

# Smart Cities: A New Relationship Between People and Technologies



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**Abstract** Smart cities are often presented as an efficient, effective and unitary vision of the application of new technologies for city management, especially in term of services, which are provided to the users in different sectors. The concept and the activities relating to smart cities are strictly connected with activities relating to Living Environments and even more with the context of Ambient Active Living. This sector focus mainly on creating support services, adaptable to the user's different characteristics. The relationship between these two sectors is here introduced, in order to point out the elements to be considered for a more correct design of smart cities, which take into the appropriate consideration different aspects of human beings and their behaviour.

## 1 Introduction

Smart cities are often presented as an efficient, effective and unitary vision of the application of new technologies for city management. Therefore, they offer great benefits to the citizens, especially in term of services, which can be provided to the users in different sectors. At general level, smart cities can be defined as “systems of systems”, or systems that structure and integrate different functionalities for a more efficient overall use. The concept is complex and manifold; a large number of specific and structured definitions and descriptions are present in literature [1]. There are also various perspectives of analysis, ranging from the level of the architecture of the infrastructures, to the level of the applications sectors, such as energy, rather than the transport and management of buildings, up to the level of public administration, which involves socio-economic aspects too. These are only a few examples, without exhausting the list. Numerous activities are currently underway, including the CNR DIITET proposal for “a prototype of an urban environment provided with a new generation of innovative ICT services and technologies to improve energy

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and resource efficiency, environmental sustainability, emergency response, climate resilience, social cohesion and quality of life of citizens” [2].

In this new urban vision, a technological perspective often represents the starting point to structure in a more rational, sustainable, efficient and effective way the citizens’ services, in all areas of their life, from transport to work, from domestic life to health care, from energy management to environmental sustainability.

## 2 Users and Smart Cities

The concept and the activities relating to smart cities are strictly connected with the context of Living Environments and even more with the context of Ambient Active Living. This sector focus mainly on creating support services, adaptable to the user’s different sensory, motor and cognitive characteristics. These personalized services cannot be the result of the aprioristic automation of some processes. On the contrary, they require the adoption of a wider user profile, as opposite to stereotype that is often used at the technological level in the design of complex systems. The concept of a widened user profile is not new, since appeared in ICT in the ’80s. Anyway, when this new and wider user profile was introduced, services had precise requirements. Since the focus was on human–computer interaction accessibility, a specific functionality was identified, with its related accessibility problems, and specific solutions were studied, according to different users’ profile.

Furthermore, the distinction between the physical level and the information level of the systems was clear. The interaction was limited to the one or the other area. For example, for a person with sight problems it was sufficient to create a screen reader for the access to information, thus defining a level of interaction limited to the person-device. This did not make the problem less complex from the technological point of view, but clearly defined its boundaries. Similarly, in order to overcome the obstacle of the stairs at architectural level it was often sufficient to create an access ramp, where, even in this case, the level of interaction was well defined, at physical level.

The solution was however addressed to the single user, or to the group of people with the same specific problem, without considering the social level, i.e. interpersonal interactions and relationships [3].

In the context of smart cities, this model of human–machine interaction is no longer valid.

The model used so far is limited and inadequate in the new context of smart cities, where the individual and group (or social) dimensions are strictly interconnected, and where the physical dimension and the virtual or cybernetic dimension are no longer separate part of the system. In the transition from the interaction between person and device to the interaction between people and environment (a physical and social environment), in the transition towards a unified and organized management of services and information, both the design of users’ services and the smart cities activities which involve citizens requires a new discussion.

## ***2.1 Smart Cities Definitions Including Services***

One of smart cities definition, which better present this relationship between citizens and smart cities is provided by Hitachi [4], which identifies for the city two distinct infrastructures, strictly connected to a more general infrastructure, which covers areas larger than single cities:

- 1) Urban infrastructure, which is based on the geographical and physical characteristics of individual cities. The sectors of the urban infrastructure layer include energy, water, mobility, communications, and waste. These are closely integrated with the more general infrastructure layer.
- 2) Service infrastructure, which contains city's facilities and other services including medicine and healthcare, education, administration, and finance. This layer can be considered from a citizen's perspective as being the layer in which they obtain services, and from a city manager's view as the layer in which services are provided to citizens.

### **2.1.1 A New Role for the Person in Smart Cities**

This "two-levels" definition highlights that the smart city can be assimilated to and Cyber-Physical Social System (CPSS), a concept developed in the industrial field, but that helps to correctly define the new scenario of the environment of life [5–7].

The relationship between citizen and smart cities highlights a new, more articulated way of considering the user within the system. In this context, the person loses the dimension of a simple user of the services, and becomes an active part of the system, for example as a producer of information, in both an active and passive way. In a passive way since most of data produced by the users, (for example with any transaction on the personal mobile), contribute to the amount of data which are processed in the public systems of recommendations (according to appropriate conditions for privacy). In an active way, first because she can provide information also directly to public system, (for example sending detailed information about traffic jam is a direct contribution to a city Transport Information System). Secondly because, since human behaviour is not automatic, different way to react to public services, for example to traffic recommendations, also influences the efficiency of services [8, 9].

## **3 New Aspects of Users' Services**

In order to rethinking the users' service design in the framework of smart cities, it is essential to rethink also some basic concepts. We introduce here two examples about personalization and collective intelligence.

### 3.1 *A New Idea for Personalization of Services*

For the final user a great importance assumes the concept of service personalization. If we examine this concept in the framework of smart cities, we have to understand if, when and how new elements do arise in this process, in comparison with the same concept applied in the past [10]. Even if the main objective comes from the user (preferences, interests and above all needs), it is necessary to take also in account also all the constraint presented by the environment. An interesting perspective is offered by the literature [11]. The key point is represented by the different parameters, which represent the optimization function. In a smart city this process of optimization contains multiple coexisting goals. Each user lives in a physical space, and not alone, but together with many other people. Therefore, the behaviour is conditioned by both these elements. This implies that in the personalization process, many are the variables to be considered. Not only the user and the IT application, but also the space, the relationship with other people, and the context. The optimization function is much more complex.

### 3.2 *A New Perspective for Collective Intelligence*

In the context of users' services, another important concept is represented by collective intelligence. An example of application in the field of e-Inclusion was given by [12]. A more recent perspective is presented in the context of CPS [13]. An accurate analysis carried out by those authors put in evidence three main aspects. Firstly, CPSS is a system-of-systems, with the integration of social software or crowdsourcing platforms. The review highlights a lack of methods to explore and analyse the design of data integration, dissemination and actuation phases especially for human interaction.

Secondly, there is a variety of definition for CPSS, such as for smart cities, and consequently for its 'social' aspect. These different perspectives of social involvement "*range from humans simply being the users of the system to humans being involved*", [13], which is the most appropriate use of collective intelligence systems.

Thirdly, concepts such as privacy, data security, and architectural design methods are not yet introduced in most studies, even if they represent a basic aspect of this social problem. An accurate activity is required and represents one of the elements to be investigate in the future.

## 4 Future Work

Many questions still emerge in this regard, for both the system and the user.

For the system:

What is the level at which the automation barrier is placed?

Which is the most appropriate user model to be adopted?

How does the user operate within the system?

For the user:

Which are the criteria that foster its acceptability and collaboration?

What should the user know about the choices and mechanisms of the machine (system) to increase confidence in it?

## 5 Conclusions

While the concept of smart cities is becoming increasingly widespread, its connection with the services, which support people in their daily activities, is much less defined. The adoption of the smart city concept for our Living Environments and above all for the design of services in these environments requires an accurate analysis of the mechanisms of interaction between the general infrastructure and the level of each user or groups of users. A first analysis about this comparison is here presented and a few elements of interest, such as about personalization, are here discussed. Only an appropriate trade-off between these aspects can guarantee efficient services and satisfied users. Indeed, the system does not work only because the “machines” make it work, but because the whole process in which the person is included is efficient and effective.

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