Smart Cities: Supporting Citizen Participation in City Planning

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ABSTRACT

Smarter cities are those able to effectively and efficiently react to changes in the environment enabling at the same time the broad participation of its population in the decisions about its development. Collaborative computer based tools can help to achieve this goal. A new law was recently passed in Santiago, Chile, which aims to give its population an opportunity to participate in the decision about whether a new mobile communication antenna should be placed in their neighborhood and under which circumstances. This work shows how computer technology can help the affected citizens to collaboratively work together in order to achieve this goal in a more efficient and effective way, thus making a contribution to the development of smarter cities and citizen participation in decisions directly affecting their living environment.

Keywords

Smart cities, urban planning, collaborative computing informatics, social computing informatics.

1. INTRODUCTION

Global population is growing fast and mega cities are appearing all over the world. These cities are daily facing the complex challenge of offering various services without interruption to millions of people [1]. These services typically involve multiple governmental, private and social entities. Many of these entities have been developed in the last decades and they have been very often conceived to work as an isolated entity [2], [3], [4], [5] and [6]. However, in order to manage the often-limited resources they count on to accomplish their duties it is necessary they interact with each other and exchange information [7]. This is especially true when they have to manage resources such as properties, installations, vehicles and any other resources, which may vary their locations when they are on duty. In such cases they face the problem of managing geo-located resources, which has to be solved by various actors, like in the event of heavy rain, fires, traffic accidents or people requesting assistance, or when making decisions concerning urban planning, like defining a place for a construction, decide the locations for transmission antennas or planning new streets or parks in a city. This is a typical collaborative decision scenario with referenced resources.

In the past, some systems supporting decision-making processes have been developed for Wind Farm Sites [8], Water Resource management [9] and Urban Design [10]. However, these have been developed mostly to support the work of a specific entity using data generated exclusively within one organization without having the possibility of using important information generated by other entities, nor sharing its own data with others. In order to design a proper platform to support the complex process of decision-making in a "mega cities" scenario it is necessary to consider that entities interacting with each other when offering their

services are of various areas. Each of these areas has its particular perspective of the problem and hence it might consider a different solution to the problem than another area[11]. Therefore, it is necessary to analyze which are the various problems each entity has to solve in a comprehensive way when designing a supporting platform.

The various perspectives are often related to public policy, industrialization, urbanizing processes and economic incentives, which create opportunities to develop various activities in the city. Policymakers must find a complex balance among all variables affecting the interacting entities in order to solve the intrinsic dilemma on how to make decisions in a smarter way in order to establish a developing capacity. This allows the city to react in a more adequate way to changes in the environment.

This work presents a specific example aimed to solve the problem of locating antennas for mobile phone communication which was triggered by a new law regulating the places where such facilities may be installed to avoid proximity to educational and health care facilities. In order to solve this problem from a holistic approach, it is necessary to gather data from various sources combining them in a consolidated view in order to make smart decisions.

This recent Chilean law on antenna placement specifically restricts the location and height of the antenna according to the context of the surroundings where it will be installed. For example, the law states that an antenna should be installed at a distance of at least four times its height from schools, healthcare facilities, such as hospitals and drop-in clinics, which might be affected by the signal emitted by the antenna. It also includes some tax-related regulations affecting the neighborhood: the law forces the company, which is installing the antenna to propose some works to improve the urban environment of the area surrounding the area where the antenna is to be located. These improvement works should be approved by the people living in the area.

Since the law touches multiple aspects, requiring various sectors of the community to interact with each other. This includes: the private business sector, which is responsible for the installation of the antenna, various governmental agencies which are responsible for analyzing different aspects of the project and decide if the required permissions for installing the antenna will be granted or not. Also of high importance, this includes the citizen organizations representing the people living in the proposed antenna zone, who have the possibility of analyzing the project and raising concerns within a limited amount of time after the project is proposed, typically 30 days. In order to be able to properly react in such a short time, it is highly recommendable that people use computational tools allowing them to analyze the necessary information in an effective and efficient way. This is mainly because there are too many variables involved which considerably raise the cognitive complexity of the task. A tool which supports citizens in gathering, combining and visualizing the information would certainly help them to accomplish this task, thus contributing

to the formation of a more participative society and a smarter city with better reaction capabilities to changes in the environment. Section 2 describes the process of locating a new tower antenna, highlighting the various entities involved. From this description, a set of design principles are derived and described in Section 3. Section 4 describes the tool and section 5 concludes this work.

2. ENTITIES INVOLVED

The process of installing an antenna tower for mobile telephone communication starts when a representative of the company wishing to install the tower applies for the required permits to the local public works agency, the telecommunications regulatory authority, the ministry of Housing and Urban Development and the Federal Aviation Administration. The company representative must also notify the neighborhood residents' committee and the affected neighbors. Thus, four government agencies and two citizens' entities are involved in the decision process.

From the moment the citizens and their organization are notified, there is a 30 day deadline for them to analyze and discuss the project. The project includes a presentation of the characteristics of the antenna tower and the proposed works for urban improvement, which cannot exceed 30% of the total cost of the whole project. The discussion process is carried out by three entities: the neighborhood residents' committee, those living in the area surrounding the antenna which will be affected by the improvement works - and the local public work agency (Figure 1).



Figure 1: Entities involved in the collaborative decision making process

The results of the discussion might be a complete acceptance to the proposed project, a proposal modifying the work plan for urban improvement or a rejection of the project due to non-compliance with the technical requirements. The technical aspects of the project are mostly checked by the various entities described in Figure 1, however, there are some requirements regarding the surrounding environment encompassing a certain distance from the tower:

- Affected Neighbors Distance, 2x (antenna height): All neighbors living in a circle with a radius equal to two times the height of the tower centered at its location must be notified about the project.
- Healthy Distance, 4x (antenna height) or 50 meters as a minimum: there should be no nurseries, kindergartens, schools, hospitals, or any other health care facilities inside a circle with a radius equal to four times the height of the tower centered at its location.

- **Single antenna radius, 100 meters:** there must be only one antenna inside a circle with a radius equal to 100 meters and having its center at the tower.
- Urban improvements, 250 meters: the affected neighbors may require urban improvement works inside an area defined by a circle with radius equal to 250 meters and having the center at the location of the tower.

These four distance criteria are graphically explained by Figure 2.



Figure2: Graphical representation of the distance criteria stated by the 4 requirements described in the previous four points

From the requirements described above we see that there are two questions the three entities discussing the submitted project must answer:

- Q1. Does the proposed installation fulfill the requirements imposed by the distance criteria?
- Q2. Which urban improvement works do we really want to be performed considering that the cost of these works cannot exceed the 30% of the cost of the whole project?

These two questions must be answered within a period of 30 days. Therefore, a tool supporting the analysis of the situation as well as the decision making process in a collaborative and rational way becomes highly desirable.

3. TOOL'S REQUIREMENTS

In order to define the requirements of a tool supporting the discussion and decision process we will first analyze what the roles and the common work areas are based on the required information and the interactions among the various entities. In figure 1 we see the six entities involved in the process. Four of them have an immportant degree of interaction among themselves. From thesese four entities, three work collaboratively in order to prepare e a an answer within the 30 days deadline. The collaborative pr roocess can be divided in activities having a direct relation to thee question's answers. These were identified as follows:

- A.1 Definition of the radios and the affected neighborhood.
- A.2 Empirical checking of the distance requirements.
- A.3 Presentation of the urban improvement Works proposed by the company to the three entities analyzing the proposal.
- A.4 Counter-proposal of urban improvements.
- A.5 Open discussion of urban improvement alternatives, generating a list of the most important ones.
- A.6 Prioritization of the improvement works, done by the public work agency.

Some of these activities are performed in a collaborative way and others by individuals belonging to one or more entities. Table 1 summarizes the way each activity is performed ("C" representing collaboratively and "I", representing individually) and by members of an entity (the public agency works, E2 affected neighbors, E3 neighbors' committee).

Given that Al as well as A2 are simultaneous tasks, the platform must provide the means to perform an analysis process for both entities. The A3 activity corresponds to the presentation that the Public agency work makes to the social entities, with this outcome A4, A5 and A6 are made. These activities must have methods and tools that support a georeferenced discussion including assessing proposals features in order to be able to fulfill A6, providing a prioritization of the discussed urban improvement proposal.

In the complete process we identify two points of strong interaction among the various entities. The first one corresponds to the interaction between the companies presenting the project for building an antenna tower with the public work agency. The interaction between these two entities corresponds to the simultaneous management of multiple geo-localized projects inside the area for which the governmental entity is in charge. In order to manage these projects efficiently we used a software platform for developing an application supporting geo-collaborative decision making, over which the tool presented in this work was implemented [12]. This platform allows the management of multiple projects, categorizing them in the typical discussion steps: brainstorming, planning and execution. Moreover, it allows the management of workspaces associated with geographical areas including space-time metrics, including iconographic information, tools for collecting information from various sources, as well as incorporating autonomous agents in order to perform simulations and analysis over the physical area represented by a map (Figure 3). This tool has been extended in order to include an autonomous agent which could represent and simulate the behavior of

transmission antennas. When one of these agents is located on a certain location over a map (utilizing drag and drop) the tool creates two working spaces, which will be used by the public work agency and the affected neighbors for working collaboratively.



Figure 3: Collaborative platform. The square marks the area under analysis, which corresponds to the geo-referenced workspace. Red circles represent antenna tower locations.

The generated workspaces are accessible via a URL. Each one helps users answer each of the questions presented in the previous section. The first one is related to the question of whether or not the requirements about distances have been fulfilled (Q1). In order to help answer this question the workspace displays a view with the map of the area being analyzed (where the antenna was located by drag and drop) showing in a simple way all circles corresponding to the constraints and urban issues imposed by the law, considering the position and height of the tower (Figure 4).



Figure 4: Red circles correspond to sensitive zones like schools and health caring facilities; the green circle is the urban improvement zone; the black circle is the zone of affected neighbors; the blue circle is the zone where only one antenna can be placed

As we can see in Figure 5 this first view supports the performance of activities A1, A2 by providing a clear picture of the situation. It also displays a link to the second view which supports the revision of the proposals for urban

improvement works and provides a link to the project proposal A3. The second space is oriented to answer the second question (Q2) which refers to the revision of the urban improvement works (Figure 5).



Figure 5: Second question view. Left size: Urban improvements voting system; Right: allows adding an urban improvement proposal by clicking on the location.

4. CONCLUSIONS

This work aims to make a contribution to the development of smarter cities by allowing their inhabitants to actively participate in the decisions about its development. The need of this tool was triggered by a new law issued in Santiago, Chile, which allows citizens to participate in the decision making process about granting permission for building an antenna towers in their neighborhood. Since the time frame given by this law for discussing the proposal presented by the company is rather short, it is desirable to have access to a tool which facilitates this process. We developed such a tool on top of an existing platform for supporting the construction of systems for geo-referenced decision-making. The tool eases and speeds up this process by presenting the relevant information in such a way that efficient and effective decisions are easier to make. Since the tool has just been finished, it has not been tested vet. However, other tools developed with the same platform have been successfully tested, which leads us to think that this tool will also gain the same acceptance. Nevertheless, a formal testing of the tool is already planned for the near future.

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