Province and from nearby valleys, and some even live in student houses during the week. A group of approximately 30 third-year students (16-17 years old) were introduced to the basic concepts of usability, evaluation through field studies and scenario prototyping; then, they were asked to try out ViaggiaRovereto in their daily life for a month. At the end of this period, students had come up with a variety of proposals about functionalities they felt necessary, including for instance the possibility of planning a journey by specifying the intended arrival time rather than the departure time. Proposals also addressed the interaction design of the application: for instance, one of the students suggested prompting the user for delay notification rather than relying on his motivation to actively open the relevant form, as this would facilitate user contribution and result in increased collaboration.

4.2. Downloading the app

Since the publication of ViaggiaTrento on the Google Play Store, we have been witnessing the growth of a critical mass (Figure 8). Active installations raised from 20 to 171 within a week from the publication, reached 232 by the end of the month and kept on growing steadily during the following months. A small peak occurred around mid March 2014 as a new class of students entered the evaluation of the Smart Campus apps; a more evident peak occurred around mid May 2014, when the Smart Campus staff organised a contest where teams of students were invited to present their suggestions for improving community involvement in the project: the number of installations grew from 643 to 752 within ten days and kept on growing steadily since then. As of June 9th, 2014, we have reached 886 active installations of the app over 1415 total downloads (63%); the average rating over 64 reviews is 4.5 out of 5.

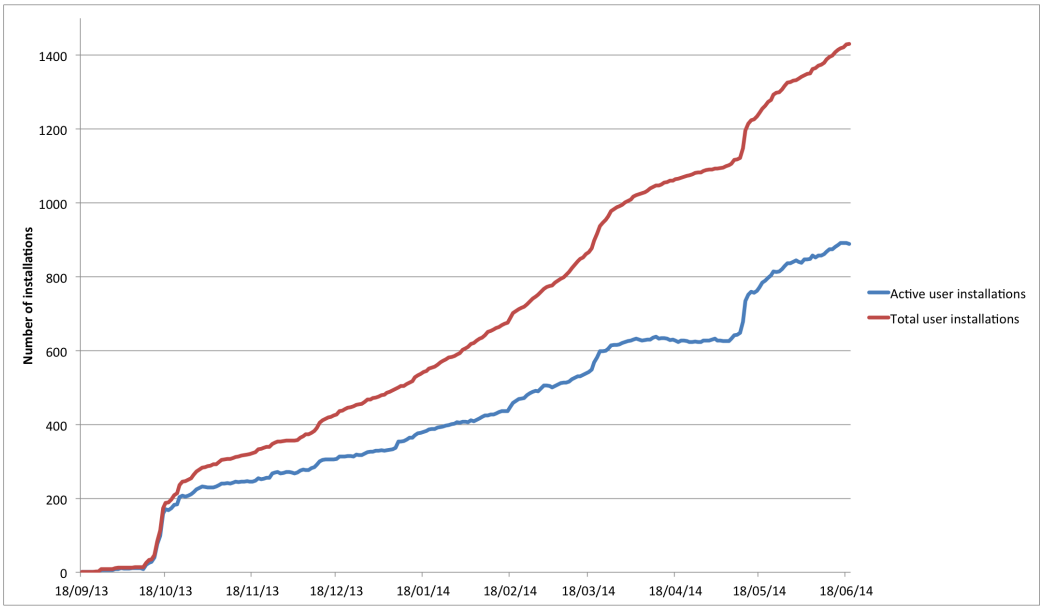

Figure 8: ViaggiaTrento installations over time

This is indeed a good result if compared with the other apps about Trento available on the Play Store: only four of these urban mobility apps, in fact, exceed a thousand downloads. The most downloaded one is the official app developed and advertised on buses by the local transport company: launched in January 2014, it has more than 5000 users, but shows the very low rating

of 2.7 on the Play Store and rather negative comments overall. The other three apps we take into account all have between one and five thousand users; however, one of them only provides information about events in town, while the others only provide a subset of the ViaggiaTrento functionalities (e.g. timetable checking, journey planning). The rating of all these three apps is anyway below 4 out of 5. These results seem to suggest that the design activities conducted at the beginning of the project and the overall process of involving students have been helpful in delivering a satisfactory user experience.

ViaggiaRovereto was released on the Google Play Store around mid October 2013 as well, reaching around 300 active installations within the first two weeks (Figure 9). However, the number of installations has been growing little since then, topping approximately 400, but overall remaining almost stable. As of June 9th, 2014, the app had reached 324 active installations over 660 total downloads (49%); the average rating over 33 reviews is 4.5 out of 5. In this case, no other app about urban mobility or urban events appears to be available on the Play Store for comparison.

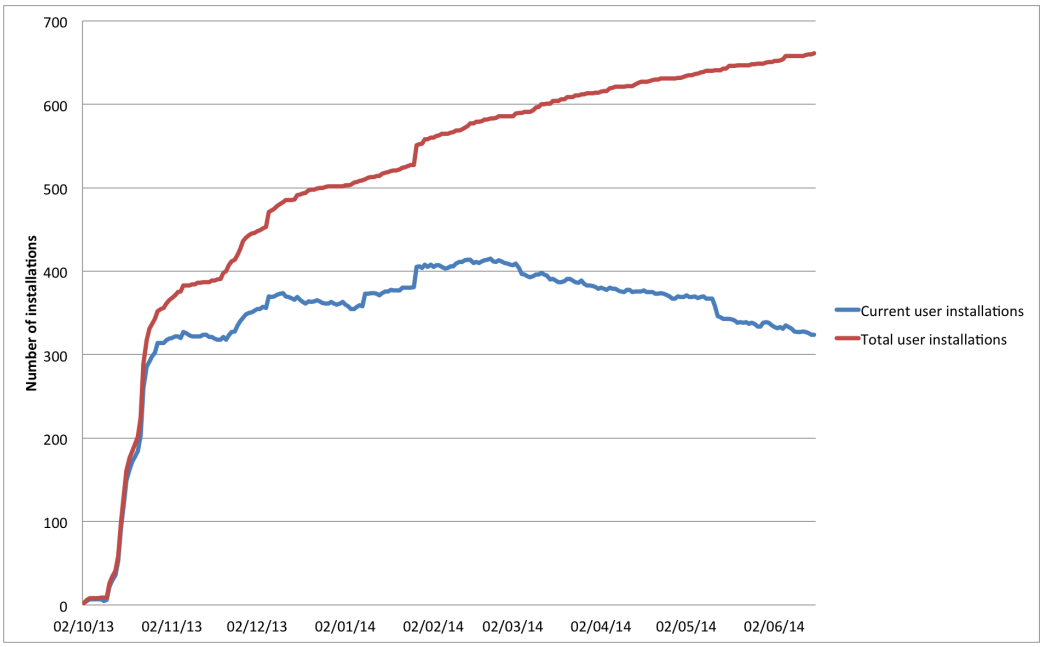

Figure 9: ViaggiaRovereto installations over time

Given the good results in terms of the number of downloads and ratings of the two apps, we feel that the requirements expressed by student commuters reflecting on their travelling experience with local transport were indeed representative of the needs of the local population with respect to transport. We need to underline, however, that the establishment of an underlying social and technical infrastructure and of a local institutional support were both instrumental to ensure that ViaggiaTrento could really make a difference on the daily life of people. This can be clearly seen by comparing the trends of the number of active installations of ViaggiaTrento and ViaggiaRovereto. In the first case, the increase in the number of installations was constant until June 2014, except for a few weeks of stability between April and May 2014. ViaggiaRovereto seems to have followed a very different path: the number of installations grew very rapidly in the first days after the release, more than for ViaggiaTrento; however, it then came to a slow arrest, reaching just 400 and then steadily dropping.

4.3. Getting information

We have analysed available data about the frequency and context of train and bus timetable checking in the case of ViaggiaTrento. First of all, we can see that, after a peak immediately following the launch of the application, the activity around the app is still sustained. Timetable checking is an action that is only occasionally performed, typically when the user already knows which bus or train line to catch, and just wants to make sure about when to do it or at which stop it would be most convenient. Given this, the fact that there is an almost permanent group of 20 users every day checking the timetables through ViaggiaTrento makes us confident that the user base is consolidating around the app (Figure 10).

Since the release of the ViaggiaTrento app on the Play Store, the timetables have been checked 1189 times. We have broken up this result to see what kind of timetables were most frequently checked (Figure 11): those related to the urban buses in Trento are understandably the most frequent ones, followed by the Bolzano-Verona and Trento-Bassano del Grappa train lines, and finally by the Trento-Malé railway, which connects the city with one of the nearby valleys. Given that the large majority of timetable checks concerns urban buses, we can see that the related trend mirrors the general trend of timetable checks quite closely, as can be seen in Figure 12.

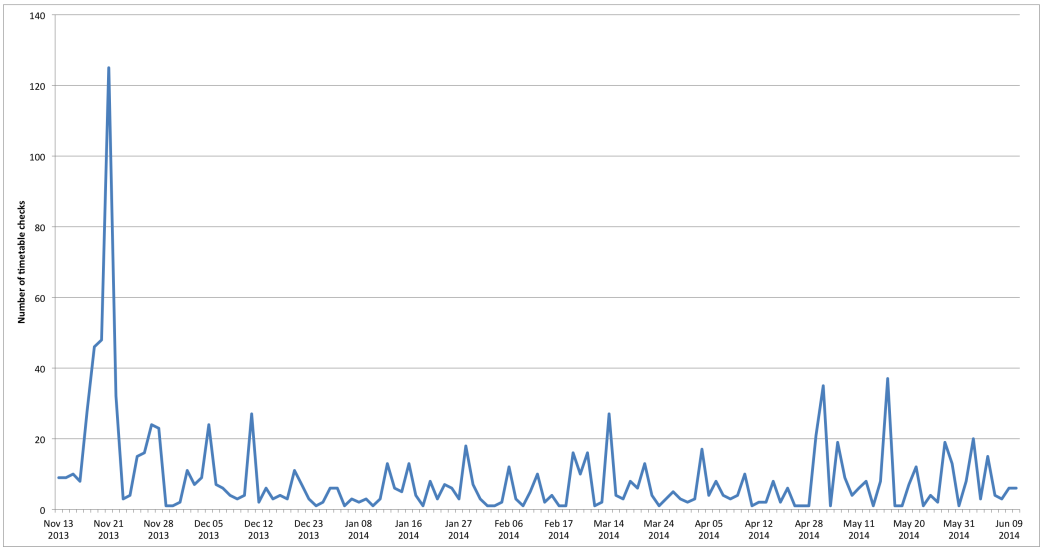

Figure 10: Total timetable checks in ViaggiaTrento

We then moved to a more fine-grained analysis, trying to understand how the frequency of timetable checking related not only to the kind of means of transport, but more specifically to the different transport lines. From the chart in Figure 13, we can see that the most checked timetables refer to bus line A, which covers the whole urban centre including the old town area forbidden to cars, bus line n.5, which connects the city centre with the scientific university departments, and to local trains. This is likely to indicate that the majority of the collective is still composed of students, but that there are indications of a contribution also from other people: interestingly, in fact, the trend of timetable checks for line A is very similar to the general trend of timetable checks, as shown in Figure 14.

Finally, we have also been looking at the distribution of timetable checks according to their corresponding stop (Figure 15). We noticed that checks are very concentrated around the local train station (stop 247), which also corresponds to the major urban bus junction: the trend of timetable checks there closely mirrors the general one and the one for the urban line A (Figure 16). Timetable checks are also very frequent around the train station in Bolzano, a large city near Trento from where several students commute daily.

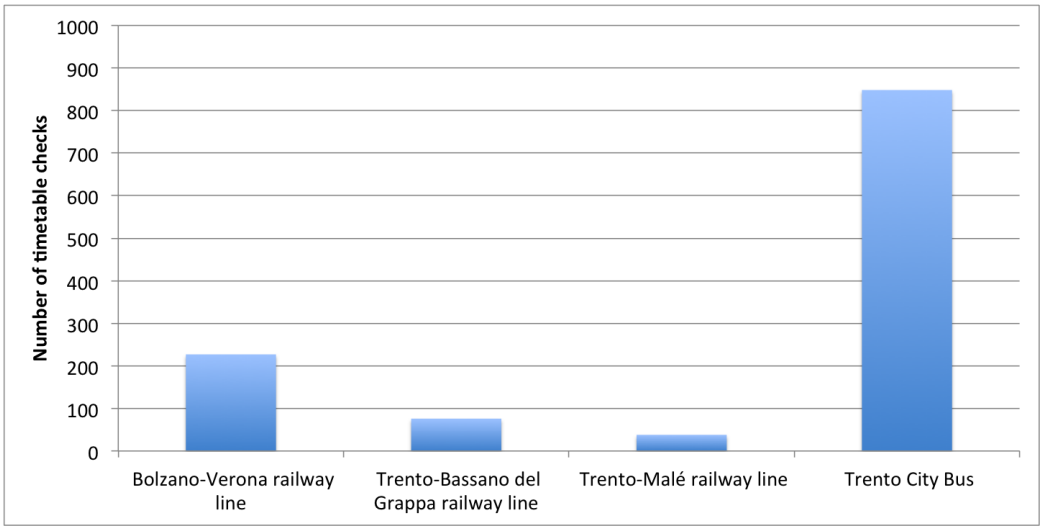

Figure 11: Timetable checks per transport agency

In the case of ViaggiaRovereto instead, we realised that the timetable checking activity was very low, whereas the main form of opportunistic use was checking traffic-related public notices (about roadworks, detours, etc.), suggesting that users of ViaggiaRovereto rely more on private means of transportation (automobile, bikes, motorbikes) than on public transport (Figure 17).

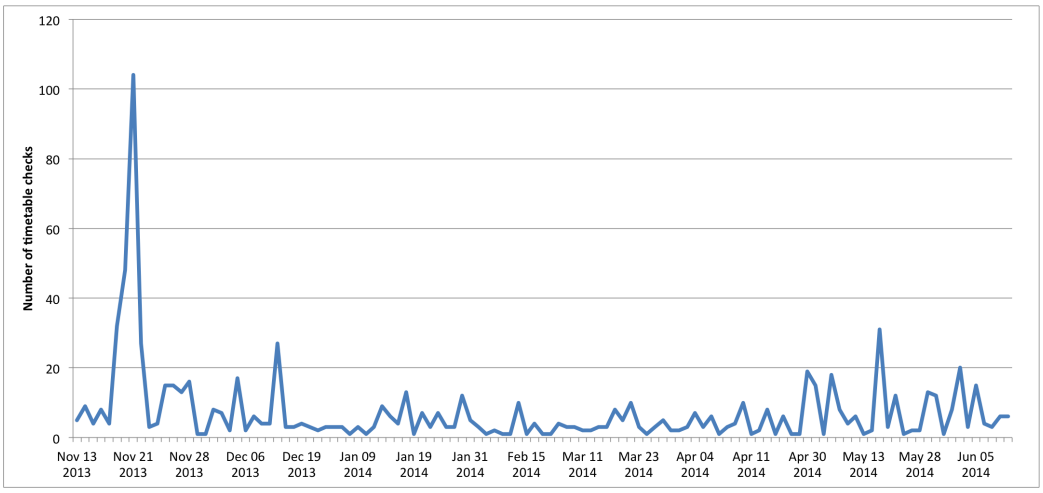

Figure 12: Timetable checks for the urban bus

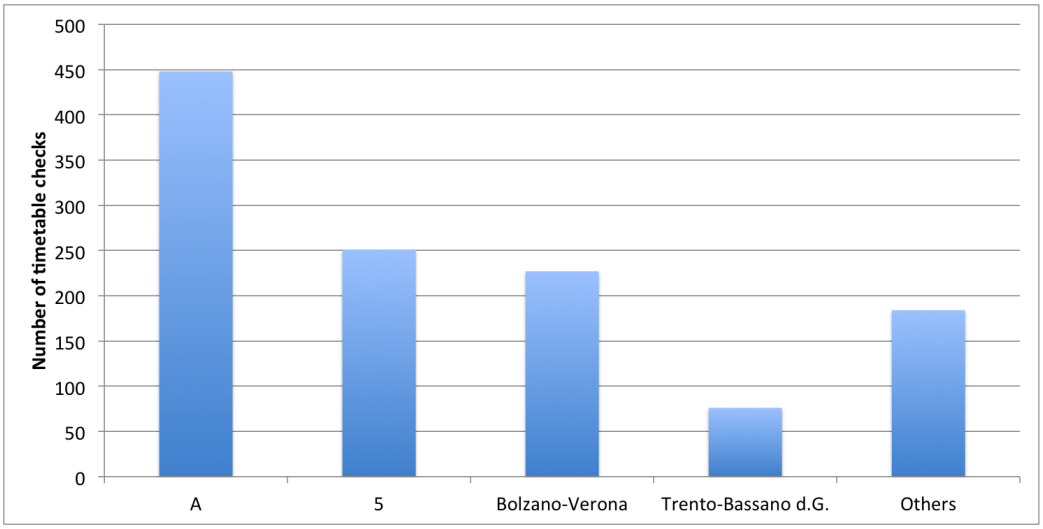

Figure 13: Timetable checks per line

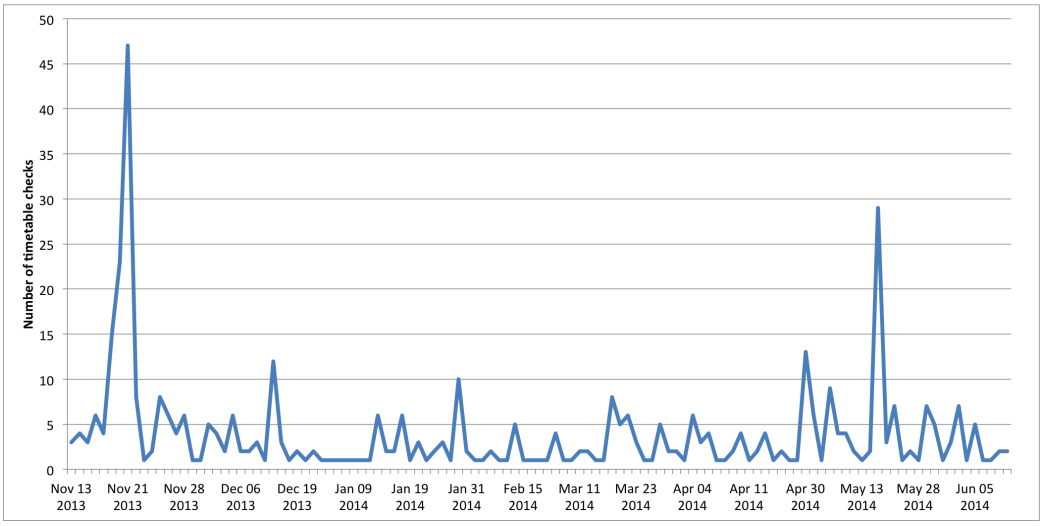

Figure 14: Timetable checks per line A of the urban bus

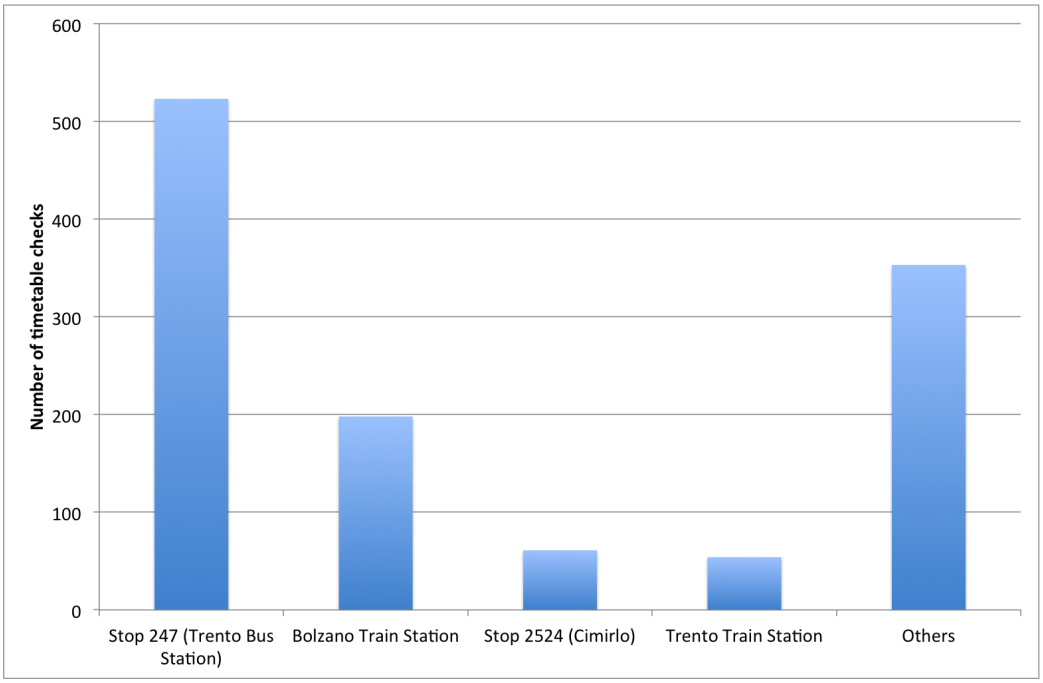

Figure 15: Timetable checks per transport stop

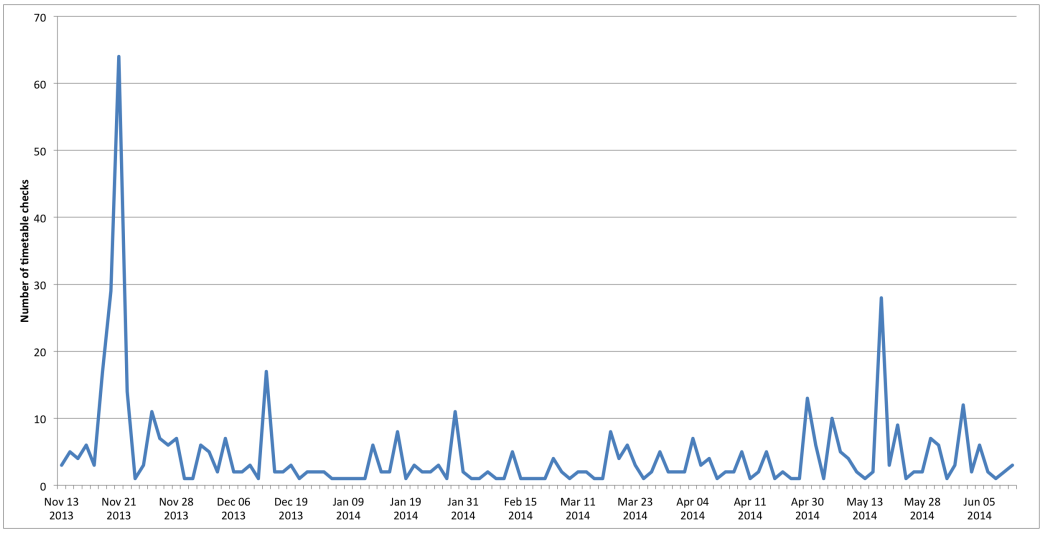

Figure 16: Timetable checks at the Trento bus station

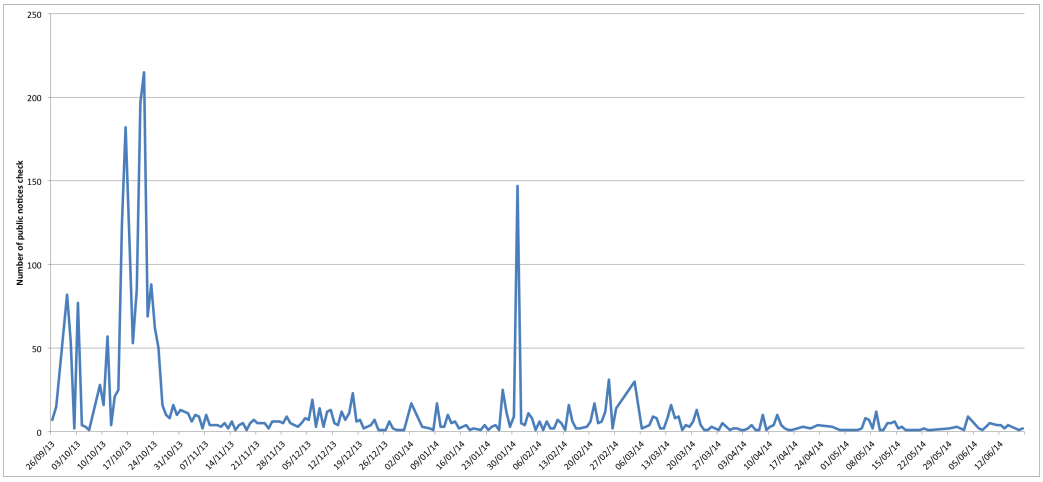

Figure 17: Public notices checks in ViaggiaRovereto

4.4. Delay notifications

In this section we reflect on data we gathered about the usage of a specific functionality of ViaggiaTrento and ViaggiaRovereto, that is the broadcasting of delay notifications: in our opinion, in fact, it can be indicative of the activity of the users and of the differences between the user bases of the two apps. As soon as users experience a delay in public transport, they can fill in a dedicated form (Figure 6) and broadcast this information to other users. We compare and contrast the number of delay notifications issued until June 19th, 2014 in ViaggiaRovereto and ViaggiaTrento (in this case distinguishing the version of the app that was publicly released since the beginning from the one used by students for testing).

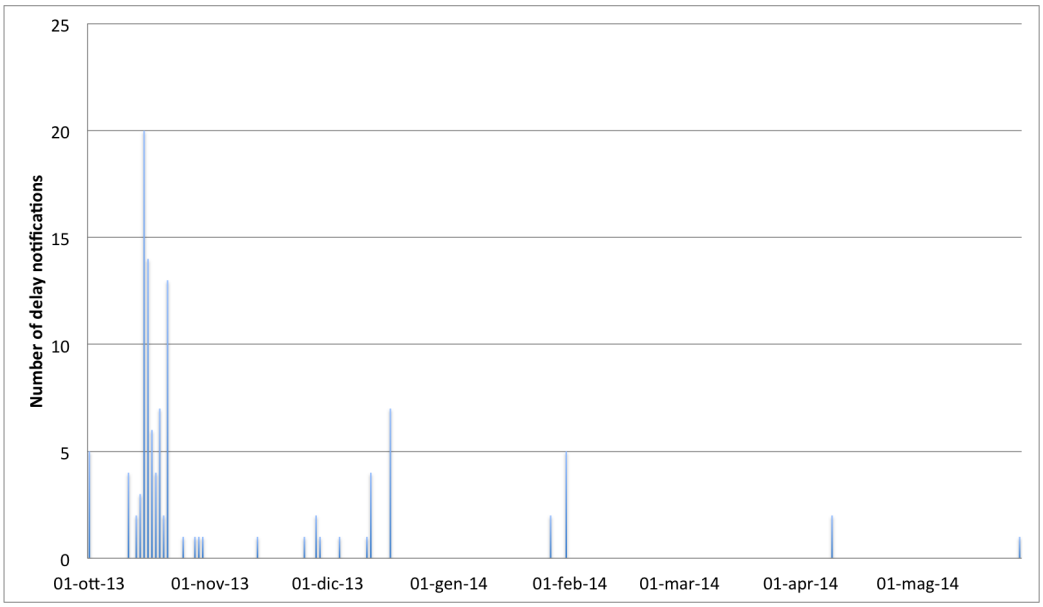

Figure 18: Delay notifications in ViaggiaRovereto

Similarly to what shown by the charts about the number of installations of the apps (Figure 8 and Figure 9), we can see that the ViaggiaRovereto collective is indeed less lively (Figure 18): its involvement appears to fade progressively after some time from the public release of the app. In the case of ViaggiaTrento instead, we witness once more the existence of a consolidated user base contributing content to the app (Figure 19 and Figure 20); furthermore, we see another indication of the large proportion of students

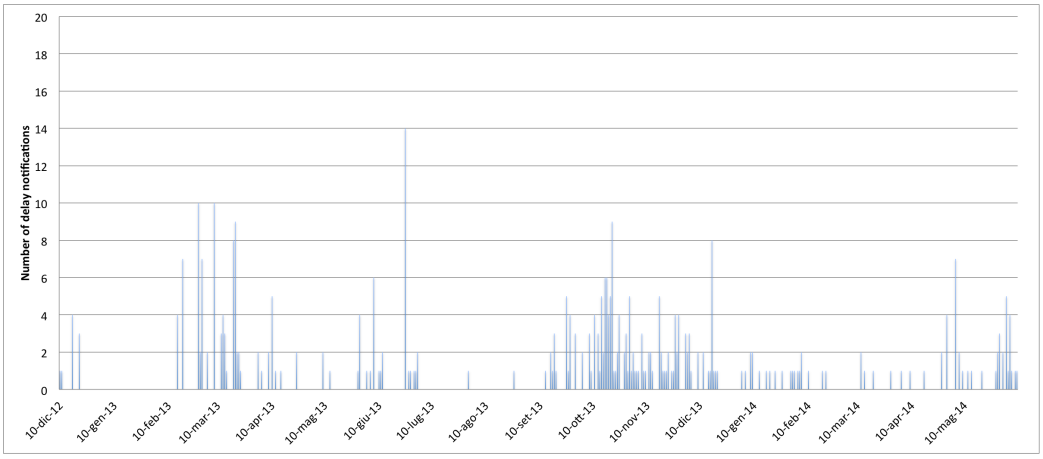

Figure 19: Delay notifications in ViaggiaTrento

in the collective, suggested by a seasonal trend in participation related to university breaks and examination periods.

We also reflect on the proper content of the charts, i.e. how often users report public transport to be late. This information can be better interpreted in light of what stated by the local transport company in their corporate social responsibility report of 2012 [7], which is the most recent one where the topic of the offered and perceived quality of service is discussed. In response to an explicit request issued by the Municipality of Trento about reducing the cost of public transport, the company operated a general reduction of service, and reported that 63% of local bus rides was on time; no information was instead provided about Rovereto. Such data was then compared with the quality of service perceived by citizens through a series of interviews carried out by the company: 300 people were interviewed over the phone, while another 200 were interviewed in person. In the first case, the local mobility service is rated 6.8/10 in Trento and 7.9 in Rovereto; in the second case, it is rated about 7.7 in both cities, suggesting that the timeliness of public transport is indeed a concern for our collective. A space to stimulate a deeper engagement with the technological infrastructure therefore emerges.

[7] http://www.ttesercizio.it/Public/Bilanci/2012/Bilancio%20Sociale%20e%20Ambientale%202012.pdf

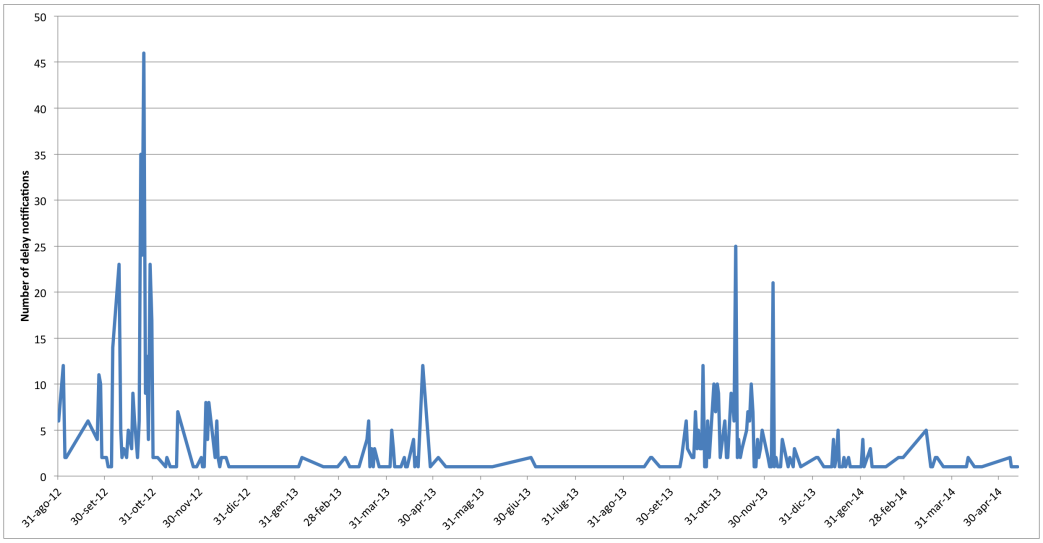

Figure 20: Delay notifications in ViaggiaTrento (students' test version of the app, discontinued after release on the Play Store)

4.5. Recursive engagement

Dialogue between the Smart Campus Lab team and users was channelled through an online forum and virtual diaries: here students wrote spontaneous comments regarding all of the Smart Campus apps. The forum was opened on 7th November 2012 and, by 18th June 2014, it contains a total number of 92 threads about ViaggiaTrento and 382 replies. The first diary entry was written on October 2012: 115 entries here concern ViaggiaTrento and 15 concern ViaggiaRovereto. In this analysis, we only focus on the content of forum threads about ViaggiaTrento, as they constitute the most lively source and show the emerging topics in a dynamic of sustained engagement of users.

Posts are generally initiated by users; the conversation flows between users and Smart Campus developers and tends to finish with comments by developers in which they thank users for their contribution and write that their issue/suggestion will be considered. However, the current design of the forum does not support users' awareness on how their reports and suggestions are being considered and whether they will actually become part of the design/implementation of the technology. In the last months there seems to be an increasing tendency in open posts (e.g. posts which end up with an issue which is not answered by anyone, or suggestions which do not receive any feedback), showing how sustaining the construction of a public is a non

Theme	Definition	Threads	Replies
Bug reporting	Errors related to software flaws	17	28
Device issues	Runtime errors related to technical problems	21	80
Data issues	Problems related to inconsistent or outdated data	8	33
Help request	Information request on how to use a feature or functionality	5	10
Suggestions	Ways to improve existing functionalities or add new ones	21	108
Communications	General communications from the SmartCampus project or from users	4	6

Table 1: Themes on ViaggiaTrento in the Smart Campus forum

trivial task that requires permanent commitment.

Conversations on the forum suggest that, in general, students were very positive about the application. Functionalities such as train and bus timetables and parking slots availability were broadly perceived as very useful. Time optimisation and enhanced awareness of information regarding transportation and parking services in the city are perceived as the main added value of using ViaggiaTrento.

After performing a thematic analysis (Smith, 1992) of diaries and posts in the forum, we identified seven main content categories: bug reporting, device issues, usability issues, data issues, help request, suggestions and communications.

Bug reporting refers to posts where users describe issues due to app flaws: reports varied in their level of detail, ranging from high-level descriptions of how the error occurred to elaborated reports with representative screenshots and, in some cases, suggestions for solution: *"A few days ago I wanted to send a message due to a delay of the bus, but the application blocked in the loading and subsequently crashed. This did not happen with the other "ViaggiaTrento" application, the one that isn't in the SmartCampus apps. This has happened again on another day."*

Device issues refer to errors due to the smartphone on which the app was running, such as internet connection or GPS localization.

"Hi! When I try to plan a journey the 'current location' under 'select location' tab can't detect my location correctly. Also in 'point in map' it doesn't show my current location, it doesn't even focus anywhere near my location. The focal point seems static. "

Usability issues contain problems related to information architecture, data visualization, and interaction design.

"After selecting a line of urban bus by going to the maps tab, I expect to see a map with the stops of the selected line instead of all the stops without reference to the chosen line, but only to the current position."

Most of the suggestions contained ways to improve the existing functionalities or to add new ones; they often were illustrated with mock-ups and came from everyday life situations, where users were able to identify new needs which could be addressed by the technology: *"There were a lot of us in Povo [the suburb where the scientific departments are located] today, blocked by snow, and the buses were not circulating because they had no snow chains. An imperative, a priority for Journey Planner, would be to allow Trentino Trasporti [the local transport company] first, or the bus drivers themselves, to send notifications and messages to the users."*

"It might be useful to know, as well as if a bus is late, even if it is so full that I could not board it anymore."

Data issues are related to inconsistent or outdated data. Although the number of data issues was not very high in comparison with other categories, it is relevant if we consider that data such as timetables were retrieved from a web service offered by the local transport company itself, and were thus supposed to be highly reliable. Complaints on data highlighted underlying problems beyond the technical implementation: *"Unfortunately it is not a matter of technology , but merely a political one: Trentino Trasporti still does not give us their data despite our pressures and the municipality of Trento ones."*

Help requests are related to posts in which users required additional information on how to use a feature or functionality.

"I tried to create some of them [recurrent journeys] and found several difficulties. After selecting date, starting and arrival place, hour and options, I reach a page where I can select between many different ways, buses, trains to complete my route. The point is: how can I be sure to not keep on monitoring them, if I have never tried them or, simply, if I haven't ever used them?"

Communications mainly concerns communications from the Smart Campus project, such as those informing about new features or upgrades of the app, or from users, such as one noting that bus timetables about the whole Province had just been released as open data:

"New version of ViaggiaTrento released!"

"I have found an error in the bus timetables, present also on the tester version of ViaggiaTrento. The two timetables of line 6 are inverted."

Comments regarding usability, device and data issues seem to become less relevant over time, while comments regarding new functionalities become increasingly frequent. Also, as the applications became more mature, developers progressively tried to actively involve users into the implementation of the Smart Campus app, including ViaggiaTrento. In the last months, developers explicitly invited people to contribute by implementing solutions to the bugs they spotted or by improving existing functionalities. However, no user picked up on these invitations.

Table 1 illustrates the number of threads in the forum, along with number of replies, distributed per category. Communication and clarification are the most unidirectional categories: replies are very short, if any, and no proper discussion is ever engaged. Instead, usability issues and suggestions are the categories which generate the highest interaction: this is probably due to the fact that these are the two categories that most involve the users. It is in fact through usability issues and suggestions that users can indicate how to improve existing functionalities by referring to daily life situations and without referring to more "technical" matters. This is a clear example of tendency to recursivity: as long as the the technical issues are solved, people start to engage with the improvement of the applications including domains of action which were not part of the initial design. The example on the reliability of timetables, which opened the political issue, as well as the suggestions on how to enlarge the collective through the inclusion of other actors such as the local transit company and the bus drivers, are pointing to reflective contribution as able to enlarge the collective to the institutional and political context. It seems therefore that reflective contribution is suggestive of the formation of a recursive public, with people oriented towards improving the means that makes it possible for them to live their common life.

5. Conclusions

In the case of the mobility application ViaggiaTrento, part of the Smart Campus project, we have shown how urban computing applications can be designed in the frame of public design of digital commons. In particular, the recursive path of engagement, with people getting information, contributing through the provision of content like delay notifications, and suggesting changes in the technology itself, has different trends according to the way the relation between the designers and the users has been established. In the case of a broadcast communication, with the strong involvement of the mayor and a press-conference, the trend of use and engagement appeared weak in the mid-term. Differently, a more sustained process of involvement, connecting the use of the application to what concerns people, as university courses, a deep understanding of mobility issues, etc., has proven able to stimulate a stronger and deeper engagement. This first conclusion tells us something on the public dimension of public design: the focus on "matters of concern" is not only a methodological tool but also a way of improving the possibilities of success in stimulating recursive engagement.

In digital commons, like Smart Campus, the theme of recursivity is a crucial one: only through that the focus on specific needs translates into an opportunity to question the wider context into which the digital commons is located. In our case, what shows recursivity are the suggestions to include information on how full the buses are, the politicization of issues relative to the data included in the application, and the suggestion to involve directly the transportation company in the use of the application with specific tasks. In all these cases, users have become co-designers through the communication channels provided by the project. Fostering recursive engagement is for public design of digital commons not only one of the aims but also the statement of the background awareness of designers, who are planning to lose control on the product of their activity. That happens both legally, through the distribution of free software, and socially, leaving the stage to concerned people. The need for constant and sustained work of formation of publics is the main results we bring here, as a necessary premise to the emergence of recursive engagement.

In conclusion, we have tried to establish how this perspective could be beneficial in promoting urban computing, as the city is the place where common living take place, and a common-oriented design perspective could fruitfully intercept concerned people. How, and if, the engagement of recursive

publics is able to connect the specific digital commons to the more general orientation to the common remains as an open question.

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