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MiraMap: A We-Government Tool for Smart Peripheries in Smart Cities

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ABSTRACT Increasingly over the last decade, there has been attention and expectations on the role that Information and Communication Technology (ICT) solutions can play in increasing accountability, participation, and transparency in the public administration. In addition, attention to citizen participation is more and more at the center of the debate about smart cities. However, technological solutions have been often proposed without considering the first citizen's needs and the sociotechnical misalignment within the city, i.e., in peripheral area. This paper outlines the design and implementation process of a we-government IT tool, called MiraMap. The project has been developed in the Mirafiori District in Torino (Italy), a neighborhood, which is characterized by the problems of marginality and by several undergoing urban transformations with a very high potential for social and economic development in the next few years. This makes Mirafiori Sud a valuable case study environment to experiment new methods and IT solutions to strengthen the connection between citizens and public administration. The object of MiraMap, indeed, is to facilitate communication and management between citizens and administration in reporting of issues and claims but also in submitting proposals. Collecting and handling of this information in an efficient way are crucial to improve the quality of life in urban suburbs, addressing more targeted and better performed public policies. In order to achieve those results, we combined First Life, a new local social network based on an interactive map, with a business process management system for easing reports about claims and proposals to be handled. The research process involves an interdisciplinary team, composed by architects, computer scientists, engineers, geographers, and legal experts, with the direct participation of local administrators and citizens.

INDEX TERMS Citizen engagement and smart governance, mobile crowdsensing for smart cities, modeling the social impact of smart technologies, case studies and testbeds for smart cities around the world, applied research in smart cities.

I. INTRODUCTION

A. THE SMART CITY AND THE NEED OF CITIZENS PARTICIPATION

Increasingly over the last decade, there has been attention and expectations on the role that Information and Communication Technology (ICT) based technology platforms such as web-sites and wikis, social media, interactive geo-mapping, distributed sensors, big data but also more traditional solutions such as SMS and voice based reporting can play in increasing accountability, participation and transparency in the Public Administration [1], [2].

The attention to citizens participation and interaction is nowadays at the center of the debate about Smart Cities [3], also because too many times technological solutions have been proposed without considering first needs and usability by citizens. Recently Jimenez[1] noticed that:

- technology should be considered as a tool not as an end (on the basis of defined targets)
- citizens needs in the city must be identified as the target for action (citizens involvement)

Technologies are never neutral and imposing them on a pervasive basis without consultation leads some authors like Calzada and Cobo [4] to argue that it is necessary for the

[1]http://www.slideshare.net/estratic/openness-innovation-jimenez-chiicago

Smart City to be deconstructed to avoid techno-deterministic conditions and to observe how relevant unplugging dimensions can be to social innovation in a more realistic, grounded, and socially equal urban sphere.

The Smart City paradigm is based on making possible new form of social innovation through the use of ICTs. In Caragliu *et al.* [5] a ''Smart City'' is as a city in which ''investments in human and social capital and traditional and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance''.

However, the adoption of new technologies and technological evolution occurs at highly dissimilar rates, suggesting significant socio-technical misalignment within cities, i.e., in peripheral areas [6]. This enlarges the digital divide both in the availability of technology and in the ''ability'' of use technology [7].

Likewise, following Mongomery it can be said that ''it is not too late to rebuild the balance of life in our neighborhoods and cities and, in so doing, to build a more resilient future'' [8].

Therefore, while the construction of social capital requires a place that allows for physical contact among its members, it could benefit from plugged-in artifacts to share and create a sense of belonging. The simple adoption of social networking interactions (i.e., Facebook, Twitter, WhatsApp, etc.) does not imply a direct, positive correlation, nor does it increase the rate of development of a trusting social interaction. A Smart City requires integration between people and social structures through the use of ICT.

B. RESEARCH QUESTIONS

At this point some questions emerge. Notably, we asked: how to create an IT solution for a Smart City to facilitate the interaction between citizens and administration in urban peripheries?

The general aim of our work is to facilitate citizens in reporting claims and making proposals, and the administration in managing them. However, we want also to make administration more transparent and accountable by exposing how reports are managed and to improve the sense of identity and citizenship and thus participation of everyone who benefits from a proper management of public space. Citizens in reporting problems and proposals are transformed in human sensors whose information can be visualized on an interactive map: we thus want to combine crowdsensing with crowdmapping.

The solution must be usable from mobile but also via traditional channels like text messages and phone to increase accessibility of disadvantaged citizens. To avoid the shortcoming of other Smart Cities approaches, in achieving our aim we asked the following research sub questions:

- How to involve citizens and identify city needs as targets?
- How can we combine offline and online environments to create a smarter balance?
- How can we realize a citizen-centric oriented service through crowdmapping?
- How to evaluate the impact of the solution?

II. CONDUCTING THE CASE STUDY

In order to address the research questions mentioned above, we conducted a case study research as a method to design and develop our application, according to the principles of design for social innovation [9]. Notably, we focused on Mirafiori Sud neighbourhood, which is a peripheral area of Torino, to collect requirements and to design and implement the MiraMap platform. In the next sections we will describe the social and economical context of Mirafiori Sud and we will give details of methods applied in the case study to identify the features and functionalities needed in MiraMap.

A. THE Mirafiori Sud DISTRICT IN TORINO

Mirafiori Sud, due to the presence of the FIAT plants, is the italian equivalent of Detroit during the economic boom, which subsequently lost power due to the employment market crisis which led to the drawing up of new manufacturing areas. Nowadays, the District shows several conditions that deliver a sharp picture of the contemporary Turin, interesting as paradigmatic of many post-industrial cities in Europe and North America. The existing housing development is the result of a project for a quickly growing city, defined with a successful vision but realized with inadequate financial resources and in a too short time: low quality of buildings, often inadequate for contemporary requirements and expectations in terms of efficiency and size; a social fabric in need of younger generations; a poor level of services; public spaces with an high unexpressed potential, with agricultural and green park areas of relevance to the local and urban scale. The southern area of Turin - and particularly Mirafiori Sud - due to its high potential in terms of social and economic development, has already started an important strategic change: in the next future it will be the target of several transformations, with an interesting mix of private top down initiative, public support, facilitation and management and bottom up social enterprise experiments. This will give a sparkle for services and housing demands, a new micro economy and urban polarity.

Furthermore, Mirafiori Sud is an active neighbourhood, with dwellers keen to participate into the urban transformation projects, in order to overtake the actual situation of crisis and poverty. A rich and lively network of local associations support them in this sense.

B. A TWO PHASES CASE STUDY

The case study in Mirafiori Sud has been structured in two phases. First, the research group from Politecnico di Torino developed, through a participatory approach, a simplified prototype within the project called Crowdmapping Mirafiori Sud, involving citizens with different age and

technological skills in mapping problems, proposals and positive aspects of their neighborhood. Secondly, in 2015, the group, together with the colleagues of the University of Torino, implemented an innovative solution, MiraMap, to make citizens interact with public administration. The novelty of the approach stands in connecting a new local social network based on an interactive map, called First Life, with an open source Business Process Management system (BPM). Therefore, MiraMap architecture has:

- an interactive map, which is used by citizens to report claims and proposals located in the neighbourhood and to make those visible to everyone;
- a BPM used by the administrative staff to manage claims and proposals. The map automatically shows the progresses of the administrative processes as the workflow proceeds in the BPM, and it provides citizens and policymakers with a comprehensive view of problems and opportunities of the neighbourhood.

The presented applied research contributes to give an operational answer to the arising demand of citizens, institutions and to fulfill the gaps in current implemented policies.

C. THE PILOT: CROWDMAPPING Mirafiori Sud

Since 2013, thanks to the international student design competition *Tur(i)ntogreen farms in a town* (www.polito.it/turintogreen), the Politecnico di Torino established strong connections and institutional relations with the local Authorities and multiple stakeholders in the Mirafiori Sud neighbourhood, i.e. the Fondazione della Comunità di Mirafiori Onlus and the City Council District. Therefore, the successful collaboration over the years among the Politecnico di Torino and the Mirafiori Sud District in the field of urban regeneration has being ensuring the project significant impact and results. In continuity with one of the research lines of the Politecnico di Torino, mainly focused on emergencies and fragile contexts, the pilot project Crowdmapping Mirafiori Sud (www.polito.it/mapmirafiorisud) was put in place in the neighbourhood. The project, granted with 5 × 1000 funds from Politecnico di Torino, involved the academic (including students) and the local community in a participative and inclusive process to identify and categorize returning information on a geographic map the nature, the location and consistency of the obstacles/barriers which prevent vulnerable categories to access and use the public space. In order to allow an easy crowdsourcing of data and the total transparency of their diffusion [10], the open source platform ''Ushahidi'' (developed in 2008 in Kenya to map the violence in the post-electoral period) has been adopted and customized. One of the key aspects of Ushahidi is the possibility to use mobile phones as a mean to send reports and receive updates, not needing an internet connection, which is not always available. Outcomes of data collection were published, widely presented and made available to local authorities. This crowdmapping process has been useful not only to sensitize population and to define the state of the art, but mostly to share and interpret the results, analyzing the problem from the point of view of the community, the public actors and the scientists, in order to hypothesize active and participative solutions [11].

1) METHODOLOGY AND TOOLS IN THE PILOT PHASE

The project has been developed from April to October 2013, through the following phases:

1) **Kick off**. A necessary phase of identification, contact and meeting with the local actors and representative of the categories identified as ''vulnerable''. After the launch the students group planned meetings with both civil society's representatives and public administrators in order to better explain the project, advertise it and gather consensus to form a group which would have then make the first signals (see Fig. 1).
2) **Definition of Criteria**. Starting from the interaction with local actors through a series of transect walks, and ending with a reflection on criteria, categories, standard identification of the phenomena to be signaled, for a coherent achievement of a data base. The formed group took some transect-walks along the neighbourhood in order to better understand the area, let the involved people discuss and transmit their knowledge and finally start looking for obstacles. The willingness to involve people since the first steps is innate in the nature of the project, which does not want to have fixed

FIGURE 1. Kickoff meetings.

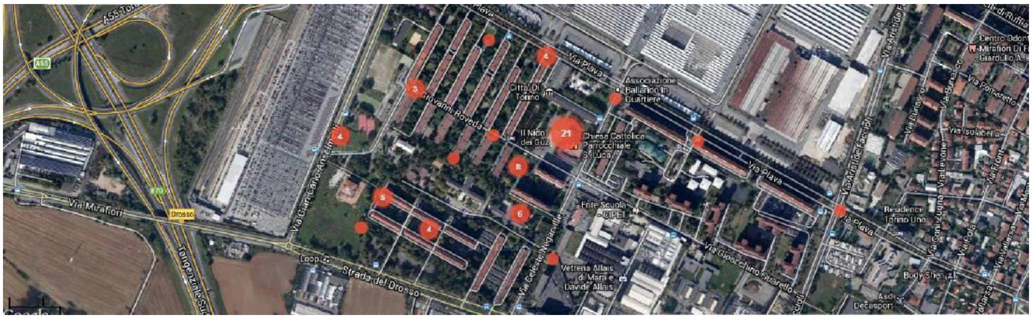


FIGURE 2. The map on Ushahidi.

prejudiced but it would like to look at the real obstacles for whoever lives the neighbourhood, either them being physical, mental, intellectual or visual.

3) **Set up**. Starting from inputs acquisition from the local actors. Setting of the Ushahidi platform for a better response to the project's goals. In order to better improve the system, a website was designed to host all information and news. An email address, a telephone and an SMS numbers were also provided, to allow civil society and public administration to have all the means to get in contact and send their posts. As long as the aim of the project was to create and to use an instrument which has to be affordable, appropriate and easy to use, the team decided to implement the use of SMS to send information, which could be done by any mobile phone, both basic ones and smartphones (see Fig. 2).
The iXem Labs, a component of the Department of Electronics and Telecommunications of the Politecnico di Torino, which field of activity is mainly related to wireless systems and networks, radioplanning, radiofrequency propagation and high frequency electromagnetic compatibility, created a system which could send SMS direct to an email address. The system is based on the Arduino, a low cost open-hardware platform with the addition of a GSM/3G shield. The platform is connected to Internet by means of Ethernet connection. It may be also possible to set up a 3G connection in case of absence of Ethernet connectivity. Once an SMS has been received, the program performs two automatic actions, it forwards the information to the Maps platform and sends an alert via e-mail to the administrators. Afterwards the Platform takes in charge the information received from the Arduino and with an automatic procedure it publishes the reporting on the Map. The new message is not public yet waiting for the approval by the administrators. In order to improve the reliability of the system, the Arduino platform logs all the data and actions on a local SD such that even in case of failure of connectivity it is possible to recover all data locally. Furthermore it is possible to query the SIM card, by means of special string sent via SMS, in order to retrieve information about: status of SMS storage capacity, ask to re-send a particular SMS, delete all SMS, automatic reply, etcetera (see Fig. 3).
4) **Training**. With the support of the Fondazione della Comunità di Mirafiori, a group of 30 inhabitants was selected for collecting data on the area, and stimulating the 'crowdmapping' effect. A period of training was conceived in order to understand how the platform works and how to send information by the means of SMS, emails, phone calls and website.

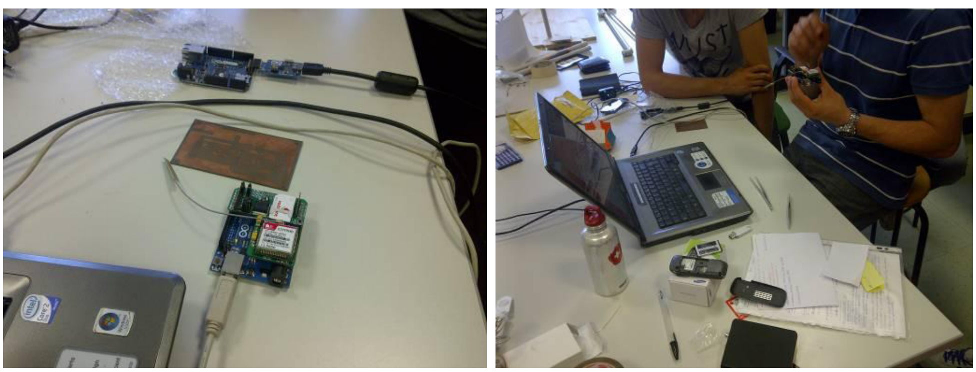


FIGURE 3. The Arduino-based system set up by iXemLabs (Politecnico di Torino).

FIGURE 4. Data collection.

5) **On field data collection**. The data collection began through a direct analysis, with the representatives of the interested categories, and an indirect analysis based on the received inputs on Ushahidi. During June and July 2013 the group formed by the university students and the involved citizens made different data collections in the neighbourhood, sending information direct from mobile phones, app and computers to the Crowdmapping Mirafiori Sud Website, email and numbers. Once the information was received, it was checked for approval and then, if appropriate, was made visible on the map (see Fig. 4).
   In the meanwhile, an analysis of data was needed, in order to understand the weak points and to discuss with people. The analysis was organized with all the involved people using more traditional ways such as meetings, in order to gather other important information which could be seen on both the map and the website. This process was important to enhance participation, involving people from the first to the last steps.
6) **On line**. Once the data collection was completed, the elaboration and dissemination phase took place through preparation and distribution of the material (reports, videos, photos, etc.) to all the stakeholders involved in the project.

Final results of the crowdmapping over 3 months-data collection long had been 63 reports, of which 47 were about claims and 16 about proposals on the use of public space in Mirafiori Sud.

In conclusion, ''Crowdmapping Mirafiori Sud'' had experimented a possible application of participative methods and techniques, via:

- the set up of a low-cost smart system accessible to everyone;
- the set up of a partnership constituted by Civil Society, Public Administration and representatives of Non-Profit Sector right from the early stages, i.e. from the identification of problems and their classification, that can support and guarantee administrative social and technological transformation;
- the training and capacity building process - in relation to the use of the technology - for the identification, mapping and reporting of key factors connected to existing or potential problems;
- the capacity of all the players involved to promptly access data and to offer an immediate and transparent response to reports received;
- the availability of a decision making support tool, not only in response to single/specific problems, but also for planning district scale interventions.

The second phase project MiraMap has moved from these insights. A further and indirect achievement of ''Crowdmapping Mirafiori Sud'' that has contributed to move to MiraMap has been the setup of a social network of key actors and stakeholders interested in producing projects and actions with high social impact on the area, with a strong characteristic of innovation and sustainability. Since Crowdmapping Mirafiori Sud had started, many projects of social innovation have been activated in the neighborhood. As further evidence of this phenomenon is the increasing availability of funds provided by local Non-profit Sector that have doubled from 84,000 (2013) to 176,000 (2015).[2]

D. FROM AN EXPERIMENTAL EXPERIENCE TO A PROPER GOVERNING TOOL: MiraMap

''MiraMap'' project is the follow-up of the ''Crowdmapping Mirafiori Sud'' pilot whose main aim was to investigate whether the use of ICT might concretely be the way to foster social inclusion. Notably, the pilot phase made evident the positive demand of the community toward a more direct communication with the Public Administration. Citizens demonstrated strong expectations from an e-government platform requesting a more active participation of the institutions.

[2]Fondazione di Comunitá Mirafiori Sud ONLUS, www.fondazione-mirafiori.it

As a consequence, MiraMap has been carried on in the same district of the pilot but with a more structured approach in term of IT system implementation in order to directly involve public officers in the reporting process. This starting point has to be considered as an essential prerequisite to design a proper governing tool to enhance open policy-making and citizen responsive urban planning. It integrates citizens' perspectives through their effective engagement by setting a new ICTs process up that undertakes real needs and aims and awaken willingness of the involved citizens. Today, MiraMap engages both citizens and the local administration in a report process of critical issues as well as positive trends and resources within the Mirafiori Sud District area. Methodology has been settled on the basis of the pilot phase. Nevertheless, the participatory approach inherited from the prior experience has been considered essential to foster technological sustainability and it has been settled up in each phase of the methodology:

1) **Preparatory phase**: it has included the Kick off, definition of Criteria and Set up of methodological and technical issues that have been examined together with the administrative executive. After an official launch of MiraMap, a series of meetings had place with the local administration in order to set up real objectives, data management and platform's features. The result of this phase is a collaborative platform which integrates social network features to the administrative workflow.
2) **Operational and training phase**: On the one side, a series of weekly meetings with public officers are ongoing in order to test both the platform in terms of usability and the management workflow of the IT solution in terms of administrative features. We are adopting a fragile methodology to be more efficient in providing requested features concerning:
   - the Legal Policy responsibility for data management and publication;
   - the setup of a data management process with respect to the Public Quality process;
   - the setup of a user-friendly back office architecture;
   - the setup of a data management process corresponding to real administrative management of territory.

   Today the public management in the District is guarantee by an operational network of Public Offices and Subsidiary Companies that are providing public services in the area (electricity, gas, public transport, ...); the IT solution gives this network back in terms of digital process. On the other side, a critical dialogue with the Nonprofit Sector is encouraged in order to create awareness and interest on the project in relation to the use of ICTs among the population.
3) **Data collection** use and validation of the platform. This phase is on-going throughout transect-walk, crowd-mapping, spot interviews, events, public meetings. His general purpose is to implement the platform both by providing data and by testing new projects and practices that can validate the interactive map.

E. THE TECHNOLOGICAL IMPLEMENTATION PROCESS

The alignment process of MiraMap in order to provide a set of governing tools has meant to integrate an offline environment to process data collected (an open source Business Process Management system, BPM) with an online reporting environment (the local social network based on an interactive map, First Life). The interactive map comes from the First Life local social network (see Figures 7 and 8) developed by the University of Torino. It combines characteristics of a social network (posting information, creating connections among users) with characteristics of map based interaction. It can be used via mobile or desktop. Differently than most community mapping tools like GeoKey (http://geokey.org.uk/) it does not only allow to put information on a map on a specific topic, but it is a general social media which integrates the information from different verticalizations. For MiraMap the social network is adapted to be a moderated tool since it hosts official information from the local administration. The moderation of posts and their evolution depending on the administrative workflow (e.g., verified claim, solved, why it cannot be solved, etc.) is processed via the BPM, and reflected on the map. So the social network and the administrative tool are connected in a two way fashion. Being a (local) social network, First Life allows to create a stable connection of administration with citizens, which can be informed about the evolution on topics of their interest. The interaction with the participants has been put first, and the workflow and interface of the BPM have been developed in strict collaboration with the administration: it has been considered the tool compliance and integration into the current administrative process, involving in each step the administrative executive in order to co-create and test the technological platform. Citizens can properly sign in FirstLife via the project official website www.miramap.it (see Figures 5 and 6) and start creating and sharing geo-referenced reports on the web-based map. Reports individually submitted are shown on the public map and everyone who is connected could become aware of the report management advancements by means of graphical markers and eventually comment and share. A further implication of such accountability process is related to the BPM system by which administrative staff manage reports and directly communicate with the citizen who has submitted a new report. In fact, each step of the administrative process is communicated to the citizen via email and, at the same time, it can be seen as a change of status on the map. Concerning the accountability process, another important peculiar feature of First Life adopted in the customization for MiraMap, is the managing of time in relation with the geographic dimension. Markers on the map are visible for a long period of time no matters how many they are because it is possible to specify the interval of time the user is interested in. In this way, it is possible for example

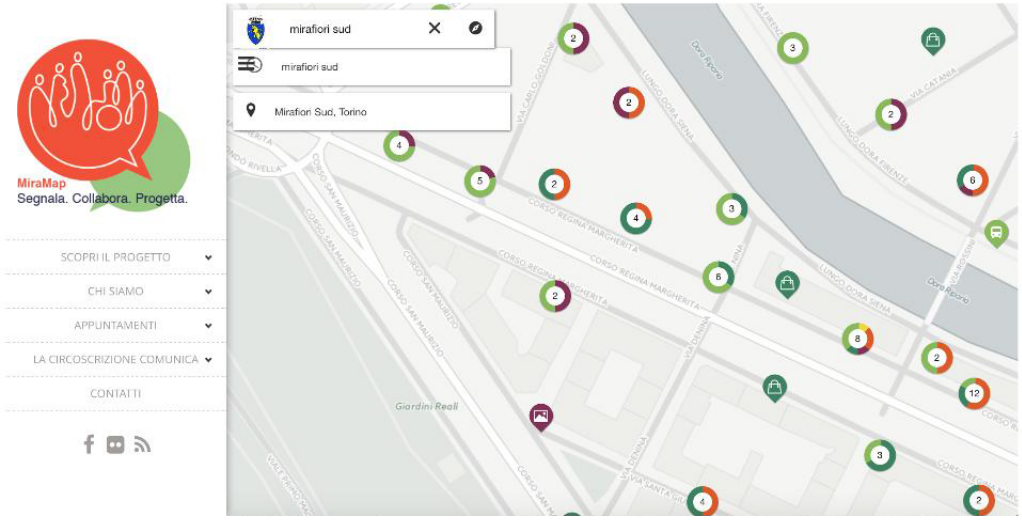


FIGURE 5. The MiraMap website with the map of First Life.

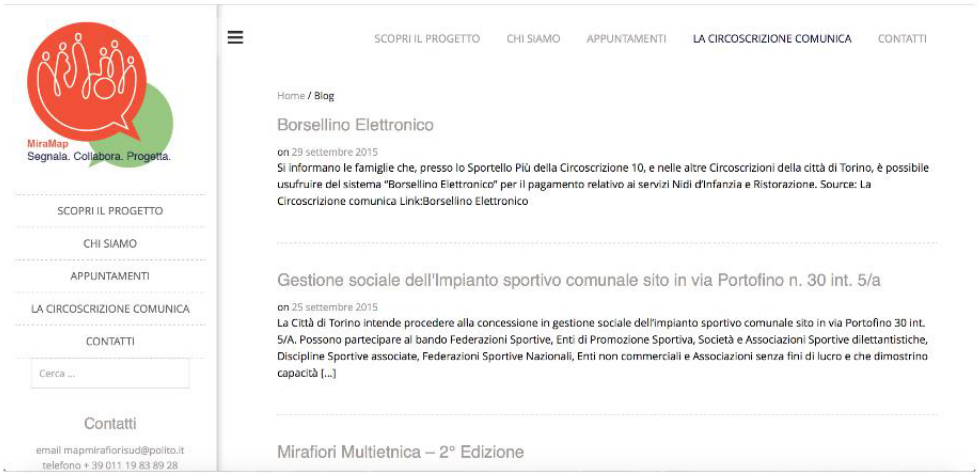


FIGURE 6. Screenshot from miramap.it : newsfeed on what is going on in Mirafiori Sud.

to check promptness of the local administration feedback and proper resolution or how many crowdmappers share the same issue.

F. MiraMap PLATFORM: INTEGRATING FIRST LIFE WITH A BPM SYSTEM

First Life is a local social network offering a map-based representation where citizens can add information and discuss about the local reality they live in and the places they care about. It is developed by University of Torino within a series of projects.[3] So far, First Life has been used to collect information about youngers points of views of the city through two projects called ''Campus Luigi Einaudi and the Territory'' and ''TeenCarTo''. Both of them have been organized with students, but of different age. The first was organized within seminars where university students were asked to map the surrounding of the campus, thinking at what is important in their daily life as students. The second involving 650 high-school students with the commitment of the Turin city council, which has asked for a map of what is considered a resource or a critical aspect in the city from the teenagers perspective. In the same district Mirafiori Sud, First Life is experimented in the Mirafiori Social Green project of Fondazione della Comunità di Mirafiori Onlus with several associations. Also, First Life has started collaborating with Eco Borgo Campidoglio a Turin no-profit association with the objective to strengthen the ties between Borgo Campidoglio inhabitants. In this case, First Life can be use to organize festivals, events and collaborative activities within the neighborhood. However, to guarantee the involvement of local authority in Mirafiori Sud the use of a BPM system has been an asset. Notably, having connected the administrative procedures to a map, changing markers color with the change of report's status, has enabled administrative staff

[3]http://firstlife.org

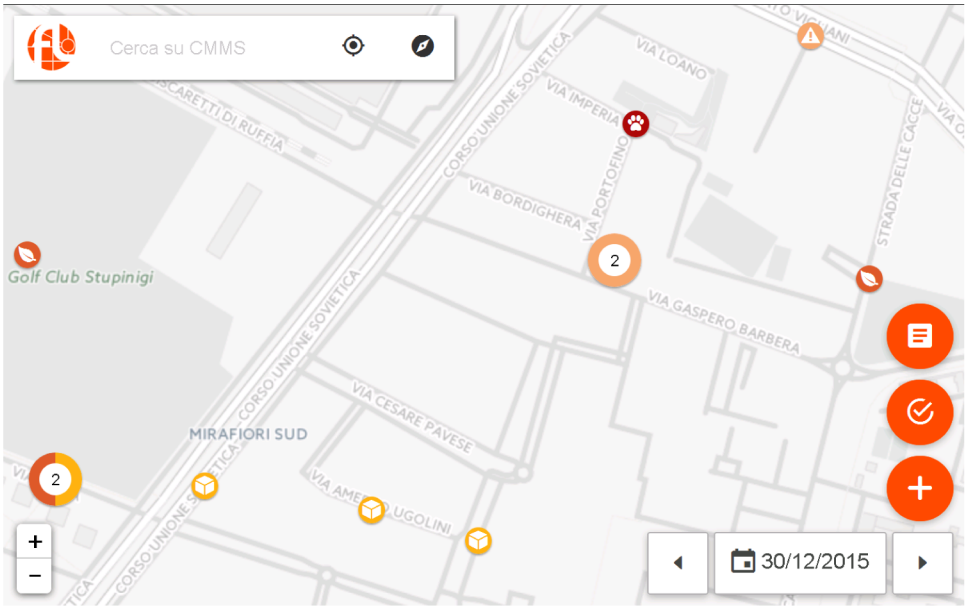


FIGURE 7. The First Life interface: markers on the map.

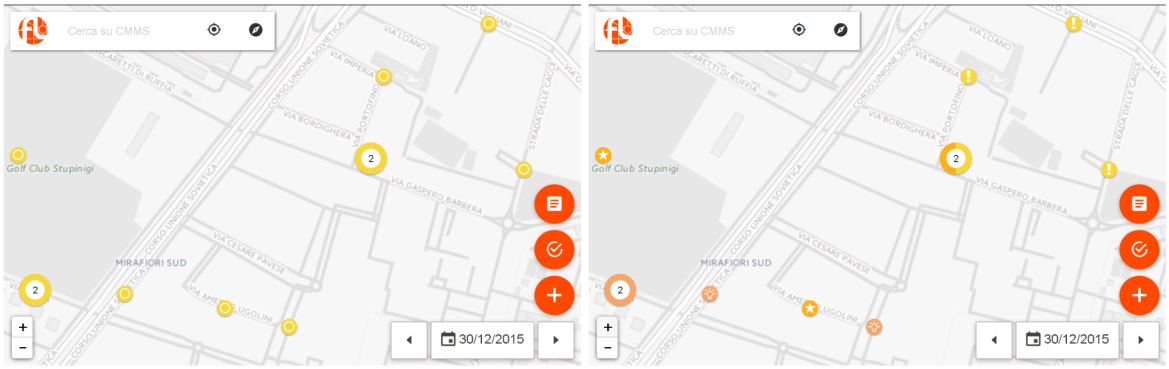


FIGURE 8. Different views on markers: by status and by typology.

toward a broader and immediate communication with the citizens.

Therefore, Points of Interest (POIs), bottom-up descriptions, stories, opinions, conversations and discussions are populating the platform. The relationship between users in First Life will not be a friendship among people of the same circle (such as the case in Facebook or Google+), as this has been shown to be of little value for creating a local community based on geographical proximity and heterogeneity. Rather, it will be a relationship among residents of the same local community, based on trust between people and local stakeholders. Users' local network of relationships will be the basis for assessing whether someone who is not yet personally known can be trusted. The aim of the social network is to bridge the virtual and the real world, rather than keeping the user closed in the bubble of the virtual one.

First Life wants to provide solutions to enable connected citizens to efficiently self-organise, opening up new opportunities for citizen-to-citizen co-production of services (in the spirit of the Nobel Price Elinor Olstrom [12] and of the notion of Core economy by Goodwin [13]), and, integrating the BPM system, for citizen-to-Public-Administration interaction.

In summary, First Life is combining a range of new, innovative functionalities to harness the 'network effects' for the achievement of sustainable change in the cities through bottom-up social innovation. Also, it is based on mainstream opensource technologies: AngularJS and Ionic for the front end and NodeJS for the backend.

Also, in order to achieve a connection between the community of crowdmapping citizens and local administration a Business Process Management system has been used t implement the administrative workflow. Two environments have been created and then integrated: one for citizens using First Life as interface that we can call the Social Network environment (SNenv), and the other based on the BPM

system for local administrative staff in public Institutions, or the BPM environment (BPMenv).

The environments are also characterized by two different groups of users having different roles. In the SNenv users are citizens and can freely sign in and use the application. All the registered users visualize, modify or add information in First Life. Since the application aims at promoting individual initiative, users can freely register. The second group of users is administrative staff. Thus, they are defined a-priori, with precise responsibilities, following the local institution organization. To each of them specific tasks in relation of their institutional position are assigned. Also, tasks in the BPMenv cannot be delayed and they have temporal constraints for the execution.

The SNenv is based on First Life's architecture, which is composed by an interactive geographical map interface as frontend and a backend for managing and searching geographical data. The interactive map is created with AngularJS, Ionic, Leaflet and OpenStreetMap. It shows by means of graphical markers the POIs of the area of interest and it allows a user to insert new POIs directly from the map. Depending on the type of POI, the frontend offers different kinds of interfaces for visualising or inserting/modifying the data. For example, an interface for events allows to register to them while visualising them, or to specify date and time when creating the event. Finally, this module offers the interface to manage the user profile in the social network and the dashboard summarizing the relevant information. The social networking functionalities are:

- Profile of user.
- Activity stream of user.
- Connections with other users.

To reduce the amount of POIs visible on the map, they can be filtered using (a) categories using an ontology, (b) search by tags and (c) temporal dimension. The map is continuously updated by the backend to show new POIs and posts which are posted by other users in real time. The backend supports the filtering mechanism of the frontend, executing geo-referenced queries on the bounding box requested by the frontend. For this aim it uses a PostGIS database, which is compatible with GIS software for urban planning. Maintaining the information about the last query of the user, it sends to the frontend the updates when new information is created by other users on the bounding box the user is looking at. Concerning the maps, the module relies on OpenStreetMap, using a dedicated tile server and the OSM interfaces to import and export data not related to users to the OSM database.

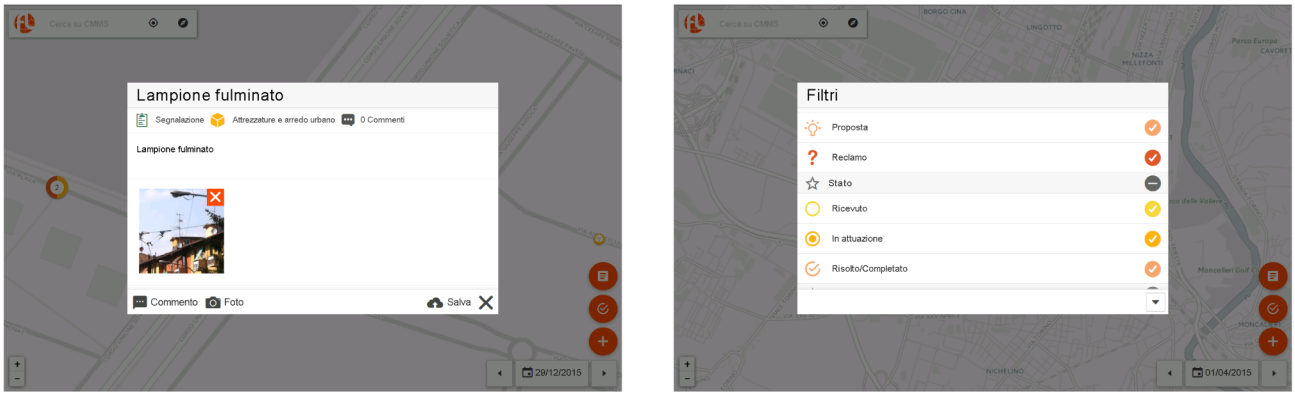
In order to set up an instance of First Life for MiraMap, a new kind of entities has been introduced: reports. Differently than standard entities of First Life, such as places or events, reports do not appear immediately on the map but they are moderated by the administration. Only after they approved by the administration they appear on the map. The information added by the citizen is forwarded to the BPM creating a new case to be processed. The user is informed via mail. See Figures 10, 11 and 12. Also photos can be added to the report (see Figures 9a and 9b).

Moreover, the classification uses two dimensions: categories (green areas, safety, animals, mobility, etc.) and typologies: problems, positive realities and proposals (see Fig. 12). Differently than in the standard First Life, POIs are associated with a status: reported, verified, closed. These statuses depend on the evolution of the report in the workflow. The information on the map can be filtered according to these different classifications, presenting the entities under different perspectives (see Figures 7 and 8).

The search interface in the top left corner allows to search for addresses as well as for keywords and tags in the entities shown in the bounding box of the map.

In the SNenv users can create and share geo-referenced information, while in the BPMenv information is managed by administrative staff to manage problems reported by citizens and, in a broader sense to communicate directly with citizens.

A Business process management system is a set of activities in order to define, optimize, monitoring and integrating



(a) (b)

FIGURE 9. **Information management in First Life. (a) A window showing the content of a marker. (b) Categories for filtering markers.**

FIGURE 10. First step for inserting a new report on the map.

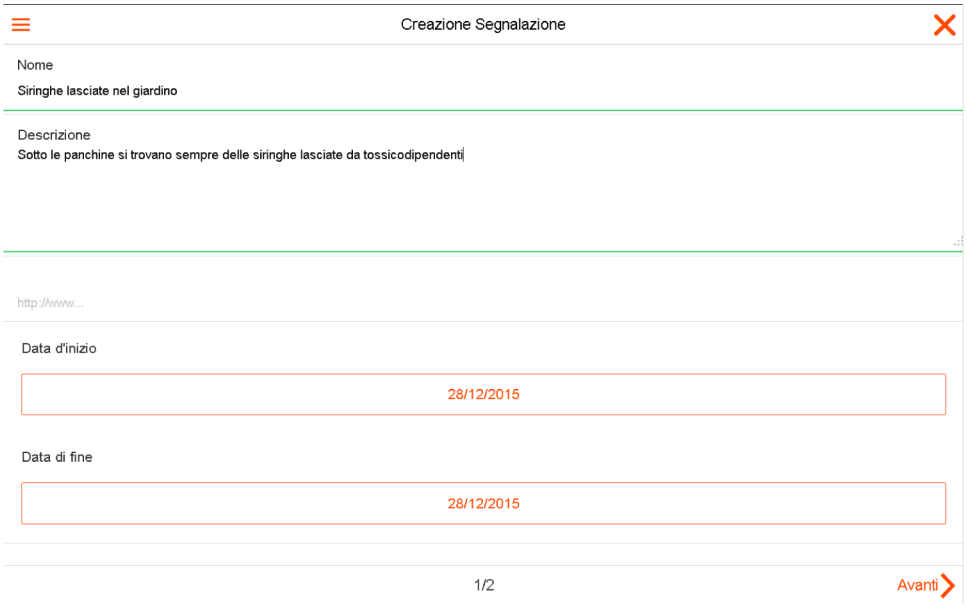


FIGURE 11. Second step for inserting a new report on the map.

business processes and make them more efficient. From the defined workflow the BPM generates the IT process using an engine. In our case, it has been set on the basis of existing institutional procedures to carry out solutions. Fig. 13 shows the workflow implemented in the BPM system.

To create the workflow has been identified three groups of actors, administrative staff working in:

- Public Relation office (PRo);
- Technical office (To);
- Operational office (Oo).

Furthermore two macro-types of reports have been defined:

- Report managed by the PRo;
- Report managed by the To.

The workflow (see Fig. 13) has been defined to balance and handle interactions among offices taking into account different report-types.

Also in this phase, the interaction with the participants has been put first, and the workflow and interface of the BPM have been developed in strict collaboration with the administration. After collecting on paper the requirements

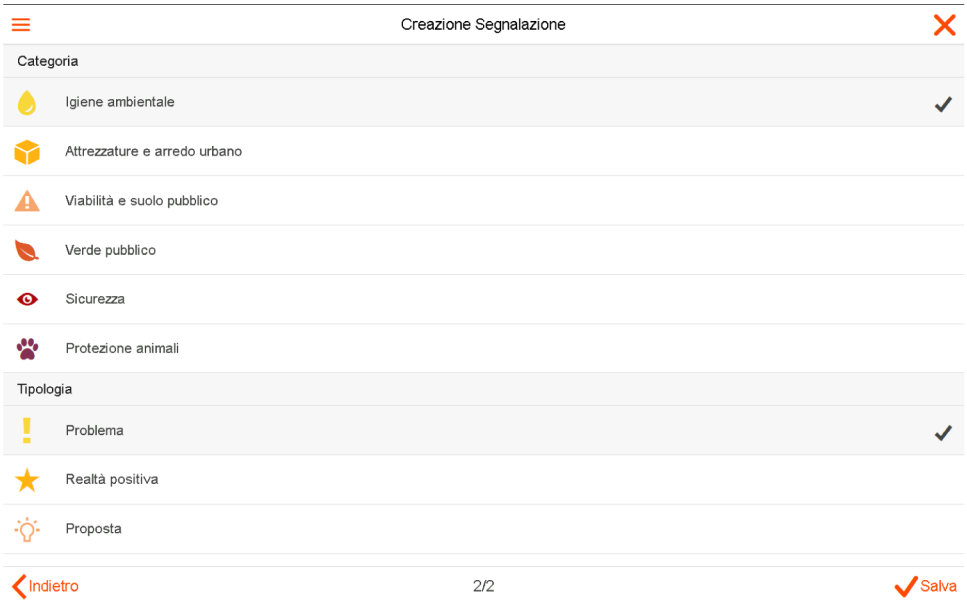


FIGURE 12. Third step for inserting a new report on the map.

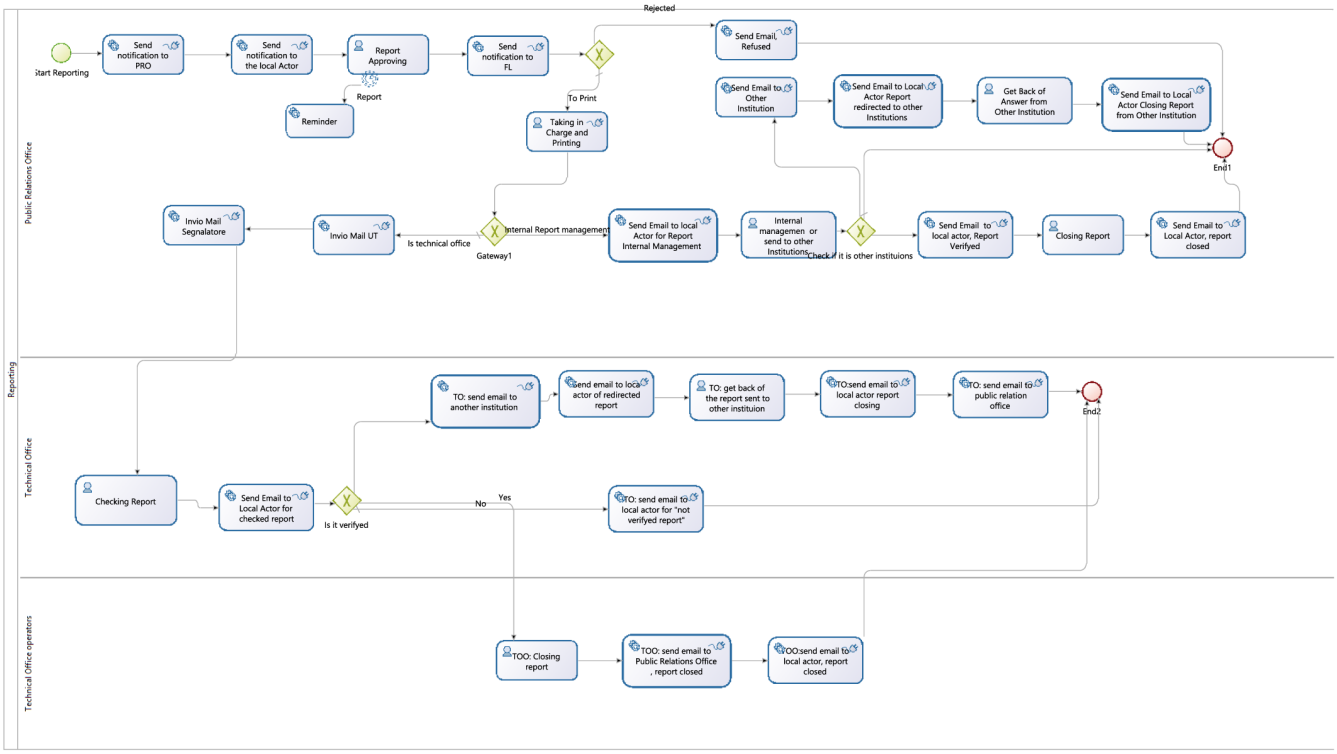


FIGURE 13. The workflow in the BPM editor.

from the employees and directors in the administration, we adopted a scrum methodology with an iteration of testing phases after fast developments of the platform to get feedback from users. This strategy has been made possible without too much overhead due to the use of the BPM system. The BPM system is composed by a design tool to model the workflow and an engine which creates instances of the workflow (cases) executing the steps of the workflow (activities), using HTML forms where it is necessary to get information from users. Thus, a BPM system allows programmers to restructure quickly the workflow to cope with the new requirements.

In brief, the workflow is divided in three swimlanes depending on the offices. All reports are sent to the PRo. The initial step of the process (circle) is performed automatically by the First Life platform upon insertion of a report by a citizen or manually by the PRo himself in case of reports reported at the desk of the office, via text messages, phone calls, emails, etc.

First of all, the PRo rejects the reports which are offensive or irrelevant. The approved ones appear on the map with status approved. Reminders with a deadlines are activated if the approval step is not executed. Then the report is either taken in charge by PRo (e.g., it asks to remove an abandoned car) or dispatched to the To since it concerns technical issues (e.g., it asks to repair a playground game for children). In the former case, the report can be dealt with internally or redirected to external offices. In the latter an email informs the To that a new task is added to his dashboard with a link to it. The To analogously has to verify the problem and then to decide whether to deal with the problem directly passing it to the Oo or to dispatch it to external services (e.g., the power utility). The verification step changes the status of the report on the map. In case of external delegation the last step for both PRo or To is to close the report by uploading the documentation received from the external service.

In case of proposals rather than complaints, the report is passed to the political level and their reply is published with the closing step of the workflow.

Since at each step of the workflow (approval, verification, conclusion), the administration can add a reply to the citizens, the report on the map is not only changed in status, but also the reply is added to the report on the map as a comment.

At each moment, the different roles in the administration have a view about which are the actions to be performed (within a deadline) in their role dependent dashboard (see Fig. 15). Another dashboard (see Fig. 16) shows the list of open and closed cased, so that the administration have an electronic registry of what is going on in their district and it can abandon the paper based previous management of reports.

The two environments exchange information using Application Programming Interfaces (see Fig. 17). For example the information exchange starts when a citizen inserts a new report in First Life, through the social network interface, reporting for instance a problem (a garden infested by mice). Once the report form is fulfilled and submitted to the server of First Life (1), its backend calls the BPM, though API, creating a process instance (2), which enables administrative staff at handling the report of the pothole. As it can be noticed in Fig. 14, a report can be inserted also via the BPM system by the administration, and it is inserted on the map as a side effect. This allows the administration to deal with reports which are signalled at the desk, via mail, SMS, fax, etc.

The task's responsible in the local institution is informed by email that a new report has been submitted (3). At this

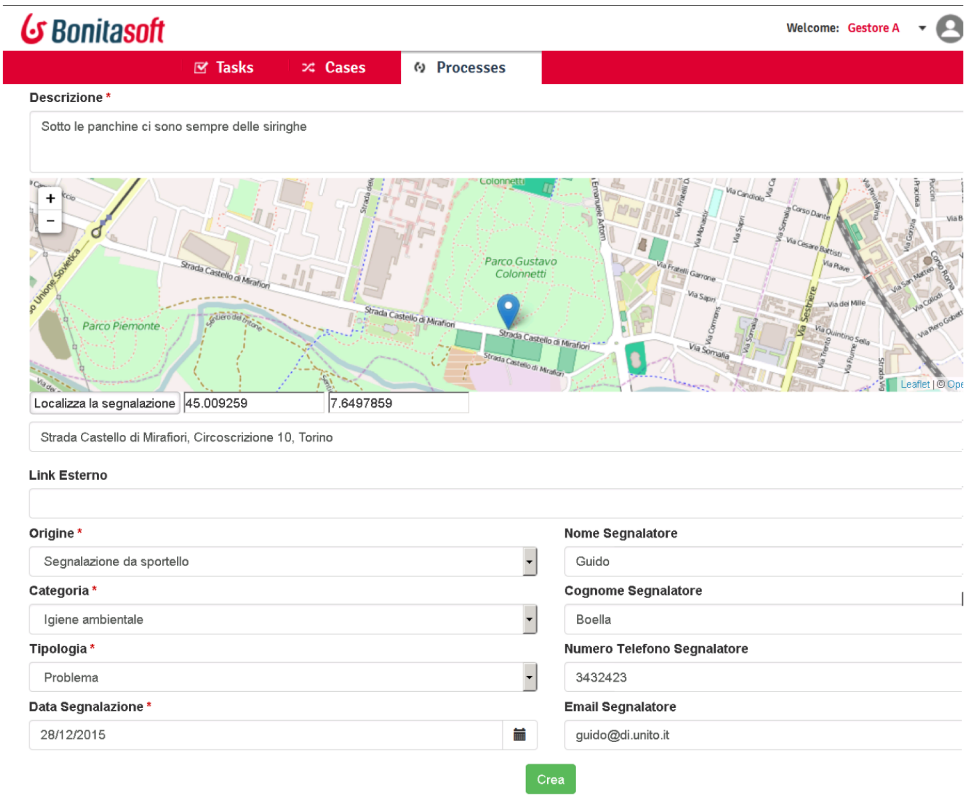


FIGURE 14. **Inserting a report via the BPM system.**

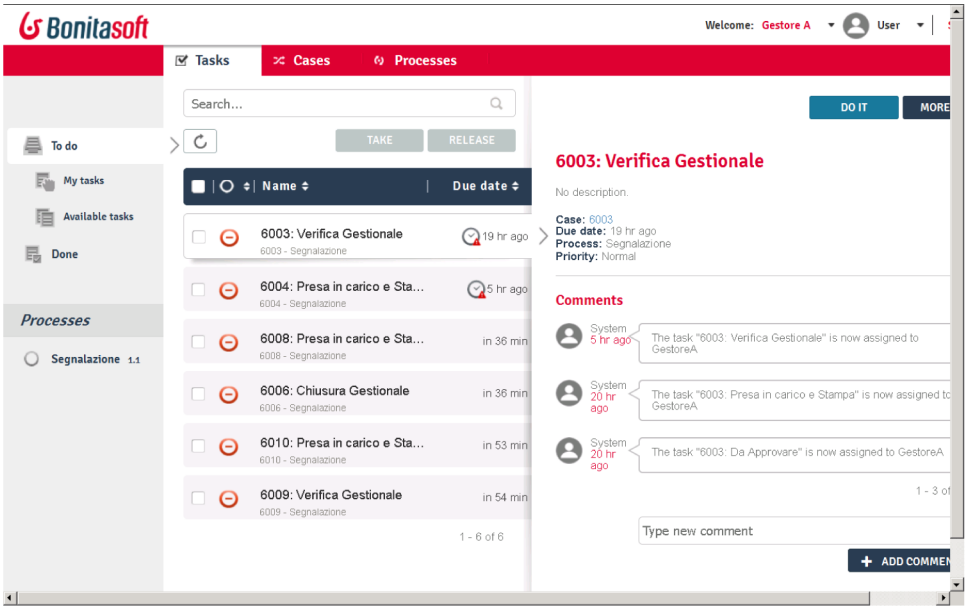


FIGURE 15. The dashboard for the PRo, with the list of tasks to do.

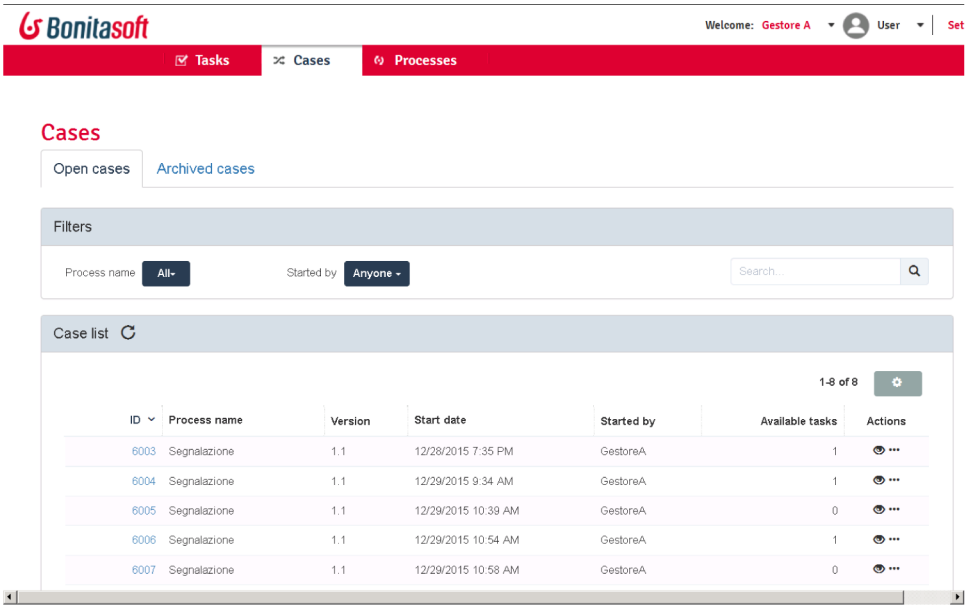


FIGURE 16. The dashboard for the PRo, with the list of open cases.

point, he/she can access the BPM in order to read all details of the report. User's access to the BPM starts the workflow designed to manage the report (see Figure 1). Each step of the workflow is communicated to the citizen who sent the report (4) and to the First Life back end, passing by API, until the end of the process (5). Steps in the workflow can be seen as change in statuses of the process instance. Communicating these changes between the BPM and First Life results in making them visible on the map. In this way, not only administrative staff and the citizen who sent the report are aware of the report management advancements but also the rest of the community.

III. THE METHODOLOGY FOR MONITORING AND EVALUATION

The focus on monitoring and evaluation of projects concerning collaborative platform projects is justified by referring to an emerging literature that identifies the issues and challenges involved in implementing systems to evaluate the quality of projects in terms of inclusiveness of end-users, as well as

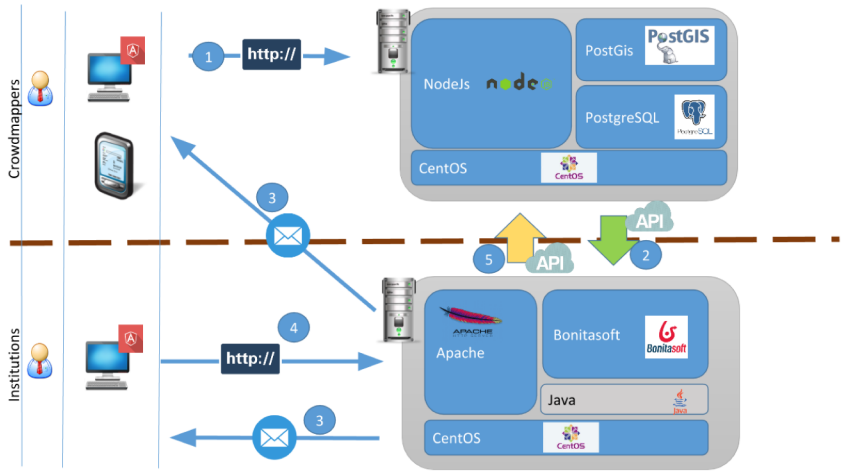


FIGURE 17. The architecture of the two environments and of their connections.

public and private actors, local communities and social stakeholders. Monitoring and evaluation of collaborative platform projects presents items of multiple nature and scale: on the one hand, these experiences stemming from EU and national policies that recognize the role of ICT as a social innovation and to support either social innovations; on the other hand, such experiences should foster social needs expressed by the local actors being able to promote synergy between public and grassroots initiatives, with mutual benefit. Not last, they should strengthen the capacity of social planning and citizens' engagement. The scientific debate is rich [14]–[17]; however it is not yet addressed specifically to collaborative platform projects and it is still analysing projects rather than growth processes enabled by collaborative platform projects. But experimental researches on collaborative platforms have evaluated built-in quality processes by analysing results of the three following actions: to provide an answer to the social needs expressed by the stakeholders involved, to simplify those activities which facilitate the synergy among public initiatives at different administrative levels, to promote and to plan those inclusive actions which directly involve the citizens.

Literature regarding models and indicators for monitoring and evaluation in the quality processes of the public administration has recently gained importance [14]. This normally presents the following phases:

- ex-ante, this phase focuses on the verification of the consistency of the project in terms of roles and responsibilities of the involved stakeholders. It identifies the requirements to reach the political-institutional goals;
- in progress (the monitoring as generally accepted): this phase pursues the strategies and the implementation of the action points identified during the first phases of the control project. This is to support the management of the decisional process and to provide with corrective actions.

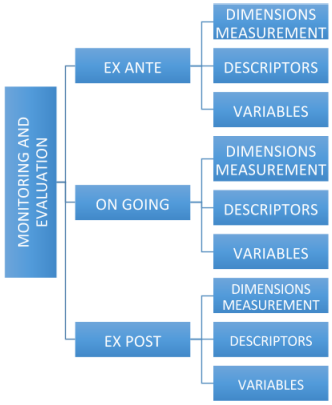


FIGURE 18. Scheme of the process of monitoring and evaluation of the case study.

- ex-post, this phase assesses the final results of the collaborative process, its organizational impact and the cost/benefit analysis.

To date, the process of monitoring and evaluation of Phase 2, MiraMap, ranks during the ex-ante and on-going phases.

The tree model (see fig 18) illustrates the methodology for monitoring and evaluation applied for the case study.

In order to identify the proper methodology for monitoring and evaluation that suits the case study, we have compared models adopted in different operational sectors. We referred to the Wenger model [18] for defining areas of evaluation and evaluation criteria as units of measurement and variables (see Table 1):

- Definition of strategic objectives and quality of the preliminary analysis
- Role of stakeholders,
- Mode of governance and engagement,
- Outcomes of the collaborative process.

Wenger model has also been used to define the stakeholders analysis into community groups (see Table 2).

TABLE 1. Check-list of monitoring and evaluation criteria.

AREAS OF EVALUATION	GENERAL CRITERIA	CASE STUDY CRITERIA
Definition of strategic objectives and quality of the preliminary analysis	• Level-depth analysis (in information technology /software / user target, etc.) • Clear statement of analysis methodologies and sources of information used for the analysis • Correct formulation of objectives in relation to the analysis conducted and timely formulation of objectives in terms of expected results and skills / performance observable and measurable	• Network • Co-design • Capacity building and sharing knowledge • Long-lasting quality of the project
Role of stakeholders	• See Section II C. • Classification of participation based on the model of Wenger	• Inclusiveness of: stakeholders/ no in-out/ gender and nationality • Analysis of stakeholders and perceptions - scrum methodology
Mode of governance and engagement	• Transferability and interoperability of the design solution to other subsystems • Appropriateness of the professional skills of human resources with reference to the proposed design solutions • Quantitative Adequacy of human resources with reference to the solutions proposed design • How to transfer the structures of the results, the skills and techniques used Outcomes of the collaborative process • See Section II-E.	General monitoring for achieving the specific objectives of the project: collaboration and networking
Outcomes of the collaborative process	• the co-design of a participatory plan while considering the long-established resources in the community and socio-innovative projects ongoing in the territory; • the co-design of a plan of shared needs, interests and aims within the citizen?s community; • the co-design of specified macro-categories strategically depending on shared needs and mapped resources; • the co-design of an activity plan in relation to those macro-categories.	• Shared platforms for the interoperability of data generated by the front-users • Degree of inclusion of projects and initiatives (how much presence, how often, how many messages, how many projects)

The model of Wenger [18] has had numerous applications in administrative processes (for example in the field of e-learning); in the case of Crowdmapping Mirafiori Sud it was assumed its classification that distinguished participants in a community in four categories:

- Core group: small number of participants (usually 10-15% of the entire community) representing the largest component active and productive community.
- Assets: larger group of actors who actively participate the community but without the intensity of previous (usually 15-20% of the entire community).
- Peripheral: peripheral countries are participants who work only occasionally activities, both low motivation for both problems integration with the rest of the group.
- Outsider: people who are not part of the community, but, intellectual interest, can occasionally get in touch.

Qualitative evaluations of the case study have been introduced with the application of the Community Impact Analysis method (CIA) [19]. The CIA method is an evolution of the traditional Cost-Benefit Analysis (CBA) and it is particularly suitable for the evaluation of no-monetary effects. Thanks to its qualitative indexes, CIA can identify both the positive and the negative effects for each community group [20].

The CIA has been applied ex post in the pilot of the case study to identify the potential positive and negative effects and impacts not only of the project, but also of the growth processes enabled by the project. We defined nine objectives which will be listed below that are suitable to properly lead actions (nine scenarios) supported by the application of a collaborative platform [21]:

1) Context;
2) Reversible;
3) Processuality;

4) Cooperation;
5) Innovation;
6) Attractiveness;
7) Sustainability;
8) Inclusion;
9) Democratic participation

We will focus here on the 5), 8) and 9) scenarios. The CIA assumed the community groups as indicators to define and highlight effects and impacts of the project and growth processes on the community and the territory of Mirafiori Sud district. As defined by Lichfield *et al.* [19], the "effect" is "the natural and physical change resulting, directly or indirectly, from the development process, also the product or the consequences of these effects on which to put a collective value or individual or the consequences of the effects on the local community which affect the way they live".

Starting point in defining the community groups is the stakeholders analysis resulted from the application of the Wenger model, called Role of Stakeholders by Wenger (see Tables 3, 4, 5). The CIA considers all sectors on which the project has influence, disaggregating the community for interest groups. The dynamic mapping of stakeholders and the Community Impact Evaluation are derived from behavioural economic theory that analyses system of preference of local interest groups (stakeholders) and their trends of behavioural inside decisional process [22]. As shown in

TABLE 2. The stakeholder analysis of the case study according to the Wenger model indicators.

Direct Beneficiaries	
Resident population in 10 District	• 38,536 units, or 4.3 % of the total population in Turin; • Index of old age: 230.3%; • A city average: 202.7%; • Foreigners: 4,744, representing 12% of the District's population and 3% of total foreign population
Administrators	• Directors of the district, District 10 of the Municipality of Turin: 26 political representatives and 53 administrative officials
State owned enterprises (SOEs)	Iren, Amiat, Smat, GTT, ATC, TNE
The local No-profit sector	• Mirafiori Community Foundation South: 15 units between operational staff and internal team • Third Sector: 40 associations in the area or having operations in it; it is estimated an average of 320 people involved
City users	Workers, the Polytechnic and University Students (1,500 at the Mirafiori Sud Campus)

Indirect Beneficiaries
Administrators of other City District, Administrators of the Metropolitan City, the Public Administrators of neighboring municipalities (Beinasco, Stupinigi, Nichelino, Moncalieri), the Directors of Local Authorities at the national scale, the international scientific community, professionals operators

TABLE 3. The CIA stakeholders map: In situ producers.

IN SITU	
Producers-Operators-Owners	
Public Operators	Private Operators
• UE commission • Country • Piedmont Region • City of Turin • Mirafiori Sud district	• Construction companies • Artisans • Traders • Service Industry • Business • Associations and Cooperatives • Foundation: Fondazione do Comunit Mirafiori Sud Onlus

TABLE 4. The CIA stakeholders map: Off site producers.

OFF SITE	
Producers-Operators-Owners	
Public Operators	Private Operators
• UE commission • Country • Piedmont Region • City of Turin • Mirafiori Sud district • Mirafiori Nord district • City of Moncalieri • City of Beinasco • City of Nichelino	• Construction companies • Artisans • Traders • Service Industry • Business • Associations and Cooperatives • Foundation: Fondazione do Comunit Mirafiori Sud Onlus

TABLE 5. The CIA stakeholders map: In situ and Off site consumers.

Consumers-Population	
IN SITU	**OFF SITE**
• Permanent residents • Workers • Resident-owners • Resident-tenants • Tourists • Students	• Permanent residents • Workers • Resident-owners • Resident-tenants • Tourists • Students

Lichfield *et al.* [19], the ''players'' are classified into several groups from the different nature and role: operators in situ and off-site (public and private), consumers in situ and off-site (public and private) and related impacts from short to medium term and long term.

In conclusion, the paper does not report all the technical steps of the CIA, which has been an experimental method applied to the case study, but only the final impact assessment. The final phase of analysis emphasizes all impacts generated by the technological platform supporting the collaborative process, both on the territory and on all the interest groups surveyed.

To sum up, the final impact assessment reports social impacts and achievements goals in the matrix of strategic issues, called Outcomes in term of Impact. It shows that no group of interest would be affected by the use of a collaborative platform, but the positive impact of the project/ process instead would cross over all the local interest groups (stakeholders). In particular for scenarios 5), 8) and 9) the negative impacts (''minus'') - those who have disadvantages in terms of financial resources and negative externalities- were insignificant and only for the 20% of the interest groups involved. Thanks to the participatory approach of the project, the most relevant contribution is done by the people by means of the IT solution. No interest group is then penalized by using the collaborative platform, but instead the project seems to have crossed in a positive way (with different weights) all the stakeholders directly and indirectly involved involved. The positive impacts (''plus'') -those that generate microeconomics, positive externalities and increase of quality of life- represent the 80% of the total impact, with a high level of positivity for at least the 65% of the interest groups involved.

The research group intends to re-apply experimentally this method on MiraMap: it is ongoing the stakeholders analysis and the identification of quality criteria and impacts indicators of the case study.

IV. RELATED WORK

For some time already 'location-based services' for improving awareness and increasing participation among citizens have become more and more used. It is not new indeed the use of map-based application to engage citizens and to facilitate urban planning.

Notably, participatory planning and e-government has been eased by the growth of the so-called VGI (Volunteered Geographic Information) systems have turned traditional Geographic Information System (GIS) into user-friendly applications and web-platforms. As a result, nowadays geographical information is easily created and shared by a crowd of non-expert users. One of the most famous example in VGI is Open Street Map [23]. It allows to freely obtain base map realized through crowd mapping of non expert geographer, using the peer production model of wikipedia.

OSM has been a turning point in geographic information systems since in European countries, accurate geographical information is considered to be too expensive for individuals, small businesses, and community organizations. In the same way, many countries in the Global South do not have any cartographical resource. For this reason, the work of Humanitarian Openstreetmap (HOT) has become of paramount importance in supporting first aid during emergency i.e. in Haiti (2010) or Nepal (2015) for the earthquakes response.

By means of OSM, many other systems using OSM as base map have been set in order to collect further

geographic information. Unlike OSM they have specific purposes and particular map thematisms. They can be linked to citizen science, producing map on, i.e., conservation of biodiversity (http://www.ispotnature.org/), water quality (http://www.citclops.eu/) or air quality (http://co.citi-sense.eu/). Others give information on mobility i.e monitoring traffic (www.waze.com), or they can be related to community mapping and engagement as Mapping for Change (http://mappingforchange.org.uk/). Many of them make use of OSM as base map, allowing users to add POI with description on top. An other application based on OSM which has been used during the pilot phase (see Section II C) is Ushahidi. It is generally employed for collecting any kind of geographic information. However, nowadays mapping platform have demonstrated poor social network functionalities which can ease citizens digital engagement. Also, they do not enable efficient communication between citizens and institutions.

Therefore, the common use of map-based platform in recent year have made evident their potential in allowing visualization of interactive geo-data and increasing awareness of the territory. Likewise, we faced the need to go beyond the state of the art technology to fit with our purposes.

In our project we have examined on the one hand the application of participative methods and techniques, which support the community to identify problems and resources; on the other hand the integration of data and development of tools for public actors. Here, participative planning has been intended as a way to think at public actions, both in relation with citizens and with public space management. Moreover, the integration of e-government and social network paradigms is experimented here to enlarge the target of users and, in doing so, fostering citizen engagement.

Thus, MiraMap has been developed merging First Life platform with a BPM system. It also uses OSM as base map but, differently than in OSM, it does not have the purpose of mapping geographical object. The application, indeed, has been designed to map people's problems and proposals of change in the neighborhood they live in.

Regarding to web platforms and applications developed for residents of a neighbourhood or specific locality we can mention some of the most known.

Examples are the EU funded MyNeighbourhood platform (www.my-n.eu/da) and the Polly & Bob platform in Germany (blog.pollyandbob.com/). Discussions are enabled by blogs, discussion forums, event calendars, etc. In this case, simple Geoweb applications enable citizens to map POI and events. The general thrust is to encourage people to get involved within their own neighbourhoods and engage their family and friends to do the same. Data and functionality of existing City Information Apps (e.g., MyCityWay, Foursquare) are combined with tools that connect people locally. My Neigbourhood also experiments with basic gamification techniques to stimulate community building.

Whether in the first case the approach was mainly based on information, here the focus is on facilitating communication between people.

Finally, map based services have been used to push the attention at problems or things that have to be changed in the cities. This generation of services has only indirectly involved local Institutions since it has not allowed interaction with the platform on the Institutions side. It is worth mentioning Infalias' Improve My City and FixMyStreet, where problems are reported on a map in order to be addressed by the local council but not directly managed. Another example is Changify platform (www.changify.org), which particularly focuses on locals who wish to share things they love or would like to see changed in their neighbourhood.

Current online neighbourhood portals are therefore primarily directed towards strengthening community life with help of online technologies, thereby engaging citizens to communicate and discuss any issue of interest.

Considering MiraMap functionalities, it can be included within this third generation of technologies as well as FixMyStreet and ImproveMyCity, but differently from them it focuses also on the propositive part of citizens who can report proposals and positive aspects of their neighbourhood. It aims at further increasing engagement and at promoting co-production of services by means of the social networking functionalities of First Life.

V. CONCLUSIONS AND OPENINGS

In MiraMap project the design and development of a proper technology has been the result of an accurate analysis of residents needs.

After the first phase, Crowdmapping Mirafiori Sud, on the one hand a more direct involvement of the public authority had been required by citizens. On the other hand, the local institution needed an easy way to immediately communicate with all residents, i.e., in order to avoid requests which have already been answered.

In order to fit with these needs, the use of FirstLife has been considered. The local social network based on an interactive map, as seen in several available case-studies (''Campus Luigi Einaudi and the Territory'' and ''TeenCarTo'') offers a suitable platform as a starting point to access an interactive system for easing process reports by the local administration. At the same time, the presented research has opened to further technological implementations to relate the mapping results with local administration support and enhancement.

First Life has been used since it is currently involved in many projects all having in common the search for a more inclusive, active and shared way of living the city. As described in Section II-F with First Life's verticalizations it is possible to collect and integrate a broad variety of information having different topic but the same aim. Notably, each verticalization allows users to describe and discuss about places they live in via mapping. As a consequence, also in MiraMap is possible to integrate reports (a specific entity of the project) with information from other projects. This is

intended to ease not only the reporting of problems but also to facilitate connection between citizens and to promote their engagement.

To sum up, MiraMap acquires all the achievements reached from the Crowdmapping Mirafiori Sud experience. Firstly, having built a strong demand for a follow up both from citizens and stakeholders, secondly having built a positive collaboration to define and categorize existent social and economical resources within the territory in order to better address shared needs and real resources analysis. Thirdly, having set up a participatory approach that goes with and proves every phase of implementation, test and report of the outcomes. Lastly, having start a positive process by which citizens can positively contribute by reporting proposals and positive aspects of their neighborhood. Nevertheless, MiraMap moves from that experience and intends to provide a technologically advanced solution to better support achieving objectives set out by the project itself. Therefore, technological implementations concern: a more complex administrative process due to a much more active involvement of the local administration and a social network customization to support bottom-up solutions, opening up new opportunities for citizen-to-citizen co-production of services [12]. The management workflow needs to suit as best as possible to features of the administrative process in use and, above all, to become an opportunity to make it more efficient thanks to the scrum methodology we adopted to get feedback from administrative staff, that is made by an iteration of testing phases after fast IT developments. From a technical point of view, it has meant the adoption and customization of a BPM environment for the management process and a Social Network environment (First Life) to improve citizens' connection and thus collaborative solutions from everyone who can benefits from a proper management of public space.

The project also proved the flexibility of First Life in integrating with other technologies. The same happened in the SEeS@W project, where First Life has been used for safety at work [24]. In SEeS@W, First Life has been integrated with an Internet of Things approach, where on the map are published data of sensors about chemical dispersion in laboratories. First Life, moreover, has been integrated with the Smart Data Platform of CSI[4] in an Internet of Data approach.

In the perspective of creating a Smart City, several are the project outcomes: having created a "smart" methodology and tool, based on the use of ICT (internet and mobile phones) to map problems but also to allow co-production of services among citizens and enhancing the community participation and social inclusion; its use is not limited to identify and point out single interventions, but also to analyze phenomena at the urban scale; having built local capacities, stimulate participation and ownership; having enabled Local Authorities to access and use the data, to build and strengthen their accountability; having set up a pilot scheme that could be replicated, enriched and expanded. Finally, it has also been defined an evaluation scheme to constantly assess the effectiveness of the project.

Future work will concern integrating the BPMenv with the local administration IT system, using digital preservation technologies for maintaining reports from the citizens as formal documents. Finally, data will be published in open data format using the Open Data Node platform,[5] for enabling the reuse of data beyond the consultation on the map.

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