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From Smart City to Smart Region

Digital Services for an Internet of Places

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Foreword

A summary of the current debate on the nature of the Web is set out in The Onlife Manifesto (Floridi 2015), which presents the results of a research project funded by the EU in 2012 as part of the *Digital Agenda for Europe*[1] (https://ec.europa.eu/digital-agenda/en/onlife-manifesto). According to this analysis, the impact of Information and Communication Technologies (ICTs) on the human condition has consisted of a series of transformations: the blurring of the distinction between real and virtual, and among human, machine and nature; the transition from information scarcity to information overabundance; the shift from isolation to hyper-connection. However—and the project for an Internet of places is enlightening in this regard—the impact of the Web seems to extend much further.

Indeed, the social impact of the Web is a revelation, in the sense that it reveals the very essence of human nature. This circumstance makes study of the Web fruitful not only for philosophy of technology, but also for a social ontology and a philosophical anthropology. A human being that updates his or her status on a social network evidences the social grooming performed by many animal species (and by our ancestors); and Aristotle's definition of man as an animal endowed with language could not be better illustrated than by the spread of ICTs. Likewise, the compulsive response to a message in the middle of the night bears out the negative anthropology that views humans as in need of recognition, and characterized by a submission to normativity that is manifest from the first years of life and in pre-rational form.

However, in order to understand this crucial characteristic of human nature as revealed by the Web, it is opportune to integrate the ICT perspective with what I propose to call *Recording and Mobilizing Technologies* (RMTs). If the Web exercises a regulatory function, if it is able to mobilize people (to perform actions, answering, for example, and not simply transmitting information), it is because it does not only communicate but is able to record the communication. The message transmitted is written, or at least the recipient has a record of the message, and the

[1]Website: http://ec.europa.eu/digitalagenda/en/online-manifesto.

sender can prove that he or she has sent the message. This record is a source of responsibilization. The message cannot be ignored; it demands a reaction and, by reaching several recipients, it can create witnesses attesting to the transmission, and it can coordinate actions. The reasons for the power of bureaucracy, military command through written orders, religious prescriptions through holy texts, and the creation of debts and credits through account books—in short, the entire apparatus of human normativity—are most clearly apparent in the ubiquitous spread of RMTs through ICTs.

A company which sells a mobile phone apparently sells a device for information and communication. But in fact it also sells a recording device (a photographic, musical and postal archive) and a device for mobilization (payments, execution of requests binding because they are written, and access to social networks as means of self-representation). The company thus sells, apparently unbeknownst to the purchaser, a vehicle of normativity: it puts the world in the hands of the purchaser, making contacts and services accessible to the latter. But at the same time it puts the purchaser in the hands of the world, which can reach him or her at any time with requests which are registered and therefore binding; not to mention the enormous problems of privacy created by the fact that the data are recorded and archived by companies (when the right to be forgotten is discussed, the reference is not to an ICT, but to an RMT, a recording and archiving technology).

The reach of the Internet and the Web as it emerges from projects like the one presented by this book is even more extensive than is usually admitted. For a philosopher, it lays the basis for a rethinking the nature of the Web which may be summarized in the following conceptual points that I suggest should be borne in mind while reading the outstanding project report by Corinna Morandi, Andrea Rolando and Stefano Di Vita:

The Web is principally action, not information. It refers primarily, not to the sphere of knowing but to the sphere of doing.

The Web is primarily production, not transmission. It does not merely convey things that already exist. It constructs new objects which then populate the social space.

The Web is primarily real, not solely virtual. It is not simply a virtual extension of society; rather, it is a real expansion of society. The second life is disappearing; social networks have triumphed.

The Web is principally mobilization, and not solely emancipation. It does not provide tools of information and expression alone; it also generates responsibilities, and therefore provokes mobilization.

The Web is primarily emergence, not just construction. It does not simply fulfil the aims of its designers and the intentions of society. Rather, it imposes new directions which must be understood and anticipated.

The Web is primarily opacity, not transparency. Precisely because the Web is like society, and because society is not the result of a transparent construction or an intentional contract, the Web is opaque and constitutes an authentic epistemological object.

The Web is primarily registration and not just communication. It does not work like a television, a newspaper or a radio; above all, it operates as an archive.

Precisely for this reason, and quite naturally, the *Internet of things* can become an *Internet of places*, and *smart cities* can evolve into *smart regions*. If it were simply treated as a communication device (something like a telephone or a television) none of the brilliant proposals of the authors could ever be realized. By designing an Internet of Places in a Smart Region, therefore, the authors have not simply engaged in a technological operation; they have been able to create a new concept, for which also a philosopher is grateful.

Maurizio Ferraris

Preface

This book is partially derived from the outcomes of the research project entitled *The smart region between Turin and Milan: mobile services as drivers of spatial innovation towards Expo 2015* (developed by the Politecnico di Milano, Dipartimento di Architettura e Studi Urbani (DAStU) in collaboration with Telecom Italia) which were the starting point for the development of this publication. This research project shares the criticisms brought against the concept of urban smartness (such as the risks of an excessively technocratic and market-oriented approach to city management and planning and of an increasing social segregation in city use), but it acknowledges the potentials of the smart city concept for urban development (such as spatial regeneration, economic and social innovation, environmental sustainability). Within this context, it investigated the use of Information and Communication Technologies (ICTs) for the representation, promotion, management and dissemination of an integrated system of services; it explored the spatial impacts of digital services at different scales (local, urban, regional); and it sought to understand how a system of mobile services can encourage new spatial uses and new collective behaviour in the quest for a better quality of places. Consequently, this book offers:

- an original exploration of the relationship between ICTs and spatial planning, expanding the concept of urban smartness from the usual scale of buildings or urban projects to the regional dimension;
- a related critical analysis of international case studies with the purpose of verifying the opportunities afforded by new digital services not only to improve urban efficiency but also to foster the evolution of urban communities through the quality enhancement of public spaces;
- valuable insights for scholars and for local administrators and operators involved in smart city projects.

The research applied its reflections to the spatial configuration of the Northern Italy mega-city region's sector between Turin and Milan: a wide area where the recent completion of the infrastructural bundle (motorway and new high-speed railway) is producing significant physical and socio-economic changes. Considering the Italian context, in light of a smart concept that to date has been

mainly restricted to the urban scale, Milan is investing significant efforts and resources in smart city projects, also in relation to the 2015 Universal Exhibition. Many initiatives have been directly launched or supported by the municipality, while others have been promoted by the mega-event management company Expo 2015 Spa at different scales: the local scale of the Expo site, the wider scale of the Milan metropolitan area, and the world scale of the Internet. According to this scenario, the book suggests the redefining of well-known spatial and conceptual references, which are taken from the disciplinary debate in the fields of new media and urban studies, and which may be related to the Internet structure (based on nodes and hypertextual connections activated by the nodes themselves):

- the *smart city* concept can evolve into the *smart region* concept (identified by an area dimension), which refers to the metropolitan region between Milan and Turin selected as the spatial context of the research because of its specific features and potentials for innovation;
- the *Internet of things* concept can evolve into the *Internet of places* concept (identified by a network dimension), which refers to the integration of physical and digital services and represents the specific issue explored within the spatial context of the smart region through adoption of this experimental approach to certain urban functions important for innovation of the metropolitan region (for instance, university campuses);
- the *urban node* concept can evolve into the *urban digital node* concept (identified by a point dimension), which supports the development of the *Internet of places* concept from the scale of urban functions (such as university campuses) to a wider spatial scale by intercepting different categories of users (inhabitants, students, city-users).

Within this framework, two pilot projects were implemented in order to identify the relationships among the different scales considered by the research project (local, urban and regional). Adopting the reference to the system of university campuses within the potential smart region between Milan and Turin, the first pilot project concerned the Città Studi university campus in Milan. This was chosen in order to explore the Internet of places concept by optimizing access to university facilities through the use of mobile services, thereby enhancing the campus itself as a complex of urban digital nodes. The second pilot project sought to develop the Internet of places concept from the university campus scale to the urban scale by applying it to a more extensive area of Milan comprising the Bovisa university campus and the 2015 Expo site. Specifically, this second focus, which concerned the development of an *Urban Digital Nodes (UDNs)* network, had the following goals:

- to identify the best localization opportunities for the UDNs through an urban planning approach;
- to define the functional components of these UDNs, which could be aggregated in different ways in order to mix physical and digital site-specific services and increase the social inclusion of different categories of users (inhabitants, students, city-users);

Several case studies, which inspired the localization methodology and the functional components of the UDNs, divide between selective inventories of immaterial services and new technologies, on the one hand, and different scale spatial projects on the other. The most significant of these case studies are the following:

- at the local scale, the Living Lab in Malmö;
- at the urban scale, the Idea Store public libraries in London and the 22@Innovation District in Barcelona;
- at the regional scale, the smart city-regionalism plans in Seattle.

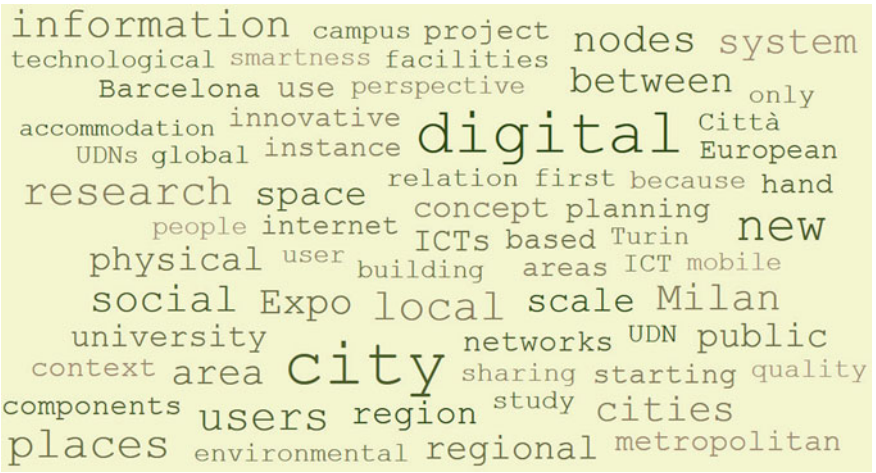
In regard to the two pilot projects of the research, these were selected with the purpose of verifying in concrete cases:

- if ICTs are really able to modify the uses, organization and planning of urban spaces and how they could concretely stimulate urban regeneration processes (as in Barcelona) and urban services innovation (as in London and Malmö);
- how the urban smartness concept can be extended to the regional scale (as in Seattle).

From this perspective, the case studies consequently made it possible to compare the theoretical ICT potentialities for spatial change and innovation with their real outcomes (which do not always correspond to the original goals), as well as to identify ways to improve current practices on the basis of the two research pilot projects.

The book finally discusses how the proposed UDNs could be integrated with other kinds of innovative places related to the current boom in knowledge-based, new manufacturing and sharing economy (and society) favoured by ICT development. In parallel, it ends with some reflections on potential extensions of the experimental approach of the Internet of places concept from an urban to a regional context.

Some issues of this book have been frequently discussed with Andrea Bragagnini (Telecom Italia).



Contents

Chapter 1
How Can ICTs Be Drivers of Spatial Innovation? Urban Digital Nodes for the Smart Region Between Milan and Turin

Corinna Morandi and Andrea Rolando

This chapter aims at presenting the research project partially explained in this monograph (entitled *The smart region between Turin and Milan: mobile services as drivers of spatial innovation towards Expo 2015* and developed by the Politecnico di Milano, Dipartimento di Architettura e Studi Urbani (DAStU) in collaboration with Telecom Italia) by showing its origins in relation to its spatial scenario, the issues it deals with as well as the concepts it refers to and it promotes. Inspired by previous research conducted within the *Osservatorio Milano Torino* of DAStU and by multidisciplinary didactic projects developed within the *Alta Scuola Politecnica (ASP)* between Politecnico di Milano and Politecnico di Torino, the research project applyed its reflections to the spatial configuration of the Northern Italy mega-city region's sector between Turin and Milan: a wide area where the recent completion of the infrastructural bundle is producing significant physical and socio-economic changes and where the large event of the 2015 Universal Exhibition is located (Fig. 1.1). Within this context, this chapter introduces the research focus, concerning the effects of Information and Communication Technologies (ICTs) and, in particular, of mobile devices for the development of new services, spatial uses and collective behavior in the quest for a better quality of places, as well as the new research concepts of internet of places and urban digital nodes.

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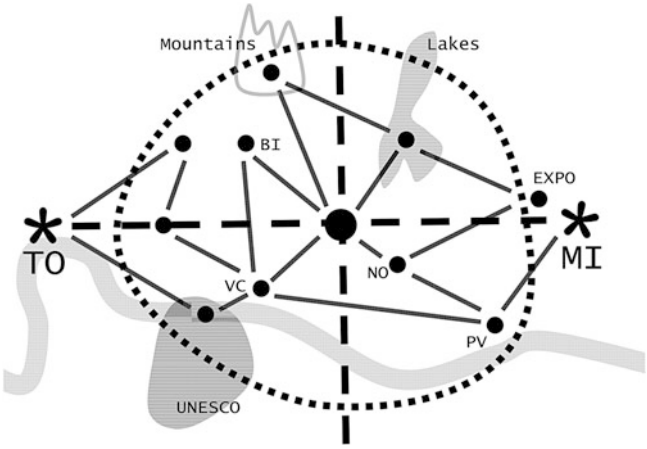

Fig. 1.1 Networks and nodes in the metropolitan region between Milan and Turin. *Source* Rolando

1.1 The Research Project's Origins and Results in the Spatial Context of the Metropolitan Region Between Milan and Turin[1]

The research project entitled *The smart region between Turin and Milan: mobile services as driver of spatial innovation towards Expo 2015* can be traced back to a broader branch of studies on the geography of metropolitan areas. Indeed, the project addressed the issues of urban and regional attractiveness and sustainability connected to major spatial and use-related transformation processes in infrastructures, large functions, and services. To this end, it adopted the spatial reference of the Northern Italy mega-city region's sector between Milan and Turin.[2] This is a wide area (which can be schematically depicted as a rectangle with a length of 150 km and a width of 80 km), which does not correspond to the organization of

[1]Given the wide range of definitions of the contemporary urban phenomenon (moreover related to different disciplines), this book uses the following terminology: 'metropolitan area' refers to an urbanized area related to one single city (for instance, the 'Milan metropolitan area'); 'metropolitan region' refers to an urbanized area related to more than one city (for instance, the 'Milan-Turin metropolitan region' or the 'Metropolitan region between Milan and Turin'); 'mega-city region' refers to a wider urbanized area extended to the macro-regional scale and including several cities. All of the expressions mainly reflect urban relationships and dynamics rather than the spatial continuity of the built environment.

[2]The research was part of the activities concerning the spatial context of the Milan-Turin metropolitan region undertaken for almost a decade by a working group coordinated by Corinna Morandi and Andrea Rolando at Politecnico di Milano, Dipartimento di Architettura e Studi Urbani (DAStU).

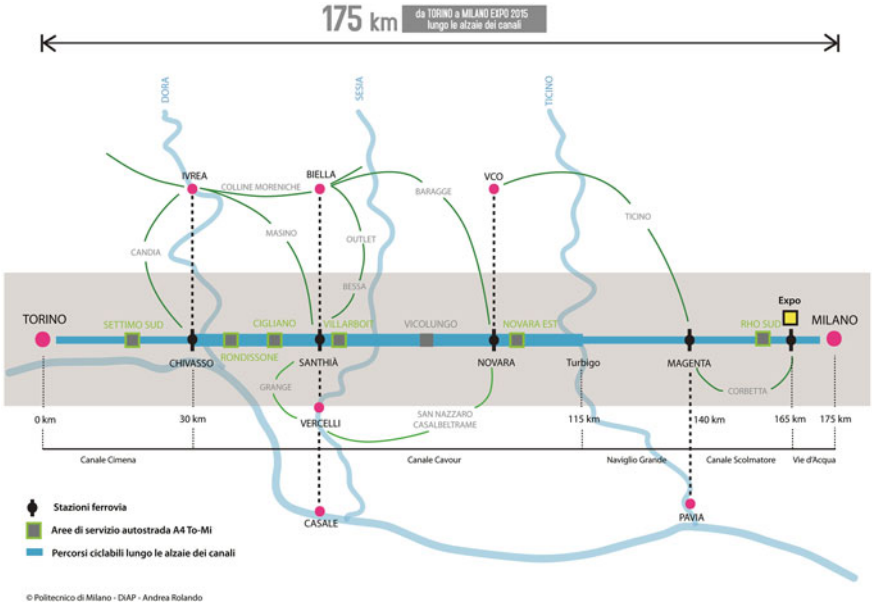

Fig. 1.2 The intermediate places within the metropolitan region between Milan and Turin as interfaces between long and fast networks and short and slow ones. *Source* Rolando

local authorities[3] but is recognizable in terms of the existing spatial and socio-economic dynamics (De Magistris and Rolando 2011).

Firstly, the recent completion of the infrastructural corridor consisting of the motorway and the new high-speed railway is producing significant changes in the entire regional system between the main nodes (related to long and fast networks) and the intermediate ones (related to short and slow networks) (Fig. 1.2): in-between places which risk being affected by segregation processes or, otherwise, being excluded from different enhancement programmes (environmental, socio-economic, productive, touristic) supported by the recently completed or planned infrastructures. Secondly, the entire area could become a privileged reference for Expo 2015 because of its distinctive economic and landscape features, which make it complementary to the official Expo site near the Milan Trade Fair in Rho. Both leisure and productive activities connected to agriculture directly relate to the theme of the event (*Feeding the planet, energy for life*) and may transform the open space system between the two dense Milan and Turin metropolitan areas into a sort of large and interregional central park (Fig. 1.3). Thus, in an analogic way, this area may be allusively compared to the urban Central Park within the dense urban fabric of Manhattan in New York City (Rolando and Di Vita 2014).

[3]Which includes two Regions (Lombardy and Piedmont), three Provinces (Biella, Novara and Vercelli), two new Metropolitan Cities (Milan and Turin) and dozens of Municipalities.

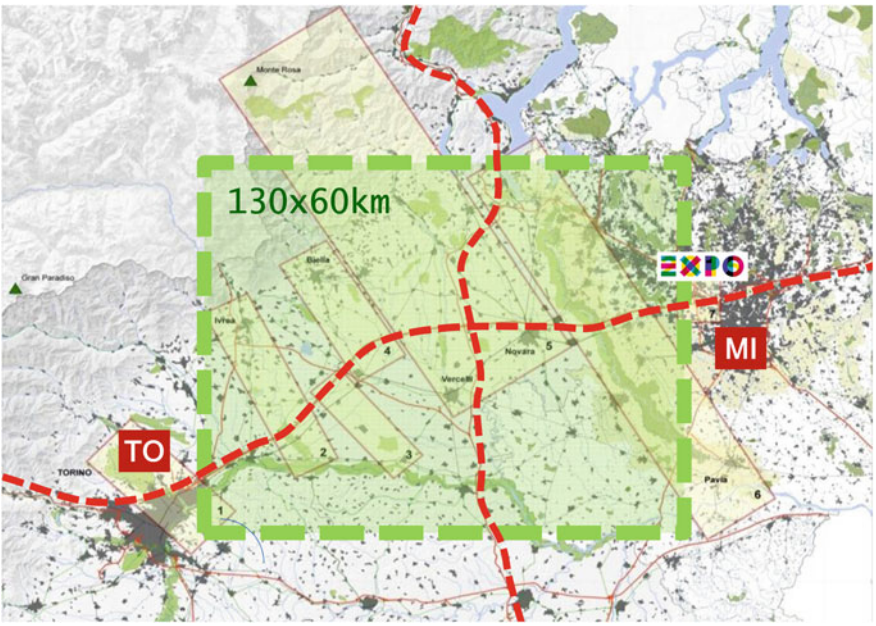

Fig. 1.3 The metropolitan region between Milan and Turin can be conceptualized as a large and interregional central park between the two dense Milan and Turin metropolitan areas. *Source* Rolando

The research questions had arisen over the years from various experiences: the research conducted within the *Osservatorio Milano Torino* of DAStU[4] and the multidisciplinary didactic projects developed within the *Alta Scuola Politecnica* (*ASP*)[5] between Politecnico di Milano and Politecnico di Torino. The focus of these preliminary activities, which preceded and accompanied the research during its 2 year development (2012–2013), was determining the importance of technology and new communication tools as factors that may affect not only people's behavior (for instance, by offering new opportunities to share activities, interests, goods or services, and by increasing awareness about environmental sustainability) but also processes of socio-economic change (for instance, by supporting forms of new and digital economy development) and spatial transformation and integration (for instance, by increasing the accessibility to places and to public services or by providing new tools and real-time data useful for spatial planning). Within this

[4]In particular, the seminars *Dove va il MI-TO? Una rete di saperi: primo appuntamento* (May 2011) and *Torino Milano. Prospettive territoriali per una cooperazione competitiva* (February 2012) and some publications (De Magistris and Rolando 2011; Morandi et al. 2013a; Rolando and Djordjevic 2013a; Rolando and Scandiffio 2013b).

[5]The multidisciplinary projects *COMPITO* (ASP, I cycle), *EXPOint* (ASP, III cycle), *EXPhOst* (ASP, V cycle), *E-Scape* (ASP, VII cycle) and *EXPeerIA* (ASP, IX cycle).

framework, a more detailed issue concerned the use of innovative technologies to maximize access to services as drivers of spatial and socio-economic development, starting from the new relationships between people and places established by ICTs.

The purposes of these prior activities were:

- to improve the accessibility of places through a multiscale approach, considering the enhancement potential of highway service areas and of smaller railway stations as opportunities for integration between infrastructural networks and local activities and places (Rolando and Scandiffio 2013);
- to enhance the relationships between physical spaces (i.e. the territorial hardware) and users through the experimentation of technological solutions (for instance, interfaces between users, on the one hand, and objects and places on the other, such as NFC tags or QR codes) which may improve the accessibility of places (i.e. the territorial software) and their users;
- to develop sensor systems which may foster local information collection, with potential consequences in terms of spatial management, agricultural production and tourism[6];
- to track movements of people in space to be integrated into innovative representation tools and/or regeneration projects (mapping).

A first phase of the research, implemented in 2012, sought to decline the concept of urban smartness by referring to the optimization of services furnished by university campuses: this research was developed within a first pilot project concerning the Città Studi university campus in Milan, that was implemented through the design of a smartphone application for the best use of in-between spaces within the campus. A second phase, carried out in 2013, was instead aimed at testing the localization and functional opportunities of innovative services for the development of smart spaces. This activity was undertaken within a second pilot project concerning Milan's north-western sector, which is directly related to Expo 2015, and it led to the proposal of new Urban Digital Nodes (UDNs).

Whilst the development of the first digital city schemes led to the growth of a virtual, completely spaceless, city dimension, the current challenge is the real transfer of this digital system of information and services to physical places. This transfer may modify material space uses, organization and planning, and it may increase the level of economic, environmental, and social sustainability of cities (Fusero 2008). Accordingly, in its overall framework the research experimented with the use of Information and Communication Technologies (ICTs) for the representation, promotion, management and dissemination of an integrated system of services (related to mobility, accommodation, tourism, culture, leisure, social assistance), and it explored the spatial impacts of digital services at different scales (local, urban, regional).

[6]These kinds of technologies are already available and used, beginning with precision agriculture methods.

The research scenario (articulated into its two application phases related to different issues and spatial components, with their methodology and contents[7]) specifically focused on observation of the roles and effects of mobile services (which have recently created new opportunities for communication, socialization and business) in the improvement of space uses, organization and planning, the development of collective behaviors, and the increased quality of places. At the same time, the research experimentation contributes to the debate on how to deal with some critical issues concerning (in terms of cost, efficiency and effectiveness) the excessive fragmentation of technologies and the continuous overlaps among digital infrastructures, as well as their indifference to the specificities of places. Taking these critical issues into account, the aim of the research was to encourage the coordination and integration of several service platforms, as well as to promote site-specific services through the application and experimentation of its key concepts of internet of places and urban digital nodes.

In regard to these goals, the research achieved several results through the use of different technological systems (GIS, GPS, internet services) by integrating top-down and bottom-up approaches:

- on the one hand, by developing traditional *few to many* design processes; that is, *looking from above*, using different tools;
- on the other hand, by giving an important role to final users on a *many to many* logic (for instance, by tracking potential users, organizing focus groups, or administering questionnaires, potentially useful in terms of spatial use, organization and planning); that is, *walking through*, doing direct experiences.

Firstly, during its testing phase (aimed at developing methodological tools and innovative concepts together with a specific technological application), the research project raised questions and reflections on the potentialities and effects of ICTs in regard to:

- urban and regional phenomena analysis;
- urban and regional space performance, i.e. territorial attractiveness and sustainability, by rebalancing the differences between major urban centers and intermediate nodes;
- improvement of local services (physical and digital), considering not only the advantages for technology expert consumers but also the benefits for technology unable users;
- enhancement of relations between people and places in the improvement of urban space uses, in the participation of citizens in planning processes, and in the activation of virtuous collective behaviors;
- identification of suitable interfaces among users, places and information, and of adequate graphical representations on handheld devices so as to facilitate access to services.

[7]See Sects. 3.2 and 3.3.

Secondly, the research achieved some concrete outcomes:

- experimentation of a methodology for urban nodes localization, based on the interception of existing places characterized by a high level of user flows;
- identification of an integrated system of (physical and digital) site-specific services and functions aimed at improving the quality and sociality of spaces; that is, at preventing the social segregation phenomena often provoked by ICTs.

In this perspective, the research sought to deal with two of the main risks and criticalities of the smart city approach: the lack of urban form responses to the new social relationships offered by ICTs; the reduction of people to service addressees, without the mediation of physical places or persons, thereby compromising the traditional system of social relationships within the urban space (Paris 2014). While the integration of e-networks with physical networks may lead the development of new urban uses and settlement patterns (Fusero 2008), ICTs may be considered opportunities for a spatial rebalancing (at local, urban, and regional scales) by making single places (which are network nodes) equipotential, independently of their effective spatial location.

The outcomes of the two research application phases may also be related to different stakeholders, such as:

- services and facilities providers (for instance, universities or municipalities), in regard to which a system of smart spaces, consisting of sets of (physical and digital) site-specific services adapted to their different users, has been promoted;
- citizens and city-users, in regard to which a system of (physical and digital) Urban Digital Nodes has been suggested in order to offer short-time solutions dedicated to outsiders (such as students or tourists), as well as to produce long-term benefits for insiders (such as inhabitants and commuters).

In the smart region perspective, the local and urban scales adopted by the research experimentation within the two pilot projects responded to some research requirements: on the one hand, reference to some well-known places, such as the Città Studi university campus, where substantial data and information were already available for the research group, and where students could help in testing the research outcomes; on the other hand, reference to the Expo's urban context, which was justified by several factors:

- the event's potential for multi-scalar regeneration (spatial and socio-economic), also according to the theme of the Expo itself (Battisti et al. 2011; Rolando 2011);
- the event's role in leveraging development of Milan's smartness at both the urban and regional scales (Morandi et al. 2013b; Rolando and Djordjevic 2013; Di Vita 2014);

- the event's interception of different categories of users (such as permanent or temporary inhabitants, as well as city users), which represented suitable reference for the experiments promoted by the research.[8]

This experimentation and its results in terms of methodology and contents, however, suggest its possible implementation on a regional scale, albeit taking local specificities into account. Whilst the relationships between people and places expressed by the internet of places concept require attention to be paid to the specific local features of the different spatial contexts in which this theoretical reference is applied, the urban digital nodes concept empowers different development potentials, not only at a local scale but also at a wider one, because:

- this concept refers to an urban space extended to a metropolitan region scale by the current phenomenon of city regionalism (Bolocan Goldstein 2008) and to an urbanity dimension related not only to physical features but also to use and relation intensities;
- it favours social innovation by achieving educational goals which may help to overcome the digital divide (often connected to the lesser accessibility to ICTs more frequent in peripheral areas, both at the local and urban scale of suburbs within or around cities and at the regional scale of agricultural areas outside the cities themselves) (Fusero 2008).

The final concern of the research, therefore, was to determine the potential application of its outcomes in terms of methodology and contents at regional scale,[9] i.e. through the enhancement of existing physical network nodes by providing them with digital services: from nodes of knowledge networks, such as university campuses, to nodes of infrastructural networks (roads or railways) such as rest stops, motorway toll booths, railway stations. Such nodes could be located outside cities, in-between the main urban poles, in low density regions where ICTs services are less used and where the positive and effective changes (until now tested) could be enhanced in subsequent phases of the research; that is, nodes upon which a new regional smartness plan (concretely related to local needs) could be developed, potentially affecting user flows as well as spatial uses, organization and planning.

[8]The research concerned in particular the 2015 Milan Expo scenario, not only at the local scale of the exhibition site or at the urban scale of the hosting city, but also at the wider scale of the metropolitan region between Milan and Turin. In this perspective, ICTs could be also exploited as governance tools in the post-event planning: that is, not only analyzing the spatial dynamics and encouraging the use and development of places, but also promoting participation in the formulation of policies, plans and projects in a synthesis of top-down and bottom-up approaches.

[9]See Sect. 5.2.

1.2 A Research Focus: Mobile Services and the Internet of Places

Technological innovation was initially considered to be the cause of the gradual demise of cities and the death of distance due to online connections to conduct business and social activities in any place and at any time. Simultaneously, however, the ongoing globalization process is generating re-concentration trends. It is doing so especially in certain cities, which are emerging as world nodes of the most advanced sectors of the economy, such as knowledge-intensive firms, operational headquarters of multi-national companies and other advanced services (Fernández Maldonado 2012). While ICTs minimize time constraints by overcoming space constraints, at the same time cities are minimizing space constraints by overcoming time constraints (Graham and Marvin 1996). This means that ICTs are simultaneously dispersing and concentrating activities, with complex effects on the spatial organization of cities; that is, they are simultaneously decreasing and increasing the importance of agglomeration and the local context, material and immaterial, in a pattern of *concentrated de-concentration* (Fernández Maldonado 2012).

The intersection between technology and space enables identification of new potentials for research and innovation: from the role of ICTs in the transformation of the space concepts and uses (from both a quantitative and a qualitative point of view) to the development of opportunities offered by new technologies for space analyses and design, also through the direct involvement of users (Ratti 2014). Together with an environmental connectivity led by ICTs, i.e. by making energy delivery and waste management systems more efficient and by making citizens aware of their environmental footprints: they have not substituted the importance of face-to-face contacts, but they have led to the revaluation of physical presence (Fernández Maldonado 2012). Within this context, the research adopted a social perspective: it aimed at providing services that foster interactions among users within physical proximity, instead of their retrieving information or accessing services individually. In particular, the purpose of the project was to share information which might be important for diverse groups of space users.

The integration of mobile telephones with web-based services and applications generates ubiquitous social contacts, as well as ubiquitous access to cyberspace, which may be considered a new urban domain (Mitchell 1995) and which favours the development of augmented urban spaces (Aurigi and De Cindio 2008). ICTs can enable people who stay or move in space to interact with each other or with the places where they are immersed. They can directly transmit information related to the physical space or socially share information received from sensors located not only in the main nodes but also along and around in-between spaces. This relationship between people and places within the urban environment, in analogy with the growing *internet of things* concept and towards that of an *internet of cities* (related to the development of increasingly connected self-sufficient urban poles consisting of systems of intelligent components) (Guallart 2012), may give rise to an *internet of places* concept. This notion refers to groups of users with common

interests who may want to share real-time information about built or unbuilt places; that is, an instant social community created by people sharing interests in specific places. Consequently, research may also contribute to definition of the boundaries of specific environments identified by social groups or social practices of use, the purpose being to understand dynamics that govern life in cities or outside cities and to improve the effectiveness of planning and design actions.

A growing branch of urban studies is now exploring the use of social networks within urban geography, planning and design (Silva Lizcano 2014). These can integrate traditional urban observations, interpretations and assessments based on static data (expensive to find and keep up to date), by furnishing temporal data which can contribute to the development of emotional and real-time urban analyses (Bauer et al. 2012; Liu 2006; Manfredini et al. 2012; Ratti et al. 2006), as well as to urban monitoring, planning, design and management (Ciuccarelli et al. 2014a; De Pascali 2012; Evans-Cowley and Griffin 2011; Morandi et al. 2013a; Soudunsaari et al. 2008; van der Spek and van Schaick 2008), also termed 'city sensing' (Ciuccarelli et al. 2014b). A collection of data and a promotion of participation processes enabled by ICTs, which can lead to the implementation of new services useful for public administrations, companies and citizens.

The post-industrial society, which has replaced the centrality of manufacturing activities with the development of a service economy, has been otherwise termed the 'information society' or 'communication society', that is, the 'knowledge-based society'. These concepts express a transition from industrial capitalism, based on the construction and distribution of material products, to cognitive capitalism, which is oriented to the development and dissemination of information and expertise. Knowledge results from information voluntarily or involuntarily shared through polycentric and global networks provided by ICTs, which have disrupted the traditional organization of polarized and hierarchical Fordist society (Rullani 2004). The evolution of the economic and social system, the spatial dynamics and technology development that have arisen in recent decades require enlargement of the concept of community services, which in contemporary cities is articulated into different forms. It integrates material services located in space (such as schools; cultural, social and sport facilities; public green areas) with immaterial services unrelated to physical places (such as, partially, welfare and health); that is, it merges fixed services with mobile ones (such as services provided through telecommunication systems using different kinds of personal devices). The research focused in particular on mobile services, which sever the traditional relationships between services and users by favouring immediate accessibility to and the sharing of information, as well as the flexible use of smarter spaces.

Whilst, on the one hand, the boom in mobile services enables (anytime and anywhere) close and distant relations between things and places, or between experiences and knowledge, on the other hand, the analogy between physical and virtual networks, or between nodes/places of material networks and nodes/sites of internet networks, requires exploration of the existence and meaning of relations between the physical spaces of urban, peri-urban and intra-urban areas and the virtual spaces of ICTs. This is another way to approach the suggested analogy

between the internet of things (a concept frequently exploited by research and innovative productions) and the internet of places (a new concept that still needs to be explored).

The spatial potentialities related to ICTs raise theoretical questions that the research framework sought to explore. The use of mobile phones has rapidly brought about a transformation of the traditional concept of space (consisting of nodes, networks and areas) as well as of its potential and use. It has done so on the one hand by making places (often standardized) in large metropolitan regions eloquent (Ferraris 2014), that is, by making them recognizable because of their 'imageability' (Lynch 1960); and on the other, by furnishing experiences of constant delocalization between the local dimension of places and the global networks of communications. The space-time extension of experiences and information provided by the digital devices introduced in the past 15 years enables recognition of close analogies between immaterial communications networks and material networks which innervate physical space (Ferraris 2014). That is, it allows places to sediment and provide more detailed and stratified data and information, and to integrate the experimental field of the internet of things (on which innovation in industrial production is taking place) towards the new frontier of the internet of places, by intercepting the activities and needs of different categories of stakeholders: from local authorities to functional institutions; from economic operators to users, be they insiders (such as inhabitants and commuters) or outsiders (such as temporary city-users, for instance students, tourists, or other kinds of visitors).

In this sense, ICT services contribute to the development of social spaces by improving the spatial quality and the social value of places. Consequently, ICT services can be considered innovative location-based services, where location is not only a position but also a stronger relationship between users, devices and surrounding spaces. At the same time, spaces which are shared (physically or virtually) by people through ICTs can be considered digital nodes: places which in a general sense can furnish services, both physical or digital, to people through the direct interaction between users and the digital infrastructures provided by the space itself, and which may therefore enhance their role. The development of this kind of places could be furthermore important if we consider not only the urban scale (the one until now adopted by the research experiments), but also the regional scale (to which the research at the end tends), where the effects of the digital divide are most marked, also because of gaps in the connectivity networks.

With the aim of investigating possible new relationships between people, places and their related knowledge within the information society made possible by the use of mobile personal communication devices, the *E-Scape* project of Alta Scuola Politecnica (ASP) in partnership with Telecom Italia sought to interpret and apply the internet of places concept by conducting a first experimentation, whose outcomes were useful for the development of the research reported here. Conceiving the metropolitan region between Milan and Turin as a network of physical nodes enriched by ICTs, and consequently as a network of digital nodes, the ASP project

considered these places as analogic internet sites which could be directly accessed by users with their mobile devices in order to obtain and share information (Rolando and Djordjevic 2013).[10]

1.3 From Urban Nodes to Urban Digital Nodes (UDNs)

In the fields of urban and regional geography and planning, the terms 'node', 'centrality' and 'polarity' are often used as synonyms. These concepts are intrinsically multiscalar, because they are declined in relation to territorial components which may assume different sizes according to the scales used for their observation: micro/local, meso/urban, macro/wide (in its turn, articulated into regional, macro-regional, global). From the services in neighborhoods, the main functions in cities and metropolitan areas, the urban poles in regional and macro-regional systems, to the territorial platforms formed by metropolitan regions in the global space: these are different scales, whose traditional tensions are increased by renewed relations between local and supra-local systems due to economic and cultural globalization.

The reference scale affects the size of these places, which ranges from a point dimension to an area one: at the local scale, nodes, centralities and polarities can be identified with a single building or an open space; at the urban scale, their size can be extended to a system of buildings or open spaces; at the wider scale, it may expand to the entire urban fabric. Tensions between global integration and local differentiation have produced a boom of spaces in which the relationships among different scales are constantly rearranged and reterritorialized. In this context, metropolitan regions are the places in which and through which multiscalar reconfigurations of physical spaces produced by globalization are contextualized (Brenner 2000). The regional or macro-regional dimension assumed by urbanization processes (Scott 2001; Hall and Pain 2006), as well as the spatial transformations produced by the digital revolution (whereby cities and their components acquire their meaning not only through their spatial proximity relationships but also as nodes of supra-local networks and flows, material and immaterial) confirm that it is necessary to read and manage urban phenomena in variable geometries from the local to the wide scale.

The heterogeneity, fragmentation, and complexity of contemporary cities require a substantial rethinking of the node, centrality and polarity concepts. New urban poles integrate community services with commercial and leisure activities, and they are based on public space quality. In general, they are like 'containers' characterized by high accessibility, quality, attractiveness, innovativeness and identity which simultaneously provide services and goods. Therefore, they are also characterized by a significant social value. In complex cases, these poles also incorporate

[10]See Sect. 2.4.

accommodation, business, logistics and sometimes residential and new leisure functions. For places characterized by greater complexity and functional importance, as well as by high attractiveness because of their multimodal accessibility, the expression 'superplaces' is suggested. These are poles able to draw new geographies often disconnected from traditional administrative arrangements and due to supra-local reticular territorial systems. These hybrid places are often replacing traditional public spaces (such as the historic city centers) and they attract or intercept flows of different users (Paris 2009).

Superplaces can also be defined as poly-functional compounds characterized by strong relationships with physical infrastructures which ensure their accessibility: on the one hand, through local flows generated by surrounding urban centers belonging to the so-called catchment area; on the other hand, through cross–flows. These poles relate to short and medium networks (for instance, malls along the rings of major urban areas) or long networks (for instance, outlets along the main national infrastructural corridors) and they are frequently configured as introverted spaces. They are places which internally deploy the relation and exchange density and complexity typical of traditional public spaces, but which at the same time reject direct relationships with their immediate surroundings. Alongside the historical urban nuclei, these large poles represent new territorial components of post-modern cities and regions: that is, 'urbanity' places which support social relations and exchanges (Bonfantini and Di Giovanni 2011). From this perspective, new digital infrastructures may contribute to the change of these superplaces, because their functions, which usually require heavy physical infrastructures (hardware) and consequently waste large quantities of space, could be partially performed by digital services, mainly immaterial (software): a radical change of superplaces without loss of their traditional intensity of uses, but potentially reducing the differences between the concepts of node, centrality and polarity.

By overcoming the extraordinary size of superplaces and recovering the multi-scalar size of nodes, centralities and polarities, urban and regional poles can acquire the connotation of places when meaningful practices take place (Malpas 2012; Norberg-Schulz 1988): for instance, through settled activities, infrastructural connections, and environmental relations, as well as beginning with their inclusion in shared strategic visions and the implementation of appropriate design strategies at urban and architectural scale. These solutions may favour overcoming the 'not-places' dimension (Augé 1992) often attributed to monofunctional, homogenizing and self-referential mega-facilities developed in the past few decades (Fini 2010; Pomilio 2009; Tamini 2011).

Nodes, centralities and polarities can therefore be considered territorial landmarks that, at different scales, integrate various flows (proximity users, such as local residents, and others, such as commuters, passengers for tourism or business, intentional visitors), representing an interface between local and global systems. Regardless of their size, these places therefore generate wider influence areas. The meaning of these territorial landmarks relates to their role as condensers of several activities and functions, and as attractors of different categories of users, affecting the spatial organization and planning of cities and regions. They are opportunities

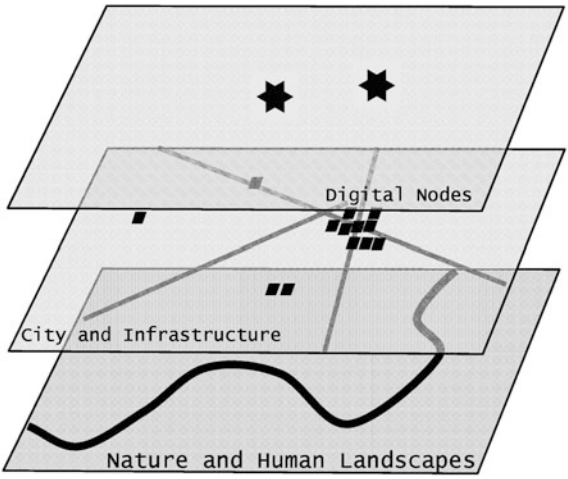

Fig. 1.4 Nodes at the intersection of layers of networks. *Source* Rolando

for the retraining, regeneration and reconstruction of both physical space (for instance, spatial quality improvement beginning with the strengthening of public spaces and the condensation of fragments in which urban and regional post-industrial systems are articulated) and the local socio-economic fabric (for instance, by modifying relation flows of different urban populations, or increasing territorial competitiveness). These opportunities should be exported from consolidated cities to peri-urban and inter-urban areas, where the demand for a system of central places (around which to promote a process of spatial re-concentration) is underlined by the development of new integrated commercial poles that began in past decades and has been consolidating in recent years (Morandi 2009; Morandi and Paris 2013).

Notwithstanding the frequent interchangeability of the terms 'node', 'centrality' and 'polarity', different meanings can be still recognized in the functional and spatial areas to which each term refers. On the one hand, the concepts of centrality and polarity ideally denote facilities which excel in the complexity and richness of their functions and attractiveness to flows of different categories of users. On the other hand, the concept of node directly refers to that of network: it corresponds to territorial junctions crossed by flows of people and goods, providing functions and services and activating material and immaterial connections between places and users.

For these reasons, the research referred to the term 'node' as its operational concept, qualifying it as urban and digital (Fig. 1.4):

- urban because it refers to physical places which are characterized, on the one hand, by the compactness and density of architectural components and the urban fabric, and on the other, by the high level of exchanges and relations activated by their functional mixing;

- digital because the boom of the ICT sector, which is leading to the widespread use of sensor systems and mobile phone applications (which affect the use of places and stimulate a new system of virtual nodes independent from their actual rank in a spatial network, but potentially influencing spatial use, organization and planning), integrates physical and virtual dimensions.

This means that the Urban Digital Nodes (UDNs) proposed by this study always comprise (at the same time) both physical and digital components: through the use of ICTs, they offer site-specific services for personal mobile devices which can directly link location-based virtual worlds and the real world (for instance, by adopting the principles of augmented reality) and are able to enhance *people–place–people* relationships (thus contributing to an increase in social inclusion and a decrease in the digital divide).

In the traditional geographical and urban planning culture, nodes generally correspond to places within physical space connected to both infrastructural and social networks and hierarchically provided with different sizes, shapes and functionalities. They are characterized by the polarization of a high density of flows and functions, as well as by the facilitation of exchanges and connections. They thus impact on the organization of the local space and on the relations (material and immaterial) between places and different subjects (Moretti 1999).

The growth of the ICT sector connected to the development of telecommunication networks leads by analogy to the identification of a system of digital nodes based on sensors installed in space to support the new technologies:

- on the one hand, the exponential development of smartphone applications affects the usage practices of places; in particular, the (increasingly numerous) applications related to space knowledge and use generate a new system of immaterial nodes (independent from space, but influencing space and affecting user flows), whose importance is established in a virtual way by the community of network users;
- on the other hand, the spread of mobile devices requires the development of a support equipment system (increasingly widespread, advanced and efficient), which has been rapidly launched and consolidated over the past decade, starting with the more technologically advanced cities and regions.

Within this context, whilst the Urban Digital Nodes aim at integrating the physical and digital dimensions, they seem able to contribute to the theoretical debate on the potential transfer of a pure virtual dimension of cities, often produced by new technologies, to the physical one, beginning with the innovation of space uses and organization driven by ICTs. That is, a place where computers within buildings may be substituted by an intelligent building itself, able to interact with its users. At the same time, it is a smart space oriented to experiment the use of the internet to promote local interactions among individuals and to stimulate the development or reinforcement of communities according to the UDN endowment with site-specific and location-based digital services by combining architectural and urban design components with technological ones.

Within the global networks of cities, which extend beyond the traditional and obsolete administrative borders, this planet-city may be compared to the internet, given that it consists of multi-scalar nodes, connections, environments and information: from the dwelling to the building; from the city block to the city; from the region to the country, up to the planetary scale. If each planet node, whatever its scale, has a digital identity, everything can be connected to everything else (Guallart 2012). According to the multiscalarity of the urban nodes concept, also that of urban digital nodes may therefore encompass multiple forms and dimensions in relation to the potentially different points of view: from services in neighborhoods (within single buildings or open spaces) and main functions in cities and metropolitan areas (through systems of buildings or open spaces) to urban poles in regional and macro-regional systems and territorial platforms formed of metropolitan regions in the global space (referring to the entire urban fabric and, eventually, to its surroundings).

A partial precursor of an Urban Digital Node extended to the entire urban fabric and related to global networks is provided by the transformation of the medieval Italian village of Colletta di Castelbianco (on the mountains facing the Ligurian Riviera di Ponente) into a so-called *electronic borgo* (designed by Giancarlo De Carlo in 1980). The aim of this intervention was to attract new residents and visitors to a place that was depopulating (because of its location distant from the main transport infrastructures) by offering both high environmental and urban quality and new housing, jobs and tourist opportunities; that is, by integrating the renewal of the physical space of the old village with the endowment of last-generation ICT infrastructures and services, in order to exploit the place's material features and connect it to global information flows.[11] Similar is the ongoing experience of Esino Lario: in 2016, this other small Italian village (on the mountains overlooking Lake Como) will host the world meeting of Wikipedia volunteers, called *Wikimania*, having won a competition with large world cities like Atlantic City (US), Chennai (India), Dar es Salaam (Tanzania), Manila (Philippines) and St. Louis (US).[12] Before, during, and hopefully after celebration of this event, Esino Lario will be transformed into a sort of Urban Digital Node by integrating its physical urban features with the digital component consisting of the Wikipedia network. Hence, both these small villages demonstrate the capacity of ICTs to overcome physical barriers and limits, to enrich (and not reduce) the quality and attractiveness of material places, as well as to produce a territorial rebalance between main urban poles and intermediate areas (often marginalized by global development processes): a system of potentials which the present research itself tends to promote.[13]

[11]Colletta di Castelbianco has been transformed into an attractive place in which to live, work and spend a holiday, because the entire village has been converted into an innovative workplace as well as in a widespread hotel (website: http://www.borgotelematico.it/).

[12]Website: http://meta.wikimedia.org/wiki/Wikimania_2016_bids/Esino_Lario.

[13]See Sect. 5.2.

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Chapter 2
The Background: A Critical Analysis of the Ongoing Milan ICT Projects

Corinna Morandi and Stefano Di Vita

This chapter aims at introducing the rapid development of the smart city concept and its different meanings and at highlighting at the same time its potentials and risks through a review of bibliographical references: from the original concepts of intelligent, digital and creative city, to the recent ones of human smart city and sensible city. Considering the Italian context, in light of a smart concept that to date has been mainly restricted to the urban scale, Milan is investing significant efforts and resources in smart city projects, also in relation to the 2015 Universal Exhibition. Many initiatives have been directly launched or supported by the municipality, while others have been promoted by the mega-event management company Expo 2015 Spa. Whilst Milan is the main urban pole of a larger metropolitan area that extends beyond the traditional administrative boundaries (metropolitan and regional) and is included in the wider Northern Italy city-region context and whilst the theme of Expo 2015 (*Feeding the planet, energy for life*) directly involves the agricultural area all around the inner city, the research project suggests a shift from a smart city concept to a smart region one (Fig. 2.1). In this perspective, it also suggests to pay particular attention not only to the main urban centers but also, and especially, to the peri-urban and intra-urban areas in order to remedy their marginality with respect to the stronger nodes.

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PoliMI SpringerBriefs, DOI 10.1007/978-3-319-17338-2_2

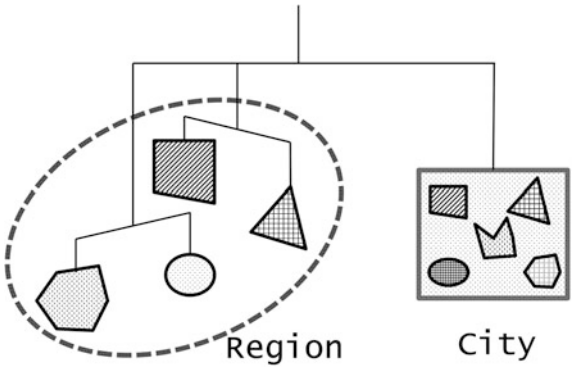

Fig. 2.1 The shift from the smart city concept to the smart region one, in the perspective of a new mutual balance between City and Region. *source* Rolando

2.1 Smart Cities in Italy: Problems and Potentials

Amid the development of the service and knowledge-based society and economy in the past decades, the recent growth of the new manufacturing sector, and the deep discontinuity produced by the global crisis, the increasing attractiveness of urban poles influences current public policies throughout the world. In this general context, by restricting the research field to the European area, and in particular to the Italian one, specific attention to the urban space could be recognized within the policies of the European Union and its member states: policies aimed at enhancing the role of cities as engines of innovation and territorial cohesion, and at addressing the significant social inequalities and the critical environmental issues generated within the urban areas.

While the 19th century was the century of empires and the 20th century was the century of nation-states, the 21st century will be the century of cities (Guallart 2012) connected by global networks of infrastructures (that is, the hardware) and information (that is, the software). In Italy, for instance, cities are playing an important role in the national development: they host almost 80 % of the Italian population, they are centers of economic and social innovation, they concentrate serious problems (such as pollution, waste, hydro-geological risks, safety, social exclusion and conflicts), but also a high amount of human physical, intellectual and cognitive capital. For these reasons, Italian cities require the superseding of fragmented and sectoral policies and the spread of a strategic approach oriented to improvement of their quality of life and to their international repositioning (CIPU 2013). For these purposes, several programmes and projects have been promoted by the European Commission or by the Italian government to tackle the issues raised by the new urban agenda, which is influenced by the impacts of the financial and economic crisis and by the growing environmental, climatic, energetic and social emergencies.

Among the latest policies and regulatory tools of the European Union and its member states, which affect the urban agendas, a specific contribution is made by programmes concerning digital innovation, sustainable mobility, energy efficiency, as well as spatial, environmental, economic and social regeneration, which are often expressed in and summarized by the 'smart city' notion. From a theoretical point of view, this is an innovative concept because it is not verticalised; instead, it is intersectoral and multidisciplinary, providing opportunities for the coordination of different sectoral strategies. Since the early 2000s, and in particular in most recent years, the smart city notion has undergone exponential growth, also because it has been frequently considered a useful response to the 2008 global crisis currently ongoing in European countries. The smart city concept could activate multidisciplinary skills and interests through the promotion of new relations between digital technologies and urban studies at different scales (local, urban, regional). These relations could, for instance, increase the understanding of urban and regional phenomena and the development of innovative projects in terms of enhancing the physical space and strengthening social practices.

The digital revolution of recent years has greatly transformed people's lives and jobs by enabling unprecedented organizational and networking capacities with significant consequences for work processes and daily life, as well as for urban spatial organization and planning, beginning with the improvement of worldwide communications and transports, urban systems efficiency, and the knowledge-based economy (Fernández Maldonado 2012). For instance, within the current so-called information or network society (Castells 1996; Edgar 2006), the boom of ICTs has modified urban space use (through the increasing web purchases of goods and services, or the growing e-governance that favours online interaction between public administrations and citizens, city users and companies) as well as the urban study, planning and design processes. This is so in terms of both knowledge acquisition and outcome monitoring (beginning with the increasing use of open and real-time data) and in terms of decision-making (through the participation of different stakeholders) (Fusero 2008). Information and Communication Technologies are radically transforming the observation of urban phenomena and trends, with effects on the development of urban studies, plans and projects. The growing number of satellites, drones and sensor networks, at macro-level, as well as the myriad of personal devices, able to furnish a huge and exponentially growing amount of real-time data which are increasingly more open and sharable, raise new research questions: for instance, how to make their use meaningful for analyses, as well as useful for increasing urban efficiency, quality, resilience and smartness, and for designing cities according to social needs. These dynamic data enable planners and designers better to assess and understand the complexity of the urban context and of its spatial, economic and social components. At the same time, these open and real-time data are radically changing the interaction between people and places, empowering citizens to make active contributions to the urban planning, design and management of cities (Luebkeman and Hargrave 2014).

Within the currently developing global economy and city network (Sassen 2001), even though urban smartness could enhance urban sustainability and

attractiveness (through spatial regeneration, economic and social innovation, or environmental quality improvement), it is not possible to ignore the risks of a smart city development exclusively based on a technocratic and market-oriented approach: that is, mainly intended to support urban marketing programmes and only based on ICT solutions proposed by large multi-national companies rather than on actual environmental and social needs. This approach may therefore induce a decrease in urban space complexity, as well as in the richness of political debate because of an acritical use of new technological devices (Fernández 2014; Di Vita 2015).

Contemporary cities are affected by the spread of means of information and communication: on the one hand, ICTs ensure consistent and accessible information flows, which influence economic activities and social practices; on the other, they require the establishment of related infrastructures and interfaces, which often qualify spaces and buildings. The smart city perspective is therefore also expressed in terms of the 'media city', although this approach tends to overemphasize the role of innovative technologies in improving the efficiency of the existing city: the long-term impacts on the urban quality and sustainability are often underestimated unless a critical assessment of the urban development, useful to support a radical change of lifestyles, is conducted.

Technology may be considered an opportunity to support innovation if the ecological and social approach is not once again subordinated to economic growth (Franz 2012). ICTs can make a valuable contribution to dealing with common urban emergencies, but they are not enough: innovation should be embedded in a wider development vision, which requires multidisciplinary skills and actions generally used to go beyond the capacity of local administrators. Therefore, necessary is coordination among different sectoral policies, which may be synthesised into the smart city platform: the implementation of a technological infrastructure able to support the exchange of information, producing intelligence and inclusion, and improving the local quality of life (Granelli 2012).

Since the beginning of the new millennium, and with an acceleration since 2010, the smart city concept has widely and rapidly spread within urban development policies. In the absence of a single and shared definition, in a few years its meaning has been extended from that of a digital, intelligent or wired city, mainly connected to the development of technological infrastructures (hardware), in particular media, to a wider meaning of an attractive and creative city, environmentally friendly and socially inclusive, particularly connected to the enhancement of human and social capital (software). This evolution from connected or intelligent city (Mitchell 1995; Graham and Marvin 1996) and digital city (Aurigi 2005) to creative city (Florida 2005) and their current convergence in the smart city concept correspond to the development of their purposes from a perspective of urban efficiency to a perspective of quality of life (Boscacci et al. 2014); that is, a shift in focus from ICTs and physical spaces to people (ICT and space users), to which the research presented in this book directly referred. This is a very short but deep transformation of meanings, which may be synthesised by the recent notion of the (smart) 'sensible city' (Ratti 2012). Within this cultural context, the smart city concept may therefore

express an urban model able to guarantee a high quality of life and the personal and social growth of people and companies in relation to sustainability targets (ABB and The European House-Ambrosetti 2012).

The definition of *smart* applied to cities is now much abused and frequently accompanied by rhetoric, often excessively awarded by a salvific value in relation to local critical issues worsened by the crisis. At the same time, it is often trivialized, because it is frequently implemented by episodic projects unrelated to an organic vision of innovation and urban development (Cassa Depositi e Prestiti and Politecnico di Torino 2013). For this reason, if it is possible to state that the internet has changed our lives, it is also possible to recognize that it has not yet changed our cities (Guallart 2012). The smart city concept is increasingly applied within the marketing strategies of cities and multinational ICT companies. Even though there is no single definition of urban smartness—because the concept involves several disciplines and consequently cannot be framed (Paris 2014)—a city can be considered smart if investments in infrastructures (such as transports and ICTs) lead to economic, environmental and social development, as well as to new opportunities and forms of urban governance and participation (Seisdedos 2007); that is, if it integrates into a networked urban pattern goals and actions of environment protection, social sharing, energy efficiency, economic sustainability, as well as urban management participation (Imbesi 2014). Whilst the smart city concept generally refers to a system of strategies intended to improve the quality of life in cities through the exploitation of ICT potentialities, the relations between innovation, new technologies and new urban form patterns are still missing (Paris 2014).

The main value of the smart concept, often belied by its real applications, resides in its capacity to stimulate, also through the use of ICTs, a lifestyle change and, therefore, profound reflection on the environmental and social critical issues which are frequent in the urban areas (decay, imbalances, poverty, un-safety, conflicts). However, in smart cities, technology (with its commercial implications) should not be seen as an end, but rather as a means to improve the quality of life (environmental, economical, social). Regardless of their spatial dimensions, smart cities must not only be based on smart infrastructures; they must also, and especially, recognize the centrality of the needs of different urban populations expressed on the public policy agenda (Castells and Himanen 2002). If people's lives are increasingly influenced by the use of digital devices which modify the perception and use of urban spaces (Ciuccarelli et al. 2014; De Waal 2014; Ferraris 2014; Morandi et al. 2013a), local administrators must promote the training of smart citizens, who should be involved and educated in planning processes through effective communication and participation activities (made possible by ICTs). From the perspective of a truly human smart city, mainly and directly oriented to different urban populations, rethinking urban spaces should be favoured principally by recognizing citizens' needs and stimulating their contributions, and not just by rationalizing the use of resources or improving the efficiency of services through the application of technology, which should be considered a tool and not as a goal (Peripheria 2014).

Despite the rhetoric frequently surrounding the smart city issue, several cities, universities, utilities and companies seek to promote services and implement

products able to support the development of urban smartness (Van Beurden 2011). Most of the projects promoted to date at worldwide level favour sustainable mobility, energy saving, intelligent buildings, or a decrease in the environmental footprints of urban settlements; but the broad and not clearly defined smart city concept involves other and different sectors. An international reference in this regard is the classification drawn up by the University of Vienna, together with the Universities of Ljubljana and of Delft, now called the *Vienna Model* (Giffinger et al. 2007), which identifies the following categories of urban smartness:

- smart environment (that is, natural resources);
- smart mobility (that is, transports);
- smart economy (that is, competitiveness);
- smart governance (that is, participation);
- smart people (that is, social and human capital);
- smart living (that is, quality of life).

Within a critical framework concerning the potential for development in the European context (Kunzmann 2011), the first indications of the Italian government, expressed by the Monti government (2011–2012), stress the importance of identifying an Italian way to smart cities. This should be based on local potentialities to be exploited and on local criticalities to be solved. This specific issue has been suggested also by some recent studies and publications. On the one side, there are the resources consisting of the heritage of ancient villages and historic town centers and widespread cultural resources (not only in terms of digital service application in order to improve their enjoyment, but also in terms of innovated construction techniques in order to improve their restructuring and requalification); the traditions related to food and nutrition, now emphatisez by the Milan Expo 2015; and the richness of art and craft activities. On the other side, there are the threats of the anthropic pressure of tourism; population aging; welfare system complexity; and the difficulties of multi-ethnic coexistence (Granelli 2012).

One of the European countries where investments in smart cities have been most intense is also one of those most penalized by the crisis: Spain, whose cities have seen this innovative approach as an opportunity to address the severe difficulties caused by the lack of resources (Postacchini 2012). With some delay, also in Italy this challenge is now being rapidly taken up: several projects have been recently implemented or activated in Italian cities, although the most common types of projects within the cities monitored by the *Osservatorio Nazionale Smart City* of the *Associazione Nazionale Comuni Italiani* (ANCI)[1] mainly refer to green mobility, urban and environmental regeneration, renewable energy, and smart building (from the energetic and seismic points of view). However, their slogans often exceed the real quality of the proposals, which, moreover, are very different in their content and method of implementation (Associazione Nazionale Comuni Italiani, Osservatorio Nazionale Smart City 2014).

[1]Website: http://osservatoriosmartcity.it.

The economic resources to date allocated to smart city projects are based on a large percentage of public resources which, however, are unlikely to be available in the coming years.

They divide among:

- municipal funds (53 %);
- regional funds (16 %);
- public-private partnerships (10 %);
- European funds (8 %);
- national funds (6 %);
- private sponsors and endowments (5 %);
- other funds (2 %).

(Fiordalisi and Tripodi 2014).

The spread of the smart city concept is relatively recent. It has been encouraged by recent European policies and, in Italy, by measures approved by the national government: for instance, the so-called *Decreto Crescita 2.0*[2] interpreted urban smartness as an opportunity for innovation of the production system and, therefore, for economy recovery in the current crisis.

The consequent scientific debate is mainly centered on exploitation of smartness potential from the perspective of local communities. It emphasises the importance of combining the technological dimension and the commercial repercussions of smart city projects with greater sensitivity and responsibility towards people's services: for instance, by increasing the quality of administrative functions or the sharing of information with citizens and city users, beginning with the supply of open data; by developing new (real-time) urban studies, plans and projects, as well as new (flexible and often personalized) urban services through the connection of the large amount of available data; by encouraging the cultural use, the social inclusion and, therefore, the development of a real smart community (Cassa Depositi e Prestiti and Politecnico di Torino 2013; De Pascali 2012; Manfredini et al. 2012; Morandi et al. 2013a).

Because of the 2008–2014 crisis, and the consequent economic downturn, there are signs that the collective enthusiasm for smart cities is declining. The former expectations have been somewhat reduced owing to the increasing difficulties of public finances, as well as to a frequently superficial approach based on the acritical importation of global models not always easily applicable at the local level (Manfredi 2014). The first critical aspect of these projects concerns their feasibility. If the interventions hitherto promoted by the Italian cities have mainly used public funds, the scenario for the future is entirely different because of the current contraction in the economic resources availability and in the spending power of local public administrations (due to the crisis), which have been determined by the so-called *Patto di Stabilità* and *Spending Review* policies adopted by the Italian government.

[2]Italian Government Decree n°179/2012.

Besides the improvement of advanced forms of public–private partnership, entrepreneurships and green public procurement, a significant contribution could also be made by the 2014–2020 European funds for urban renewal, beginning with the recently-published first Horizon 2020 calls. These are important resources, but they must be integrated with private investments and innovative financial tools, together with good programming skills of local governments (Fiordalisi and Tripodi 2014; Fusero 2008). Especial attention should be paid to the infrastructural investment potential of companies operating in the ICT sector, which could be encouraged by political and legislative stability, simplification of administrative procedures, public administration efficiency and technical skills: features in regard to which Italy unfortunately has huge difficulties. The Italian share of ICT investments in relation to GDP is one of the lowest in Europe (2 %), while digital innovation could be an opportunity for economic development and the solution of important social challenges (Cassa Depositi e Prestiti and Politecnico di Torino 2013).

A second critical point concerns planning capacity. Among the methods used to promote smart city projects, only a few local administrations have until now operated on the basis of an overall urban development strategy: a wider and systemic strategy which should be based on multidisciplinary contributions and designed not as a dirigist plan but as a flexible and shared process. This tool should coordinate different sector policies, and identify and enhance the vocations of places hit by the crisis. If urban smartness must, by definition, favour bottom-up design and construction, it is also necessary to integrate these different bottom-up proposals within the framework of a shared strategic vision which should be organic and long-term, as well as being promoted by local governments. This scenario should support the identification of priority intervention areas within a general context of increasingly scarce resources (Cassa Depositi e Prestiti and Politecnico di Torino 2013). Although this approach is widely shared, most of the Italian cities seem to operate through episodic and non-integrated interventions, which have been previously designed and which are only subsequently communicated as smart city projects.

The technological vision and the financial planning, which underlie the urban smartness, must therefore be oriented toward a social vision by requiring the hybridization of different disciplinary skills. Whilst the current schemes have been mainly centered on the use of technology to engage citizens in public decision-making processes, the smart planning challenge must be treated as an opportunity to build a stronger and more shared local governance. The latter should be based, on the one hand, on a wider partnership between territorial institutions and actors (local, regional, national and European), functional institutions, associations, enterprises, citizens and their representation; and on the other, on a suitable organization (in terms of facilities, procedures and skills) and skills improvement of the involved stakeholders about the use of ICTs to manage and develop cities. Thus the top-down approach should be integrated with a bottom-up one.

The challenge of urban smartness requires superseding the technological top-down approach (based mainly on the use of sensors), and it should offer opportunities for the development of a new awareness of its potentials (Bolocan

Goldstein and Bassetti 2014). The integrated platform, in which a smart city project should be implemented, must refer to local features. In the case of Milan, for instance, the inner city is the main urban pole of a larger metropolitan area that extends beyond the traditional administrative boundaries (metropolitan and regional) and is included in a wider context by now identified as Northern Italy global city-region (Perulli and Picchierri 2010; Scott 2001), from an economic perspective, or mega-city region (Balducci 2005; Hall and Pain 2006), from a spatial perspective: a system of urban nodes (characterized by different size and importance, and connected by an articulated infrastructural network) which constitutes a single, large, and world-level urban area.

In this scenario, the development of this city-region, which stretches from Milan to the entire Po Valley, requires enlargement of the conceptual space from smart city to smart land by disrupting the localistic logic that is usually adopted by single municipalities and frequently risks penalizing both technological and socio-economic development (Bonomi and Masiero 2014). This entails a shift from a smart city to a smart city-region (Rete Consultiva per Milano Glocal City 2013), or simply a smart region, brought about by paying particular attention not only to the main urban centers but also, and especially, to the peri-urban and intra-urban areas and, consequently, by remedying their marginality with respect to the stronger nodes (Morandi et al. 2013b).[3] This new conceptualization of physical space relates directly to the growth of virtual space articulated in a system of ICT nodes and networks which traverse administrative borders and influence economic activities, social relationships, as well as space use (Sepe 2013).

As said, by limiting the research scenario to the European area because of the relative homogeneity of its spatial and socio-economic features, the majority of smart city programmes (which have been until now launched) refer to an urban scale (Associazione Nazionale Comuni Italiani, Osservatorio Nazionale Smart City 2014; Directorate-General for Internal Policies, Policy Department A 2014). Large-scale schemes are rare. In Italy, for instance, on the one hand there are inter-municipal projects related to smart economy, environment, governance and living within the *Unione dei Comuni della Romagna Faentina*, or to the smart economy, environment, living and mobility within the *Comunità Montana Vallo di Diano* (Associazione Nazionale Comuni Italiani, Osservatorio Nazionale Smart City 2014). On the other hand, there is the experimental proposal for technological and governance innovation of the entire *Provincia di Mantova* within the so-called *Mantova Smart Region* project (Bolici and Mora 2012).

The potentialities of wider-scale smart programmes and projects relate to the involvement of marginal areas (such as peri-urban and inter-urban areas, as well as small cities in peripheral regions, often penalized by high levels of digital divide) in socio-economic innovation processes and in spatial and environmental regeneration plans also based on the improvement of ICT nodes and networks. Certainly, the conceptual transition from smart city to smart region implies not only the necessary

[3]See Sect. 2.4.

reference to a new spatial scale, but also the transfer of methodology and contents to low-density areas: issues which will be discussed in the final part of the book.[4]

2.2 The Milan Smart City Programme

The financial and economic crisis and the technological development seem to have induced a metamorphosis of the economy and society (such as, production activities and enterprise organization) characterized by the growth of digital services and manufacturing (Berta 2014; Campagnoli 2014). Some important signals of this change are apparent in the current urban policies of several European cities, beginning with the increasing development of smart city initiatives.

According to *Cittalia-Fondazione ANCI Ricerche,*[5] the first Italian cities to have promoted smart city projects are Turin, Genoa, Piacenza, Florence, Naples, Bari and Cosenza. Only in a second phase have other cities across the country, including Milan, activated similar strategies (Fiordalisi and Tripodi 2014). In particular, the Lombardy capital is currently investing significant resources in projects aimed at digital innovation, environmental sustainability and social inclusion, also with a view to the 2015 Universal Exhibition (Di Vita 2014). In recent years, Milan—which is the main urban pole of a wider metropolitan area, as well as of the entire Northern Italy mega-city region or global city-region, and which is an important node of world networks (material and immaterial)—has been affected by major weaknesses and delays in terms of the deployment and capitalization of digital infrastructures compared with the other European cities. This has determined a detriment of businesses and citizens (Bassetti 2012). For this reason, in 2011 the municipality of Milan established the new Innovation and Smart City Sector, which has begun to play a significant operational role. On the one hand, the municipality has promoted urban smartness initiatives supported by both public funds (e.g., local investments), as well as regional financings such as the POR FESR[6] application *Smart Cities and Communities*, national financings such as the MIUR[7] application *Smart Cities and Communities and Social Innovation*, and European financings such as a Seventh Framework Programme and an Horizon 2020 applications and private funds (e.g., collaboration with partners), for a total amount of 113 million euros (up to December 2014). On the other hand, the municipality has joined

[4]See Sect. 5.2.

[5]Website: www.cittalia.it.

[6]POR FESR is the *Programma Operativo Regionale* (POR) promoted by the Lombardy Regional Government in order to identify projects which may be funded by the Fondo Europeo di Sviluppo Regionale (FESR).

[7]MIUR is the Ministero dell'Istruzione, dell'Università e della Ricerca of the Italian national government.

national and international city networks oriented to ICT experimentation[8] (Associazione Nazionale Comuni Italiani, Osservatorio Nazionale Smart City 2014; Di Vita 2014, 2015).

Together with the local chamber of commerce, the Milan municipality has developed the Milan Smart City programme by integrating a wide system of initiatives. The purpose has been to catch up with other Italian and European cities and rapidly become a national and international reference. At the beginning of 2013, an internal detection led to the identification of projects and plans already activated by diverse sectors of the municipality itself, and concerning the following topics: digital city; mobility; environment; social inclusion and cohesion; services for citizens; culture and urban attractiveness. In parallel, a public hearing process has involved diverse stakeholders in the city (such as companies, universities, citizens, third sector)—consequently raising their awareness—in the design of urban smartness through the organization of participative clusters: seven focus groups, six of which are specialized in single issues related to the smartness categories proposed by the Vienna Model (smart economy, environment, governance, living, mobility and people),[9] whilst one is specifically dedicated to Expo 2015 (Milano Smart City 2014; Di Vita 2014, 2015).

The projects activated are very heterogeneous and deal with diverse topics: the innovation of services for local communities and companies (such as the city Open Data and Open WiFi, the UNI Agency and many other services for culture and tourism development, citizen inclusion and enterprise innovation); a reduction of energy consumption and pollution emissions (such as grid energy efficiency projects, district heating plans, tree-planting programmes); building retrofitting; smart public lighting; traffic and public transport planning and management; the dissemination of real-time mobility information and services; and logistics innovation (such as the Area C congestion charge, bike and car sharing, a new smartphone application system[10]). From the perspective of the research presented in this book, and in light of its theoretical concepts of the internet of places and urban digital nodes,[11] the following projects seem particularly significant:

- *My Neighbourhood—My City*, which aims at co-designing innovative services for the local community and the entire city, and at increasing social inclusion in the problematic Quarto Oggiaro district, through the use of ICTs for the connection of people, ideas and resources and through the establishment of innovation incubators (for instance FabriQ);
- *Smart City Lab* (under construction on a brownfield site in the southern city sector), an incubator and accelerator of smart city initiatives and technology

[8]Such as the national networks *MiToGe* or *Osservatorio Nazionale Smart City* and the international ones *Smart Cities Stakeholders Platform*, *C40* and *Eurocities*.

[9]See Sect. 2.1.

[10]For instance, the APPs BikeMi, iATM, ATM Mobile, PULIamo, MilanoEventi, GuidaMilano.

[11] See Sects. 1.2 and 1.3.

start-ups intended to improve the city's livability, accessibility, energy conservation, and environmental protection (Milano Smart City 2014).

The smart city transformation requires a radical innovation of infrastructures (material and immaterial), people's lifestyles, economic activities, urban governance, urban policies, urban design and planning. For this reason, although the Milan municipality has historically lacked a regional and metropolitan strategic vision, it has recently issued the first *Milan Smart City Guidelines* intended to transform the city into a real world city, not only technologically intelligent and economically attractive but also environmentally and socially sustainable: that is, a national and European laboratory of sustainable mobility, environment and energy policies, social inclusion, urban health, simplification of public administration bureaucracy, new economic activities and companies, beginning with the development of open data and open services (Comune di Milano, Assessorato Politiche per il lavoro, Innovazione economica, Università e Ricerca 2014a).

Together with environmental connectivity and social connectivity, ICTs generate an economic connectivity reflected in the development of new economic activities through the integration of production and services. This means that ICTs are significant drivers of economic changes and contribute to the shift from place-based mass production to global, flexible and knowledge-based organization (Fernández Maldonado 2012). For these reasons, beside its smart activities, the Innovation and Smart City Sector of the Milan municipality is also in charge of monitoring, supporting and promoting other innovation initiatives (also providing specific economic resources). These projects are frequently related to ICT development, and they are contributing to Milan's socio-economic transition towards the new economy based on increasing digital services (Alexander 1983), and the new manufacturing economy based on increasing digital productions (Various Authors 2012). For instance, they start from bottom-up proposals for business incubators, co-working spaces and fab-labs, which often stimulate new urban regeneration processes (Bolocan and Tajani 2014; Comune di Milano, Assessorato Politiche per il lavoro, Innovazione economica, Università e Ricerca 2014b). Because the challenge of the twenty-first century is the resumption of productivity (Guallart 2012), albeit in new and more specialized forms mixing manufacturing and services, the recent advances in ICT (determined, for instance, by the development of the internet, open-source services and new generation printers, as well as by the improvement of personal mobile devices) have favoured not only the transmission of information but also the interaction among users, with the consequent boom in shared production and consumption (Ratti 2014). This is a shift from the centralized model of resource management in industrial society, flowing from large-scale production centers to small-scale individuals, to a distributed model in the information society, connecting people with people, objects with objects, buildings with buildings, or communities with communities (Guallart 2012). The above-mentioned innovative workspaces, which usually re-use abandoned buildings, therefore correspond to the rapid and structural transition of the contemporary economy (and society) towards new sharing practices enabled by ICTs: that is, the sharing of

goods and services, ideas and skills, time and money (Campagnoli 2014; Sharexpo 2014; Valentino 2013). It is for these reasons that the high technological endowment and the reference to sharing practices of these workspaces may allow their consideration within the urban digital nodes concept proposed in this study.[12]

2.3 The Digital Expo 2015 Programme

In parallel with the initiatives and projects directly promoted by the municipality of Milan, also Expo 2015 has recently adopted a digital profile through the promotion of innovative experimentation with ICTs in the field of large events by the official management company *Expo 2015 Spa*. The scheme divides into three levels:

- at the local level, the *Digital Smart City Expo* project, based on diverse devices and applications, to develop digital services for both the management of the exhibition area (energy, lighting, security) and the hosting of visitors on the Expo site located in the surroundings of the Milan Trade Fair in Rho (information, communications, payments);
- at the global level, the web-based *Cyber Expo* project to develop digital services aimed at broadening Expo participation and at disseminating its contents on a world scale by favouring a virtual experience of the event;
- at an intermediate level, the *E015 Digital Ecosystem*[13] that enables the technological integration of multimedia totems, internet websites, and smartphone applications within the entire Milan metropolitan area in order to develop digital services furnishing information (in the fields of culture, events and news, Expo 2015, mobility, Made in Italy, accommodation, smart city and other information) to different urban populations (permanent or temporary).[14]

Particularly interesting from a smart region perspective is the *E015 Digital Ecosystem*. Promoted as a community of service providers (which more than 230 public and private operators had already joined by November 2014), this system is based on collaboration rules and common technological standards useful for sharing data and for the consequent development of a system of interoperable digital services (Di Vita 2014). This is an opportunity for innovation in terms of both methodology and contents, although it will be possible to verify its concrete potentialities only during the Universal Exhibition and in the post-event phase, when the digital ecosystem will be completely in operation.[15]

[12]See Sect. 1.2, 1.3 and 5.1.

[13]Developed with Confindustria, Camera di Commercio di Milano, Confcommercio, Assolombarda and Unione del Commercio, with the technical and scientific coordination of Cefriel-Politecnico di Milano.

[14]Website: www.e015.expo2015.org.

[15]By November 2014, only a first experimentation of the mobility system had been conducted by integrating the digital services offered by different transport operators in the Milan metropolitan

The digital innovation challenges, simultaneously but independently promoted by the Milan Municipality and the Expo 2015 management company, merge in the *Electric City Mover* project. This initiative, undertaken in collaboration with Telecom Italia, contributes to sustainable mobility development through the implementation of a *Digital Islands* system, distributed across the city, where users can rent electrical vehicles and use various services made available by equipped benches and multimedia information totems: these smart facilities provide free wi-fi, mobility information, power sockets to recharge personal devices, as well as NFC technology for purchase services. This urban-scale project of digital islands has 'inspired' the broader proposal of digital nodes developed through the research presented in this book: both by studying their potential locations and by identifying an articulated system of possible functions and services in relation to the specific features of the various local contexts.[16]

The list of smart projects related to the Milan Universal Exhibition is completed by another digital services system aimed at improving the quality of local hosting and accommodation: on the one hand, the web platforms *Explora* (developed by the Milan Chamber of Commerce with the Lombardy regional government to promote the tourist attractions and receptive facilities of the Lombardy regional area)[17] and *Expo in Città* (developed by the Milan Chamber of Commerce together with the Milan municipality to promote the Expo's collateral events within the Milan metropolitan area)[18]; on the other hand, the projects entitled *Fondazione Triulza* (developed by a specific consortium of associations set up to promote local and national third-sector activities beginning with the civil society pavilion within the Expo site and integrating other experiences and locations outside it)[19] and *Sharexpo* (developed by Fondazione ENI Enrico Mattei to promote sharing economy activities).[20]

Without excessive expectations or prejudices regarding the spread of technology within urban spaces—for which a qualitative rather than quantitative approach should be privileged—ICT experimentation and digital services implementation may contribute to development of a material and immaterial legacy of the event outside the Expo site and the municipal borders of Milan (Di Vita 2015). Even though any evaluation of the ICT potentialities should be postponed until after the 2015 Universal Exhibition, this experimentation distinguishes the Milan Expo from the previous ones. It can be considered an opportunity for an event whose originally planned implementation of physical infrastructures has been obstructed by several

(Footnote 15 continued)

area (Atm, Autostradale, Trenitalia, Trenord, Malpensa Express, Sea, Orio al Serio International Airport, Infoblu—Autostrade per l'Italia, Milanoserravalle—Milanotangenziali (website: www.e015.expo2015.org).

[16]See Sect. 3.3.

[17]Website: http://www.exploratourism.it/.

[18]Website: http://www.expoincitta.com/.

[19]Website: http://www.fondazionetriulza.org/.

[20]Website: http://www.sharexpo.it/.

problems: not only management difficulties and corruption, but also the decrease in funds due to the financial and economic crisis that has marked a profound discontinuity with the expansionary phase in which the past Expos were developed (Di Vita 2014).

In the complex network of relations among the different actors and stakeholders involved in the 2015 Universal Exhibition and the Milan Smart City processes—in which public and private players have significantly invested in the city's future—the Expo's digital legacy (local and urban) should be adequately capitalized. On the one hand, through the *Digital Smart City Expo* project, re-use of the Expo site could exploit the advanced technological services introduced for the event in order to support the activities that will be hosted in the area in relation to its post-event transformation. On the other hand, considering the *E015 Digital Ecosystem* and all the other web platforms and initiatives (such as *Explora, Expo in Città, Fondazione Triulza, Sharexpo*), empowerment of the new Metropolitan City could benefit from the digital innovation projects promoted throughout the metropolitan area on the occasion of the event. This would encourage socio-economic innovation and, consequently, its spatial and architectural configurations (Di Vita 2014, 2015).

2.4 Expo 2015 as a Node of a Future Milan-Turin Smart Region?

The current technological standards and digital services, promoted in relation to a spatial context extending beyond the municipal borders of the inner city, could contribute to develop the urban smartness on the wider scale of the Milan metropolitan area (but only after verifying the effectiveness of those standards and services during the event and in the post-event phase). However, from a smart region perspective, the more direct involvement in the event of a more extensive system of places (often marginal) outside the Expo site could have created better conditions for sustainable regional rebalancing: for instance, through the enhancement of the nodes located within the existing infrastructural networks (Rolando 2011, 2014; Rolando and Scandiffio 2013).

From this perspective, the efforts made by the City of Milan, the Expo 2015 management company, and all the other above-mentioned players should have replaced their current incidental convergence with effective cooperation; that is, they should have remedied both the lack of a metropolitan strategic vision and the fragmentation of ongoing projects by promoting a stronger coordination and integration of the different initiatives. It would have been an opportunity to exploit the territorial potential of the Universal Exhibition in time and space, with possible positive effects on the event's legacy, as well as to lead to a concrete consolidation of smart city projects and their evolution to a smart region scale.

This system of digital services provided for Expo 2015 extends beyond the city's traditional administrative boundaries. In this way, it intercepts some recent

reflections developed in the scientific debate on the scale and scope of large events (Battisti et al. 2011). In the context of socio-economic globalization and global crisis, spatially marked by the already-mentioned growing regionalism of cities (Bolocan Goldstein 2008) and by clear risks of unsustainability of large-scale interventions related to world events, it seems necessary, even for mega-events, to enlarge the spatial scenario for the relative governance and projects from the urban to the regional scale; that is, to replace individual urban projects with regional regeneration processes based on the widespread exploitation of local resources and included in shared and durable strategies responding to local needs in relation to global flows. In this regard, a best practice is apparent in the experience of the German Ruhr conurbation, which has integrated projects for the IBA Emscher Park (1989–1999) and the Ruhr 2010 European Capital of Culture events within the goals and actions of regional strategic plans promoted in the past 30 years: that is, within an organic process of landscape, environmental and spatial regeneration, and of social and economic renewal (Rolando 2009).

Given the potentialities offered by the increasing application of ICTs to spatial phenomena, Expo 2015 could be an opportunity to extend sustainability issues from individual projects to the entire process. If properly integrated into a cohesive system of public policies within a post-event perspective, the event could be an occasion to enlarge the potential smart city development to either a wider smart (city-)region extending from Milan to the whole Northern Italy or (considering the Expo site's location in the north-western sector of the Milan metropolitan area) at least to a larger smart (metropolitan) region extending between Milan and Turin (Morandi et al. 2013b).[21]

Whilst at the world level large cities are affirming themselves as the most important telecommunication nodes, there is a growing digital divide between the most connected places, such as urban and central areas, and generally disconnected places such as rural and peripheral areas. On the contrary, one of the main requirements in order to promote the balanced and smart development of any spatial context is the provision of all places and users with adequate access to ICTs (Fernández Maldonado 2012). To this end, the *E-Scape* project of Alta Scuola Politecnica (ASP) in partnership with Telecom Italia has sought to give Expo visitors opportunities to experience the event's themes—concerning food and nutrition—by directly learning from places in the Milan-Turin metropolitan region (where the rural culture, landscape and production is particularly intense) through exploitation of different ICT potentialities: from QR codes to location-based services or augmented reality applications integrated into a system of places of interest in order to provide information and knowledge related to them. Because this ASP project starts not from the main urban poles, but from the in-between areas, the proposed use of ICTs may contribute to rebalance the territorial conditions of different places. On the one hand, it may do so by making each of them more attractive in terms of services and spatial quality, not only for the Expo visitors but also for the post-Expo travellers; not only

[21]See Sect. 2.1.

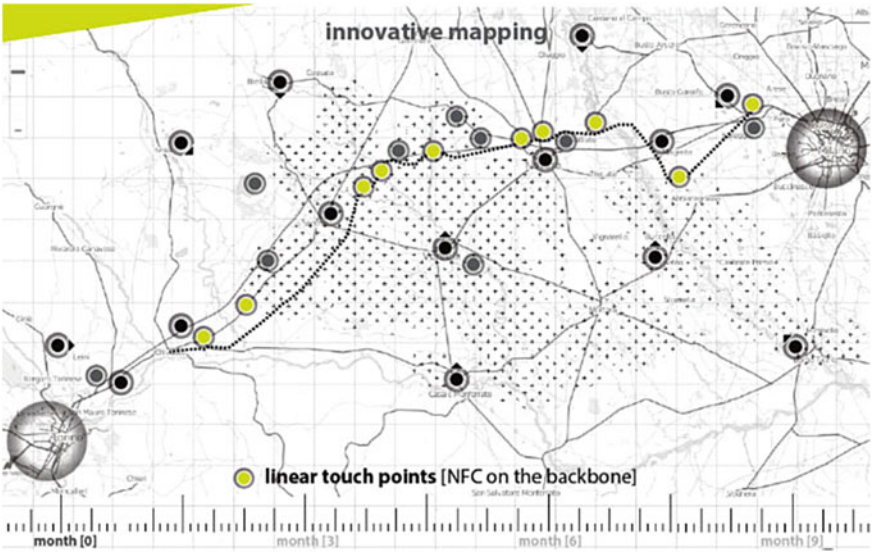

Fig. 2.2 *E-scape* project developed by Alta Scuola Politecnica (ASP) in partnership with Telecom Italia: the map of places of interest enriched with ICT services for their permanent and temporary users. *source* Rolando and Djordjevic 2013

for tourists and other temporary populations but also for residents. On the other hand, it may do so by driving the spatial innovation of the entire metropolitan region (Rolando and Djordjevic 2013) (Fig. 2.2).

By integrating a top-down approach (beginning with the potential development of wide-scale visions of collective interests promoted by official policy makers) with a bottom-up approach (beginning with the potential definition of site-specific information and knowledge by temporary and permanent users), this project drew on different disciplines, such as urban planning and spatial representation, and different concepts, such as mapping and interface, because it is not yet clear (practically and theoretically) how to fit regional scale information into mobile terminals of small size. Whilst the project tested analysis methods oriented to provide traditional and digital services and to experiment with the use of information and design tools based on GPS tracking technologies (van der Spek and van Schaick 2008), its main outcome was the design of interfaces between users and the knowledge related to places, that has figured out the *(e)-scApp* smartphone application based on a situated cognition model (requiring the users to be within the material space). On the one hand, this application provides information to users; on the other, it allows users to participate in the mapping process and to implement local information and knowledge, with the consequent enhancement of local resources and the creation of social communities. Hence, the use of sensors leads to collect instantaneous perceptions by users and of real-time information by places, with possible effects on the smart organization, use, and experience of the spatial components of the metropolitan region, not only during the Expo, but also in the

post-event phase: for instance, by determining new material and immaterial flows of people and information—that is new social behavior and statistical data—making a potential contribution to the rebalance between the main urban poles and the intermediate areas (Rolando and Djordjevic 2013).

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Chapter 3
Two Applied Research Projects: Spatial Impacts and Potentials of ICTs

Corinna Morandi, Andrea Rolando and Stefano Di Vita

This chapter aims at describing the methodologies and outcomes of two research experiences (Fig. 3.1), which have been developed in order to test the concepts introduced by the research (smart region, internet of places, and urban digital nodes) and identify the relationships among the different scales involved (local, urban, and regional). Adopting the reference to the system of university campuses within the potential smart region between Milan and Turin, the first research project concerned the Città Studi university campus in Milan. This was chosen in order to explore the internet of places concept by optimizing access to university facilities through the use of mobile services, thereby enhancing the campus itself as a complex of urban digital nodes. The second research project sought to develop the internet of places concept from the university campus scale to the urban scale by applying it to a more extensive area of Milan comprising the Bovisa university campus and the 2015 Expo site. This was chosen in order to explore the urban digital nodes concept by identifying the best localization opportunities and defining the functional components of the UDNs system proposed by the research for the Milan's north-western sector. These services specifically relate to the features of the spatial and socio-economic context in which each Urban Digital Node is located, as particularly shown by the UDN experimental application within the former QT8 market, at present owned by the Milan municipality.

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PoliMI SpringerBriefs, DOI 10.1007/978-3-319-17338-2_3

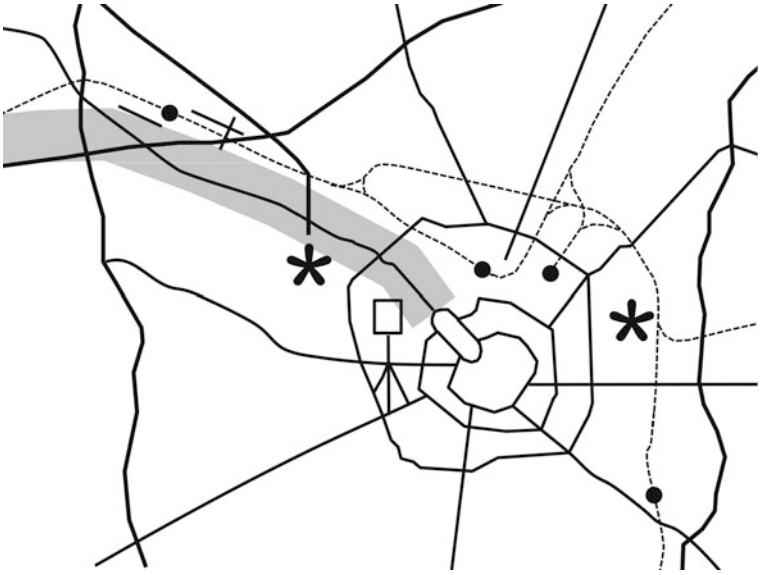

Fig. 3.1 The location (*asterisk*) of the two research projects of the research in Milan. *Source* Rolando

3.1 Networks and Nodes in a Smart Region

The Northern Italy mega-city region or global city-region is a polycentric metropolitan system whose boundaries are difficult to distinguish because they extend to the entire Po Valley. The latter is a wide urbanized area (consisting of a network of cities of different size and importance), that is connected by an articulated system of infrastructures (Balducci 2005), and directly related to the other major world city-regions because of its economic value (Perulli and Picchierri 2010).

Observation of this local context directs attention to the several descriptions made of the contemporary urban phenomenon, beginning with that of 'megalopolis' (Gottman 1961). The most recent of these definitions are those of global city-region (Scott 2001), which takes the point of view of economic and political geography, and of 'mega-city region' (Hall and Pain 2006), which assumes the point of view of urban and regional geography.

Adopting this last definition, developed in the field of urban studies, the research project's spatial reference to the metropolitan region along the Milan-Turin axis was based on its singularity due to a relationship system difficult to detect along other infrastructural corridors of the Northern Italy mega-city region: the high-speed railway opened in 2006; the large events celebrated in the two main urban poles (the 2006 Winter Olympics and the 150th anniversary of Italian Unification in 2011 in Turin, and Expo 2015 in Milan); the Alta Scuola Politecnica (ASP) between Politecnico di Milano and Politecnico di Torino; the joint venture between the Chambers of Commerce of Turin and Milan; and the MiTo Settembre Musica

Festival. These are specific features which make this broad metropolitan region an example of good practice for other territorial relations within the Northern Italy mega-city region.

The research project's spatial reference consisted of a system of nodes and networks whose components are recognizable on adopting a multi-scale approach. These territorial components can be considered the territorial 'glue' of a wide metropolitan region with high landscape values and distinctive features:

- a system of larger and smaller urban centers closely integrated with the framework of historic communication routes and the agricultural landscape;
- large polarities consisting of new peri-urban commercial and leisure facilities;
- equipped sites for logistics;
- ecological networks and natural connections (such as rivers and mountains);
- infrastructural corridors (long and fast networks, such as the 5th and the 24th European Corridors, partially built, as well as short and slow networks consisting of canals, local roads and regional railways with historic origins, but in recent decades often penalized by current development strategies) (Fig. 3.2);
- new spatial configurations related to knowledge networks and information streams.

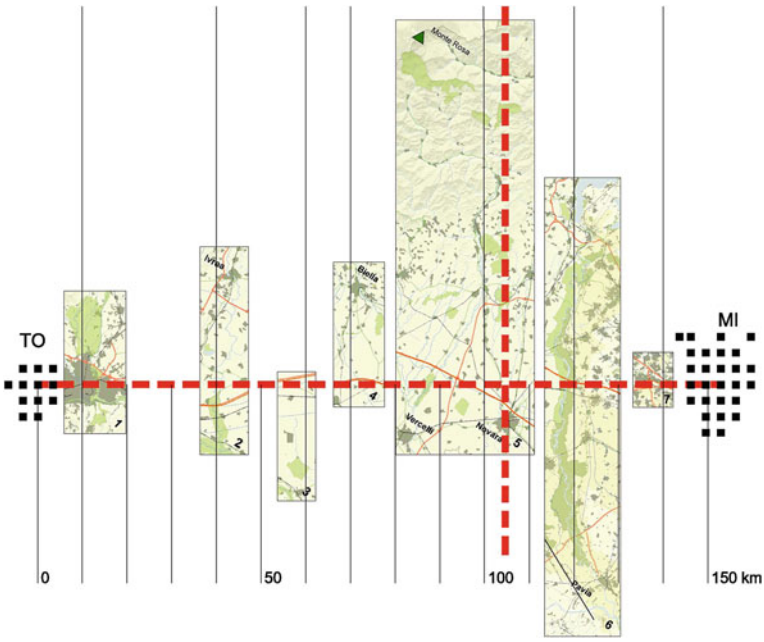

Fig. 3.2 The European Corridors 5 (Lisbon-Kiev) and 24 (Genoa-Rotterdam) intersecting at Novara in the metropolitan region between Milan and Turin. *Source* Rolando

The Smart Cities and Communities Programme launched by the European Union in 2011 has had various applications in Italy. Identification of a metropolitan region between Milan and Turin (not represented in terms of political-administrative organization but outlined by a dense system of territorial relations) encourages a deep reflection on the potentialities of a smart integrated approach (in relation to both technological innovation and social inclusion): a method that may enable the overcoming of localism and increase the effectiveness of each proposal (often promoted as isolated episodes unable to activate wider processes of urban and regional regeneration). With a view to extending the smart city concept to a broader smart region one, the aim of the research was to promote an integrated system of physical and digital services producing positive effects in peripheral areas which could consequently change their apparent marginality with respect to stronger urban poles. For this purpose, a convergence between territorial institutions (local, urban, regional, national and also European), functional institutions, businesses and citizens should be promoted, and an appropriate governance system integrating top-down and bottom-up approaches should be developed.

Despite the well-known difficulties of organizing the 2015 Universal Exhibition due to management difficulties and the financial and economic crisis (Di Vita 2014), the Milan Expo is still recognized as an opportunity to activate a process of spatial and socio-economic regeneration spread over time (after 2015) and space (beyond the new exhibition area close to the Milan Trade Fair pole recently created in Rho).[1] In this regard, potentialities for a (both) sustainable and competitive development may arise from:

- exploitation of local resources (cultural, historic, environmental, landscape, social, and economic heritage) and coordination of bottom-up initiatives recently developed in relation to the event's themes (Battisti et al. 2011);
- improvement of spatial quality and development of a system of services (physical and immaterial) at both the urban scale and (according to variable geometries) wider regional scale; an improvement that may also be based on the use of ICTs and the integration of innovative digital experiences able to enhance relations between physical places and the experiences of people moving within space.

The university campuses located within the metropolitan region between Milan and Turin may provide useful support for a space-time spread of Expo 2015 and for urban and regional technological innovation through the development of a coordinated and integrated system of material and immaterial services, and the promotion of cultural, recreational and accommodation activities. At the same time, Expo may become an opportunity to enhance local resources (such as the campuses) and upgrade services and functional excellences (such as the universities), not only in the event's short-term perspective but specifically in the post-event long-term one: that is, it may be a real and educational opportunity for encounter

[1]See Sect. 2.4.

between event visitors and local society. In this large spatial context, structured and traversed by an increasingly articulated system of physical networks, Expo 2015 may also be an opportunity to strengthen immaterial knowledge networks whose nodes are university campuses: the development, coordination, and integration of physical and digital services provided by universities may therefore boost the competitiveness and sustainability of the broad metropolitan region between Milan and Turin.

The Milan universities have an important role in the human capital formation, technological transfer, and internationalization which underlie the local socio-economic system. This phenomenon, however, must be considered on a wider scale, given the recent regional decentralization of several local universities because of the size and complexity now reached by the local urban settlements. Indeed, the Milan metropolitan area extends into three Italian regions (Lombardy, Emilia Romagna and Piedmont) and crosses the borders of the Swiss Canton Ticino (Balducci et al. 2010). The features of the Milan university system are therefore also apparent in the cases of Turin and the intermediate area between the two cities:

- in Turin, beginning with the importance of the local university system in the post-industrial spatial and socio-economic transformation of the city;
- in the intermediate area between Milan and Turin, beginning with the Università del Piemonte Orientale's role in the recent urban renewal process of Novara (Emanuel 2011).

In the research framework, the in depth study on service innovation for university users was based on the awareness of current transformation of this institution due to ongoing change in the information and knowledge system, for instance through the mass dissemination of digital information at the global scale. The transition from machines for physical manufacturing of the industrial revolution to machines for intellectual activities of the digital revolution requires a transformation of universities from places of knowledge improvement to key players of economic and spatial development within the post-Fordist economy and society (Martinotti 2010).

Adopting the concept of 'globalization' propounded by Roland Robertson—which relates the globalization process to renewed local enhancement (Robertson 1992)—if the Northern Italy urbanized area is considered a single glocal city-region from Milan to its neighboring cities, provinces and regions (Rete consultiva per Milano Glocal City 2013), universities may be identified among the meeting places between local and global scales and, therefore, as fundamental resources for urban and regional development (Bassetti 2010). In this regard, the first application phase of the research took place within one of the two main urban poles of the metropolitan region between Milan and Turin: the: Città Studi university area in Milan. This area was chosen to experiment with the use of mobile devices to improve the performance of university services, both physical and digital; at the same time, it was also chosen to explore the new relations between large urban functions and their spatial contexts and between people and places enabled by ICTs. That is, new

relations which lead to a first development of the internet of places concept and the urban digital nodes one. This choice was made for various reasons:

- in relation to the research assumptions of a bottom-up approach and a mapping experiment, the need to define a limited and well-known spatial application area in which basic knowledge was already available and where relationships with users were already consolidated;
- the existing *Sustainable Campus* project, promoted by Politecnico di Milano and Università degli Studi di Milano: on the one hand, because this comprises actions of great interest to the main actors and stakeholders involved (university rectors, teachers, students, inhabitants, municipality, municipal borough); on the other hand, because within this project, the present research aimed at promoting a smart service development perspective;
- the implementation of a related internet website as a key tool for the Sustainable Campus project[2]; that is, an interactive platform for diverse stakeholders which can be involved in the research;
- when the first phase of the research was in progress (in 2013), the lack of proposals concerning innovative mobile services for university campus users, emerged from a first exploration of digital applications related to service access (much more oriented to providing information on urban mobility or leisure, as well as tracking people or objects).[3]

The goal of the Sustainable Campus project is the transformation of the Città Studi university district of Milan into a city sector which, in the future, may become a model because of its quality of life and environmental sustainability. The project relies on the active participation of students, researchers, technical-administrative staff and local inhabitants, who can report their ideas and contribute to the development of five working groups set up according to specific issues related to sustainability: city, accessibility, environment, energy and people. This last working group is concerned with the active participation of all the campus's users (students, researchers or technical-administrative staff), paying particular attention to the satisfaction of needs expressed by people with disabilities; the development of collective livable and comfortable spaces; the implementation of a dedicated web platform and the improvement of accessibility to the campus web services; the creation of new services accessible to both the campus community and the district's residents. By referring to all these issues, the first applied phase of the research can be considered a useful framework for the trialling and development of a working method.

The research therefore had an additional and concrete reference scenario: the section of the Sustainable Campus project promoted within the People working group. In this context, the research itself contributed to enhancing the urban role of

[2]Website: http://www.campus-sostenibile.polimi.it.

[3]At the beginning of 2015, a *PolimiApp* was introduced: however, its services concern the *Politecnico di Milano* campus alone, and not the *Università degli Studi di Milano* campus, even though the two universities are partners in the same *Sustainable Campus* project.

the Città Studi university campus. At the same time, it fostered improvement in the availability, accessibility and flexibility of infrastructures, services and open spaces: for the students attending the campus and the other university ground users (such as researchers, lecturers, and technical-administrative staff), but also extending their use to the inhabitants of the surrounding neighborhoods (and also to other city users) and broadening their usability throughout the day and at weekends. In this first application phase, the smart concept was incorporated into a specific technological system together with actions aimed at promoting aware and virtuous behavior by users; that is, use maximisation of infrastructures, services and open spaces and, therefore, of the related energy resources.

3.2 Digital Services for the Città Studi University Campus

The in depth analysis of the first research phase on the topic of service innovation for university users referred to the ongoing functional transformation of that institution, which stems from current changes in the information and knowledge system. This renovation is connected to the mass diffusion of digital information at the global scale, which has exponentially accelerated since the early twenty-first century (Martinotti 2010). Universities offer a high concentration of physical and immaterial services. The efficiency and attractiveness of a university campus is connected to the quantity and quality of the services provided, which can be implemented through both an infrastructural development (hardware) and an improvement of their use and management method (software), including the optimization and expansion of ICTs. Given the lack of available resources for the implementation of costly public works, exacerbated by the financial and economic crisis, service use and management (with which the research was concerned) therefore becomes essential. This choice is also supported by a set of cases where the development of mobile services and, in general, of proximity digital technology is considered to be the interface between people and places, which suggests the internet of places concept.[4]

This first research phase therefore concerned digital services in relation to university innovation. It involved experimentation within the Città Studi university area of Milan with a view to the possible future extension of this methodology to other university campuses in the Milan-Turin metropolitan region.[5] The goal was to

[4]See Sect 1.2.

[5]Future research phases may refer to other campuses in the Milan-Turin metropolitan region by considering service access by university users in very different campus settlement patterns: for instance, from the campus integrated into the urban fabric of Milan Città Studi (Politecnico di Milano), to the satellite campus at Turin Mirafiori (Politecnico di Torino), or the widespread campus in the historic center of Novara (Università del Piemonte Orientale). Whilst in Novara the focus could be (as in Milan) on the relationships between the campuses and their surrounding urban contexts, in Turin the focus could be on places which are strongly defined and mono-functional.

verify the potential of mobile services to improve the performance of some university facilities in relation to both traditional and unconventional users. This research phase was an opportunity both to test a working method and (consequently) to repeat it on a wider scale in order to support the development of a smart (metropolitan) region. In this context, the smartness concept was declined as the development of a specific technological system in the field of mobile services together with activities intended to promote aware and virtuous user behavior; that is, ICTs employed to optimize the use of available spaces and services. This integration between physical and digital components and services suggested the Città Studi university campus as the first site for pilot application of the urban digital nodes concept[6]: a university campus provided with new digital services could indeed be identified as an Urban Digital Nodes system by including places integrating material and immaterial networks through the use of ICTs.

The outcome of this research phase was the preliminary set-up of two smartphone application prototypes conceived as interfaces between users and services—physical and immaterial (Fig. 3.3)—and related to important issues within the Città Studi university campus: for instance, the sharing of spaces for study and individual work, and the management of the demand for and supply of accommodation for students. Accordingly, the assumptions of this research phase were, on the one hand, the bottom-up approach in order to favour demand identification and supply maximization, which required definition of the features and requirements of services; on the other hand, the constant reference to a recognizable and bordered spatial support: that is, mapping, which could be useful for service location and user behavior analysis.

These assumptions were therefore translated into:

- development of focus groups and interaction with users in order to establish functionalities of the applications, and administration of an online questionnaire to students in order to complete them;
- conduct of tracking activities beginning with passive tracking of unintentional movements made by users within space; that is, a stream mapping performed to identify the main interest points (both within the campus and in the surrounding urban context) on which to test the planned applications (Figs. 3.4 and 3.5).

The functionality hypotheses for the first application, regarding spaces for study and individual work, related to:

- the sharing of real-time information about the potential use of spaces within the campus (specially equipped spaces for study and individual work or ones formally dedicated to other activities);
- the geo-location and orientation of users in relation to such places by both receiving and providing information about routes (for instance, by reading and posting related messages at the same time).

[6]See Sect. 1.3.

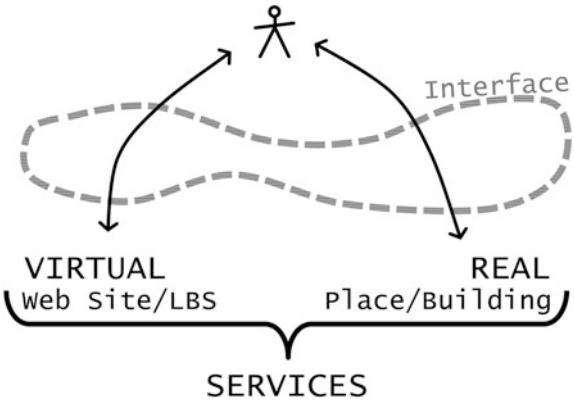

Fig. 3.3 Mobile phones as interfaces between users and services—physical and immaterial. *Source* Rolando

The second application for accommodation was instead designed as a kind of digital notice board in order to encourage and facilitate the match between the demand for and supply of housing for students. The purpose was twofold:

- social and cultural, referring to both the needs of the demand and the part of supply providing free accommodation in exchange for certain immaterial benefits;

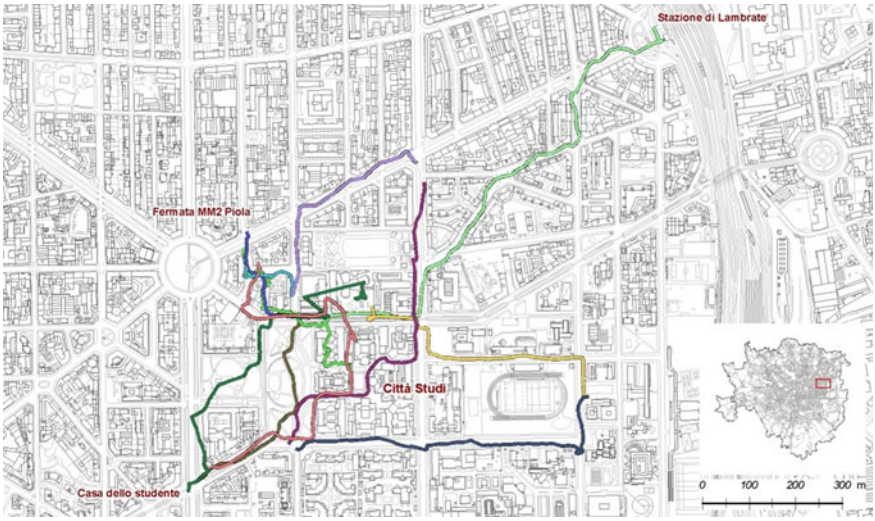

Fig. 3.4 Milan, *Città Studi* university district: GPS passive tracking of unintentional movements of users in order to identify points of interest (inside and outside the university campus) on which to test the smartphone applications promoted by the first pilot project of the research. *Source* elaboration by Giorgio Limonta for the research group

Fig. 3.5 Milan, *Città Studi* university campus: detail of the application of the Kernel Density Estimation (KDE). This is a technique for the geo-statistic interpretation of density related to socio-economic phenomena in order to identify places where the user flows tracked by GPS are greater. *Source* elaboration by Giorgio Limonta for the research group

- commercial, in regard to the needs of that part of supply which provides accommodation on payment.

These hypotheses were tested and improved by means of the above-mentioned participation activities, whose outcomes in terms of shared application functionalities are summed up in the following table (Table 3.1).

The subsequent development of the *Urban CheckIN* application[7] integrated the prototype requirements for a smartphone function dedicated to study and individual work spaces within Città Studi (Fig. 3.6). Implementation of this application and its subsequent utilization by users could favour the acquisition of further relevant information on both the current use of spaces within the campus (and the surrounding urban context) and on the needs of students regarding the endowment and location of equipment. This information could also be translated into design requirements for the renewal of spaces within the campus and its surroundings, and for the improvement of their services. At the same time, the infrastructures needed to run the application (for instance, information panels provided with NFC tags) could themselves become opportunities for the innovation of spaces, inside and outside the campus (such as, for instance, public transport stops and other meeting or crossing places), where they will be appropriately placed.

[7]Elaborated by Politecnico di Milano and Telecom Italia research team with the contribution of a master thesis of Alta Scuola Politecnica (Djordjevic 2012).

Table 3.1 Functionalities for the APP prototypes *Spaces for study and individual work* and *Student accommodation*

Service requirements	Student accommodation	Spaces for study and individual work
Informing	Supply notices (housing availability and cost, availability period)	Availability of dedicated spaces for study and individual work
	Demand notices (housing demand, available budget)	Possible other spaces usable for study and individual work
Locating	Location of available accommodation within the urban fabric	Location of spaces (specialized or usable) for study and individual work
	Preferred locations of accommodation within the urban fabric	
Describing	Supplied/demanded accommodation features (single/shared, specialized building/non-specialized building, surface area, rooms, energy performance, time limits)	Permanent space features (existing plugs, softwares or other equipment)
		Temporary space features (crowding level, usable equipment)
Referring to the context	Accommodation's distance from the Politecnico	Space accessibility
	Availability of public transports, local services, retail and leisure activities	Conditions of space achieving
Making community	Socialization potential for tenants	Communication of space information to other users
	Potentials for integration with local inhabitants	Communication of needs and requirements to the space management
Guaranteeing	Supply quality certificate	Booking of services provided by the Modelling Laboratory
	Owner precautions about user features	Printing service: booking of Poliprint
Assessing	Housing quality evaluation	Space quality evaluation
	Evaluation of the quality and reliability of available information	

Fig. 3.6 The storyboard of the *Urban CheckIN* app within the *Città Studi* university campus of *Politecnico di Milano* (Djordjevic 2012)

Fig. 3.6 (continued)

3.3 Urban Digital Nodes in North–West Milan

In the second research phase,[8] the topic of the digital services furnished by telecommunication infrastructure networks led to deeper reflection on the urban node concept. Implementation of the Digital Islands project for the Milan 2015 Universal Exhibition (on which Telecom Italia has been working with the Municipality of Milan and the Expo 2015 official management company),[9] associated with optimization of access to the experimental services within the Città Studi university campus, led to a proposal to redefine the concept of *island* into a concept of *urban digital node.*[10] The spatial area of the experimentation was further extended from the scale of the university campus to the scale of the urban sector in which the university facilities are located: this is the scale of the so-called *Nuclei di Identità Locale (NIL)*[11] defined by the Milan 2012 city plan, which were identified as the appropriate spatial contexts for this research phase. The purpose was therefore to identify places able to integrate physical and digital dimensions which could be connected to the various facets of the urban nodes concept and its evolution into the urban digital nodes concept, thus including material and immaterial components.

The second research project had various goals:

- identify the best Urban Digital Nodes' (UDNs) location opportunities through an urban planning approach referring, for this experimental phase, to the close spatial context of Expo 2015;
- define the UDNs' functional components, which could be aggregated in different ways, starting from comparison with the research case studies[12];
- select, among the different UDN proposals, one case in which to develop a functional programme for the future design and implementation of the first Milan UDN.

A bibliographic search did not identify significant sources concerning topics or experiences clearly concerning the urban digital nodes concept. The only references found related to certain 'condensers' of material and immaterial components, such as those analyzed as case studies. Reflection on the UDNs led to their conceptualization as places which can simultaneously offer physical and digital services

[8]Developed in relation to the activities of the *Joint Open Lab (JOL) S-Cube, Smart Social Spaces Lab*, recently founded by Politecnico di Milano and Telecom Italia and established within the Città Studi university campus of Politecnico.

[9]See Sect. 2.3.

[10]See Sect. 1.3.

[11]The so-called *Local Identity Units* are 88 neighborhoods into which the Milan municipality area is divided by its Services Plan, which is one of the components of the 2012 city plan. They are based on a micro-scale analysis of both existing services and the demand for additional services in order to detect potentialities and criticalities relative to demographic projections and citizen needs.

[12]See Sect. 3.4.

identified in relation to different categories of users (from local inhabitants to other temporary users) and different types of usable spaces.

Conceived as smart buildings in order to reduce their environmental impact and to increase their efficiency, and designed as smart spaces based on the interaction between humans and sensors, UDNs furnish both material and immaterial services to various kinds of users, and they provide the users themselves with opportunities to acquire experience within an intelligent building (by allowing them to verify and learn the potentials of ICTs). The digital services proposed for the UDNs are based not only on the development of a website for static devices, but also on the activation of a coordinated system of APPs for mobile devices intended to integrate and broaden the traditional services. These APPs, which are planned to integrate top-down and bottom-up approaches, to use NFC technology, and to offer augmented reality experiences, aim at direct involvement: that is, at interaction among and inclusion of UDNs users. Indeed, they both encourage innovative and dynamic uses and require real fruition of physical spaces by users during their interactive experiences of actual places (situated cognition).

Besides the specialized services offered by each UDN, which are site-specific, all the Urban Digital Nodes provide a system of basic digital devices and related support equipment (computer terminals, information kiosks, lap-top points, device charging points, free WiFi, fax and photocopy services) together with tracking services for the various categories of users, as well as services already furnished by the Digital Islands recently activated by Telecom Italia, Milan municipality and Expo 2015 Spa. Referring to specific objectives concerning economic, environmental and social sustainability, as well as the containment of soil consumption and enhancement of existing heritage and resources, the types of physical spaces suited to hosting UDNs were identified as:

- new buildings in public spaces;
- new buildings in open spaces included in the urban fabric (considering both public and private properties);
- new buildings on brownfield sites (considering both public and private properties);
- existing spaces in abandoned buildings to be recovered (considering both public and private properties);
- existing spaces in public facilities which are underused.

Functional components which could be differently integrated within the single UDNs were initially presumed to be the following: reading; watching; discovering; learning; studying; hosting; counseling; assisting; informing; purchasing; working; meeting; communicating; socializing; integrating; belonging; moving; recreating; reducing the environmental footprint. These proposals were integrated with the contents of the Digital Islands: on the one hand, identification of functions which could effectively contribute to defining the Urban Digital Nodes; on the other hand, transfer of services originally planned for the outdoor environments of the Digital Islands themselves to the indoor environments of the Urban Digital Nodes.

A conceptual milestone of the UDNs proposal was their replicability as regards goals, targets and basic components, as well as their adaptability to different physical and socio-economic contexts. The meta-project on a specific spatial context was therefore developed through the second research project, which in the future may be re-proposed in relation to other areas of the Milan-Turin smart region. The related detection and analysis of local and international cases[13] assisted the testing of these hypotheses by making a collection of previous interesting experiences available.

Within this framework, a first spatial observation referred to the Nuclei di Identità Locale (NIL) related to the Città Studi university campus (Fig. 3.7): the NIL 22, which corresponds to the local campuses of Politecnico di Milano and Università degli Studi di Milano, and the neighboring ones, which are influenced by the two campuses, beginning with their additional facilities (such as remote offices, student residences) and other local services able to intercept university user flows. These are the NILs 18 (Parco Lambro-Cimiano), 20 (Loreto), 21 (Buenos Aires-Venezia) and 23 (Lambrate) which, together with the NIL 22 (Città Studi), constitute an urban sector of 1,490 hectares with more than 170,000 inhabitants. Whilst more detailed analysis was conducted within the *core area* formed by these five NILs, the need to monitor the availability of local services according to a system of wider context relationships led to a broadening of the observation to include a surrounding *edge area* formed by the other contiguous NILs 03 (Giardini di Porta Venezia), 04 (Guastalla), 10 (Centrale), 12 (Maciachini-Maggiolina), 13 (Greco), 19 (Padova), 24 (Parco Forlanini-Ortica) and 26 (XXII Marzo), which constitute an urban sector of 1,525 hectares with more than 160,000 inhabitants.[14] The total size of this first spatial observation area, which therefore corresponds to 3,015 hectares with 330,000 inhabitants, required the development of an analysis and assessment methodology with which to identify the best potential locations for the UDNs. The first experimentation of this method within the above-described urban context may also be evaluated for its future application to a wider area (at regional scale), which is the overall aim of the research project.

The analysis and assessment were based on a specific set of parameters considered adequate to the main features of individual nodes: that is, high density of flows and functions. The parameters identified made it possible to evaluate the potential node locations according to their accessibility (such as underground and regional train stations; bus, trolleybus and tram stops; bicycle paths) and to their proximity to main urban points of attraction (such as large urban functions; sports and other collective facilities; public parks, gardens or spaces; student residences; supermarkets and commercial districts), which could be of interest to different kinds of users: not only students but also inhabitants and city users. Through a first and selective mapping of the area, all the qualifying spatial components (corresponding to the evaluation parameters previously established) of the *core area* were detected,

[13]See Sect. 3.4.

[14]Website: http://allegati.comune.milano.it/PUG/2015.

whereas within the *edge area* only the larger-scale and most important spatial elements were identified. This map was therefore integrated with territorial development opportunities (such as brownfields and free areas) and other structural components of the local area (such as water networks, main urban axes, infrastructural barriers and their gates) in order to complete identification of the UDNs' potential locations.

By exploiting the functions provided by the GIS programme used to perform this mapping activity, for each of the qualifying spatial components of the local area, a 200-m buffer zone was defined (corresponding to a distance coverable with a 3–4 min walk). By taking advantage of the potentials of this computer programme, the integration of different buffer zones led to the identification (in a second map) of areas where the concentration of qualifying spatial elements is higher in terms of flow and function density, so that they are suitable for any UDN location. Starting from these privileged areas, application of a multi-criteria analysis based on the values of adjacency (0 m), proximity (0–400 m) or remoteness (>400 m) to the qualifying spatial components enabled identification of a first selection of areas with potential for the optimal location of Urban Digital Nodes.

After this first experimentation (conducted to define a spatial analysis and assessment methodology with which to identify the best UDNs' locations) within the Milan urban sector around the Città Studi university campus, a second spatial context (considered to be the effective project context) was identified in the NILs located within the north-western sector of the municipal area (Fig. 3.7): that is, in-between the Bovisa university campus of the Politecnico and the Expo 2015 Site, covering an area of 4,730 hectares and with more than 330,000 inhabitants. The first application area was chosen because of its involvement in the first research project[15] beginning with the knowledge of the context and the information available to the research team, thereby facilitating definition of the analysis and assessment methodology. Therefore, the second application area was chosen because of its proximity to both the Bovisa university campus and the places directly affected by the 2015 Universal Exhibition, so that it intercepted different kinds of users considered by the research: students, inhabitants and city users. The previous observation was subsequently verified and refined for the effective identification of sites suitable for hosting Urban Digital Nodes.

Also in this case, the observed area was articulated by distinguishing between:

- on the one hand, a central or *core area* analyzed in detail in order to verify potential UDNs' locations, including NILs 64 (Trenno), 65 (Gallaratese), 66 (QT8), 71 (Villapizzone), 72 (Maggiore-Musocco), 73 (Cascina Triulza-Expo), 74 (Sacco), 75 (Stephenson), 76 (Quarto Oggiaro) and 77 (Bovisa), which constitute an urban sector of 1,960 hectares with more than 130,000 inhabitants;
- on the other hand, a surrounding or *edge area*, observed in its main spatial components in order to verify possible relations between the UDNs themselves (located in the *core*) and the most important spatial attractors (located in a wider

[15]See Sect. 3.2.

Fig. 3.7 The location of NILs involved in the two research projects: NILs related to Città Studi university campus, on the East, and NILs of the north-western sector of the municipal area, on the West. *Source* re-elaboration by the research group of a map included in the city plan approved by Comune di Milano

urban context), including NILs 57 (Selinunte), 58 (De Angeli-Monte Rosa), 59 (Tre Torri), 60 (San Siro), 67 (Portello), 68 (Pagano), 69 (Sarpi), 70 (Ghisolfa), 78 (Farini), 79 (Dergano), 80 (Affori), 81 (Bovisasca), 82 (Comasina), 83 (Bruzzano) and 88 (Parco Boscoincittà), which constitute an urban sector of 2,770 hectares and with more than 200,000 inhabitants.[16]

For the first application area relative to the Città Studi university campus, the spatial reference was defined by concentric rings from the core to the edge area. For the second application area relative to the Bovisa university campus and the Expo 2015 site, the spatial reference was instead defined by following the infrastructural corridor connecting Milan's inner city to the north-western sector of its metropolitan area: that is, the Milan-Turin and the Simplon railways, on the one hand, and the road system formed by via Gallarate and Autostrada dei Laghi on the other. The analysis, based on the production of different cartographic layers, mainly considered the accessibility and availability of urban facilities and poles, also taking

[16]Website: http://allegati.comune.milano.it/PUG/2015.

ongoing projects into account. The final application to the north-western Milan sector required an updating of the assessment parameters identified in the first experimentation method within the Città Studi area, regarding both high-accessibility places (such as national train stations; underground and regional train stations; bus, trolleybus and tram stops; bicycle paths and the planned Expo Water Way) and the main urban points of attraction (large urban functions like supra-local services, exhibition centers, malls and business centers; historic centers; the Expo site; sports and other collective facilities; public parks, gardens or spaces; right budget accommodation like student residences and hostels; new social housing projects; supermarkets and commercial districts).

The *Analytical Framework* (Map 1, Fig. 3.8) represented the area's main qualifying spatial components, which attract user flows in relation to their high accessibility and their endowment of urban points of attraction, as well as territorial

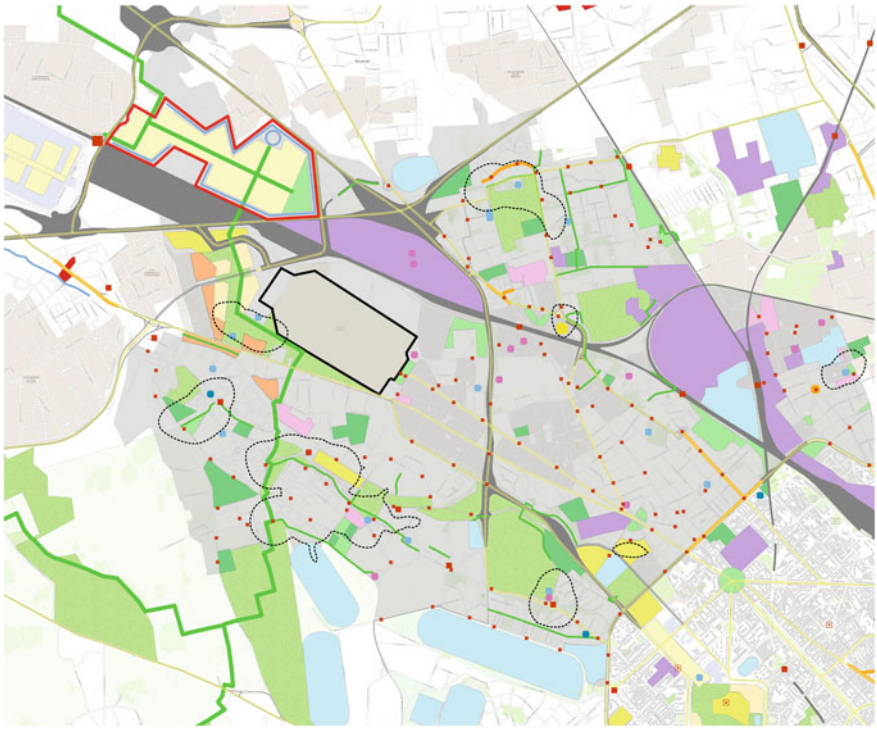

Fig. 3.8 Map 1, Analytical Framework representing the main qualifying spatial components of the area studied (such as high accessibility places—national train stations; underground and regional train stations; bus, trolleybus and tram stops; bicycle paths; the planned Expo Water Way—and urban points of attraction—large urban functions like supra-local services, exhibition centers, malls and business centers; historic centers; the Expo site; sports and other local collective facilities; public parks, gardens or spaces; right budget accommodation like student residences and hostels; new social housing projects; supermarkets and commercial districts) and territorial development opportunities (such as brownfields and abandoned open spaces and buildings). *Source* research team elaboration

development opportunities, such as brownfields and abandoned open spaces and buildings.

The *Interpretative Framework* (Map 2, Fig. 3.9) represented the densities of the qualifying spatial components obtained by layering the 200 m buffer zones (corresponding to 3–4 min walking distance) generated by each single element. On the basis of this analysis and interpretation, the *Synthesis of the Local Potentials* (Map 3, Fig. 3.10) represented the densities of qualifying spatial components in relation to structural elements of the area (such as large urban functions, the Expo Site, the planned Expo Water Way, national train stations and infrastructural barriers).

A system of sub-areas could thus be identified:

- *Quarto Oggiaro*, to the North, mainly characterized by high-density housing and local services, with difficulties of social integration;
- *Bovisa*, to the East, mainly characterized by the Politecnico di Milano campus and by several brownfields already included in an urban redevelopment project for a new technology center;

Fig. 3.9 Map 2, *Interpretative Framework* representing the densities of the qualifying spatial components (identified in Map 1) obtained by layering the 200 m buffer zones (corresponding to 3–4 min walking distance) generated by each single element. *Source* research team elaboration

Fig. 3.10 Map 3, *Synthesis of the Local Potentials*, representing the densities of qualifying spatial components (identified in Map 2) in relation to structural elements of the study area (such as large urban functions, the Expo Site, the planned Expo Water Way, national train stations and infrastructural barriers), leading to identification of a system of sub-areas: Quarto Oggiaro, Bovisa, Portello/QT8 and Gallaratese/Cascina Merlata (Expo). *Source* research team elaboration

- *Portello/QT8*, to the South, mainly characterized by high-density housing, urban parks, sports facilities and shopping malls and, in its surroundings, the San Siro Stadium, the Milan Ippodromo, as well as the FieraMilanoCity trade fair center;
- *Gallaratese/Cascina Merlata* (Expo), to the North-West, mainly characterized by high-density housing and, in its surroundings, the new FieraMilano trade fair center and the area hosting the 2015 Universal Exhibition.

This analysis suggested the possible locations of four Urban Digital Nodes within the area studied; that is, one for each of the above mentioned sub-areas. For each one of them, three possible alternative location options for UDNs establishments were supposed. Specifically, these options were identified by considering the availability of spaces both recognizable within the UDN types (described at the beginning of this section) and located close to places with a high density of qualifying spatial components (identified by the *Analytical Framework*). Within this framework, the *Potential Location of Urban Digital Nodes* (Maps 4.1, 4.2, 4.3 and 4.4) was a detailed study for each of the 4 sub-areas. The selection of the best

UDN location was based on a multi-criteria analysis which compared the three alternative hypotheses of UDN location proposed for each sub-area according to their adjacency (0 m), proximity (0–400 m) or remoteness (>400 m) to the (above mentioned) qualifying spatial components (Fig. 3.11).

Ratings were initially assigned to the various parameters (listed in the table below) by multiplying two factors: (i) the number of corresponding qualifying spatial components located in the neighborhood of each local hypothesis of UDN location; (ii) a unit value conferred on the individual spatial elements according to their distance from the potential UDNs: +2 in the case of adjacency, +1 in the case of proximity and 0 in the case of remoteness. After this first step, the partial outcomes were aggregated by distinguishing between functions with a prevalently local catchment area and functions with a prevalently wider catchment area. Considering the UDNs as interfaces between local and global systems, their ideal location would receive the highest score on both the dimensions (Table 3.2).

The outcome of the multi-criteria analysis is set out in the following table (Table 3.3).

In order to define the best UDN location for each of the four sub-areas, the analysis described thus far was supplemented with other assessments. The

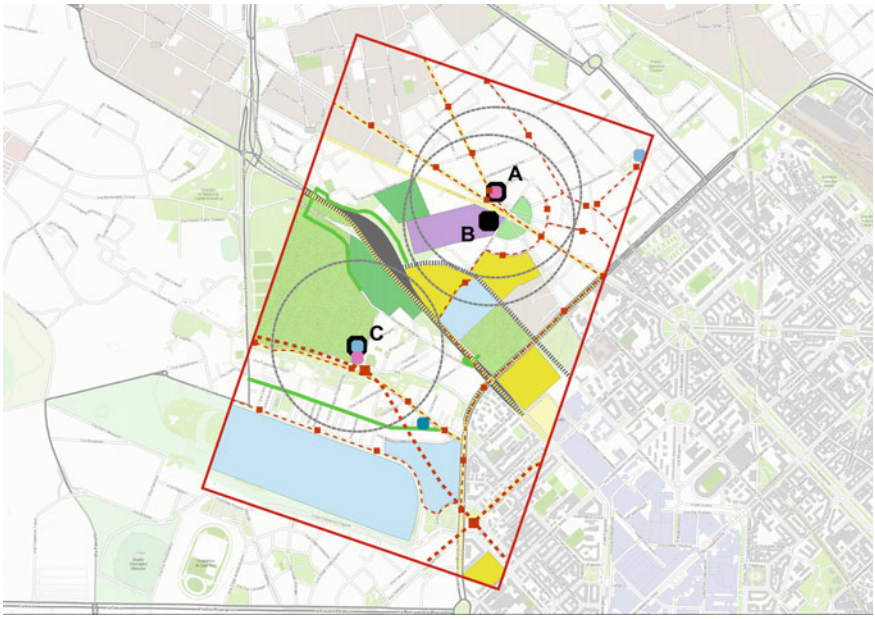

Fig. 3.11 Map 4.3, *Potential Location of Urban Digital Nodes: the sub-area Portello/QT8*, representing the three UDN location hypotheses (*A*, *B* and *C*) for the sub-area Portello/QT8, compared through a multi-criteria analysis according to their adjacency (0 m), proximity (0–400 m) or remoteness (>400 m) to the qualifying spatial components (taken from Map 1) in order to select the best UDN location. *Source* research team elaboration

Table 3.2 The parameters/variables selected for evaluation of the UDNs' possible locations in relation to the qualifying spatial components of the local area as well as their value based on both their distance from the UDNs and their importance

Parameters/Variables	Distance			Relevance	
	Adjacency 0 m	Proximity 0–400 m	Remoteness >400 m	Local	Wide
Accessibility					
National train stations	+2	+1	0	–	X
Underground and Regional train stations	+2	+1	0	–	X
Bus, trolleybus and tram stops	+2	+1	0	X	–
Bicycle paths	+2	+1	0	X	–
Planned Expo Water Way	+2	+1	0	–	X
Points of attractions					
Large urban functions	+2	+1	0	–	X
Historical centers	+2	+1	0	–	X
Expo Site	+2	+1	0	–	X
Sports facilities	+2	+1	0	X	–
Other ollective facilities	+2	+1	0	X	–
Public parks	+2	+1	0	–	X
Public gardens or spaces	+2	+1	0	X	–
Right budget accommodation	+2	+1	0	–	X
New social housing projects	+2	+1	0	X	–
Supermarkets	+2	+1	0	X	–
Commercial districts	+2	+1	0	X	–

parameters used in the multi-criteria analysis were integrated with other factors, not easily attributable to standard parameters, such as:

- the goal of ensuring an equal distance among the potential UDNs so that they can be evenly distributed in the urban fabric;
- the goal of limiting resource consumption by promoting the better re-use of existing assets;
- the existence of urban regeneration policies promoted by the local administration.

On these bases, the final outcomes of this last research phase are shown in the following table (Table 3.4) and map (Fig. 3.12).

These outcomes are the premises for the proposal of the first Milan UDN.[17] This may be the content of a new research project undertaken to develop detailed

[17]See Sect. 3.4.

Table 3.3 The potential selection of the best UDN location for each sub-area according to the multi-criteria analysis

Sub-areas	Location Hypothesis	Space type	Selected location
1. Quarto Oggiaro	A. Parco Lessona	Existing public space	X
	B. Ex Istituto Negri	Brownfield to be transformed	–
	C. Parco Verga	Existing public space	–
2. Bovisa	A. Area Via Durando	Brownfield to be transformed	X
	B. Area Via Candiani	Open space within the urban fabric	–
	C. Area Via Baldinucci	Open space within the urban fabric	–
3. Portello/QT8	A. Ex edificio pubblico Via Epinasse	Abandoned building to be recovered	X
	B. Ex Poligono di Tiro	Brownfield to be transformed	X
	C. Mercato rionale QT8	Abandoned building to be recovered	X
4. Gallaratese/Merlata (Expo)	A. Cascina Merlata	Abandoned building to be recovered	X
	B. Parco Mario Borsa	Existing public space	X
	C. Centro di Aggregazione Via Omodeo	Existing underused public facility	X

components such as urban and architectural design solutions, digital facility innovation, and management organization (identifying projects and partners): for instance, its formulation and implementation could be committed to private partners; otherwise, it could use the huge funds dedicated to Italian cities by the 2014-2020 European programming, for which the themes of smart city, technological innovation and sustainable mobility are priorities (Cassa Depositi e Prestiti and Politecnico di Torino 2013).

On the basis of the needs potentially expressed by the different categories of users to which the Urban Digital Nodes mainly refer, a preliminary definition of the system of services potentially offered follows. This proposal is summed up by the table below (Table 3.5), which identifies (for each function) both the addressees of the services and the distribution methods by distinguishing between face-to-face and online supply.

These services, which are also defined on the basis of an analysis of case studies,[18] may be specifically evaluated according to the features of the spatial and

[18]See Sects. 4.2, 4.3 and 4.4.

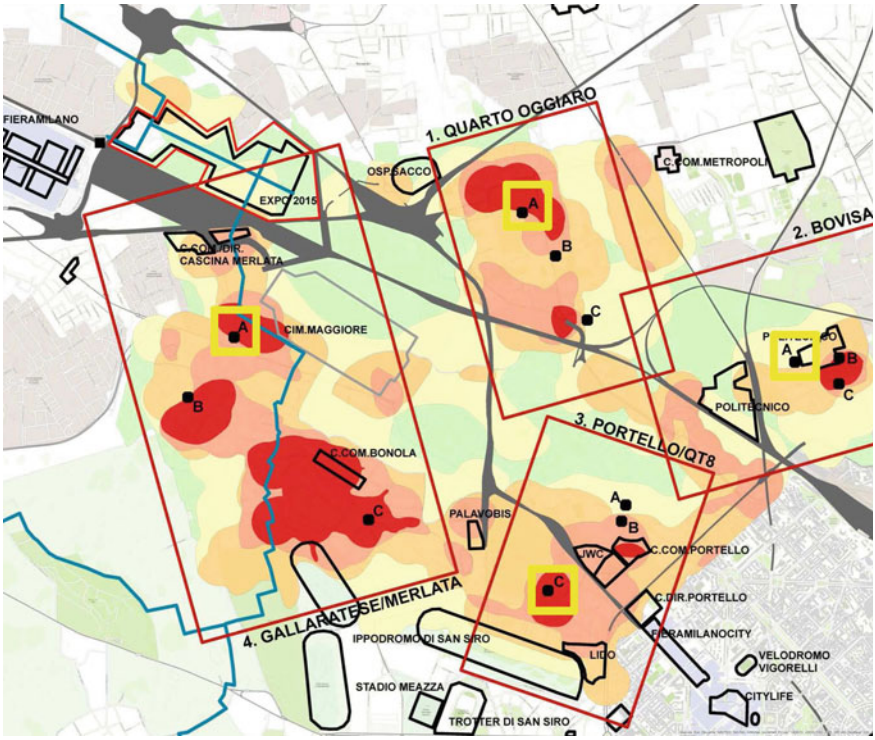

Fig. 3.12 Referring to Table 3.4, the final selection of the best UDN location for each sub-area (*yellow square*) on the basis of an integration between the multi-criteria analysis and other factors not easily attributable to standard parameters. *Source* research team elaboration

socio-economic context of each Urban Digital Node, as the following experimental application demonstrates.[19]

The research was particularly integrated with analysis of functional components which are particularly innovative and specifically connected to digital networks represented by co-working spaces and fab-labs (fabrication laboratories): spaces which refer to the current boom in sharing, knowledge-based and new manufacturing economies often considered to be the bases of a so-called new industrial revolution (Anderson 2010; Anderson 2012; Berta 2014; Bonomi 2013; Campagnoli 2014; Luna 2013; Micelli 2011; Rifkin 2011; VV.AA. 2012). On the one hand, co-working spaces—the first of which was opened in San Francisco by Brad Neuberg in 2005, and which are now rapidly growing throughout the world—favour several immaterial benefits, such as knowledge transfer, informal exchange, collaboration and interaction with others (Moriset 2014). On the other hand, fab-labs—the first of which was opened at MIT in Boston by Neil Gershenfeld in

[19]See Sect. 3.4.

Table 3.4 The final selection of the best UDN location for each sub-area on the basis of an integration between the multi-criteria analysis and other factors not easily attributable to standard parameters

Sub-areas	Location Hypothesis	Space type	Selected location
1. Quarto Oggiaro	A. Parco Lessona	Existing public space	X
	B. Ex Istituto Negri	Brownfield to be transformed	–
	C. Parco Verga	Existing public space	–
2. Bovisa	A. Area Via Durando	Brownfield to be transformed	X
	B. Area Via Candiani	Open space within the urban fabric	–
	C. Area Via Baldinucci	Open space within the urban fabric	–
3. Portello/QT8	A. Ex edificio pubblico Via Epinasse	Abandoned building to be recovered	–
	B. Ex Poligono di Tiro	Brownfield to be transformed	–
	C. Mercato rionale QT8	Abandoned building to be recovered	X
4. Gallaratese/Merlata (Expo)	A. Cascina Merlata	Abandoned building to be recovered	X
	B. Parco Mario Borsa	Existing public space	–
	C. Centro di Aggregazione Via Omodeo	Existing underused public facility	–

2002, and which have now spread worldwide—allow the transformation of digital data into physical objects (and vice versa) through their digital fabrication machines,[20] favouring both the development of specialized productions (locally oriented) and the empowerment of users (Gershenfeld 2005, 2012; Guallart 2012; Ratti 2014).

[20]The Fab Labs are globally connected with each other through the Internet so that users can share their knowledge, skills, ideas, projects and data. Their mission is to provide people and small businesses with open source tools for digital manufacturing processes. The goal is to enable people to produce objects and prototypes and to foster the development of new economic activities. The digital fabrication machines include 3D printers, laser-cuts, cutting machines, numerically controlled water jets, and 3D scanners, together with open source hardwares (for example, *Arduino* by Massimo Banzi) and traditional craft tools. All these machines allow the shaping of various materials, from natural to synthetic.

3.4 QT8 Sport and Wellbeing UDN: An Experimental Application

Identification of the UDNs' functional components leads to a first hypothesis that integrates cultural and social facilities, services to sport activities, innovative economic activities and start-ups, retail and accommodation, information on mobility and environmental quality. All of these declined in relation to the above-mentioned categories of users (Table 3.5), therefore each UDN integrates a different system of services according to the features of the sub-area in which it is located (Table 3.6).

Within the *Portello/QT8* sub-area, the proposed UDN may be located in the existing structure of the former municipal covered market in via Isernia, where the experimental QT8 residential neighborhood (designed by Piero Bottoni in 1948) is licked by the public green area of Montestella Hill.[21] The identification of UDNs' vocations, which oriented the second phase of the research, focused on the main functions of the sub-area: that is, on the one hand, the QT8 residential district, and on the other, the existing and potential urban functions related to sport and leisure facilities. The potential QT8 UDN is, in fact, close to some of the most important Milan sport venues (such as the 25 Aprile Sport Centre and the Montestella Hill) and it is traversed by important cycle paths connecting nearby urban parks (such as Ippodromo and Portello) to large peri-urban neighborhoods (such as Quartiere Gallaratese) and facilities (such as the Milan Trade Fair and the Expo Site). The habitual users of these places frequently engage in repeated and measurable behavior, and they may appreciate technological devices with which to measure, train and compare their sport and leisure activities. This feature makes them interesting addressees for a functional formulation of the proposed UDN. In this regard, the former QT8 market may be enhanced as a node of a network system through the existing, in progress, or potential infrastructures (physical and digital).

The old market, which was used until 2012, is located on the border between the QT8 residential district and the Montestella Hill, and it is directly connected to the M1 line underground station. The building (2,800 sqm) has two levels: the ground floor (1,300 sqm), facing the street and the urban fabric, and the basement (1,500 sqm), facing a large square (600 sqm) and a public green area. The idea of reusing the building for pilot functions related to sport and leisure is therefore directly connected to its location, which may be considered a metaphorical filter between built environment and green. Through some simple operations of space reorganization, these two building levels may be transformed into a wide interchange *node*, both real (in relation to the existing underground line, the road system, the cycle path network and the training routes for runners) and virtual (in relation to the proposed UDN functions such as, for instance, data exchange, info-points or fab-labs). In particular, recovery of the lower floor may favour connections between the built environment of the city and the green open space system of the

[21] In 2012, the Milan municipality promoted the development of a project for the transformation of the QT8 market into a zero kilometer market, but this project was unsuccessful.

Table 3.5 The services potentially offered by the Urban Digital Nodes in relation to different categories of users (inhabitants, students and city users) and to their form of supply (face-to-face and online)

Services	Users			Supply	
	Inhabitants	Students	City users	Face to face	Online
Library	X	X	–	X	X
Multimedia Library	X	X	X	X	X
Study rooms	X	X	–	X	–
Organization of activities and events (shows, concerts, film projections)	X	X	X	X	X
Digital devices and support equipment (computer terminals, laptop points, device charging points, free WiFi)	X	X	X	X	–
Organization of courses and workshops for adults and children	X	X	–	X	X
E-commerce dropbox	X	X	X	X	X
Food and beverage supply based on a zero kilometer policy	X	X	X	X	–
Social assistance for residents (distinguishing among children, youths, singles, families, seniors)	X	–	–	X	X
Information for the welcoming and accommodation of visiting students	–	X	–	X	X
Information for the welcoming and accommodation of tourists and city users	–	–	X	X	X
Public transport info-point and rental of ecological means of transport	X	X	X	X	X
Detection of needs and/or instances of different categories of service users	X	X	X	X	X
Incubator of micro-enterprises	X	–	–	X	X
Co-working spaces	X	–	X	X	–
Fab-Labs	X	X	–	X	–
Right budget accommodation for students and visitors	–	X	X	X	–
Coordinated system of APPs to increase and improve the provision of services and to integrate them wit hmobile digital devices	X	X	X	–	X

Table 3.6 The UDNs' vocation

Sub-area	Quarto Oggiaro	Bovisa	Portello /QT8	Gallaratese/Merlata (Expo)
Categories of users	Inhabitants	Students	Inhabitants and city users	Inhabitants and city users
UDN Concept	Social inclusion	Higher education	Sport and Leisure	Creativity and NGO

Table 3.7 The proposal of the QT8 UDN functional components and the related location-based and site-specific digital services

QT8 UDN functional components	Potential location-based and site-specific digital services
Sport e-Library and Multimedia e-Library (*with specific services related to the UDN theme*)	(1) Real time checks on the endowment and availability of books and documents, and their reservation
	(2) Outdoor and indoor navigation for users, also considering the different kinds of disability
	(3) Book crossing
	(4) User reporting of books and documents, as well as the sharing of information about and assessment of the services
Study rooms	(1) Real time checks on the endowment and availability of study rooms and their reservation
	(2) Outdoor and indoor navigation for users, also considering the different kinds of disability
	(3) User reporting of spaces, as well as the sharing of information about and assessment of the services
e-Ntertainment (*organization of thematic activities and events, such as action movies and sport conferences*)	(1) Information about events and their reservation
	(2) Outdoor and indoor navigation for users, also considering the different kinds of disability
	(3) User reporting of events, as well as the sharing of information about and assessment of the services
	(4) Screening and streaming of events
Sport e-Facilities (*dressing rooms and relaxation areas provided with digital devices and support equipment such as computer terminals, laptop points, device charging points, free WiFi*)	(1) Real-time checks on the endowment and availability of sport facilities and their reservation
	(2) Outdoor and indoor navigation for users, also considering the different kinds of disability
	(3) User tracking of sport activities and training

(continued)

Table 3.7 (continued)

QT8 UDN functional components	Potential location-based and site-specific digital services
	(4) GPS dispenser
	(5) e-CheckUp (monitoring the users' physical efforts and reporting anomalies)
	(6) User sharing of experiences, information, and assessments of the services
	(7) virtual coach
e-Lab (*organization of courses and workshops related to the UDN theme for adults and children*)	(1) Information about and booking of courses and workshops for different categories of users
	(2) Outdoor and indoor navigation for users, also considering the different kinds of disability
	(3) User reporting of courses and workshops, as well as the sharing of experiences, information, and assessments of the services
	(4) Screening and streaming of activities
e-Commerce dropbox	(1) Product purchasing
	(2) Dropbox rental for delivery or reception of purchased goods
	(3) Real-time monitoring of consignments
	(4) Outdoor and indoor navigation for users, also considering the different kinds of disability
	(5) User sharing of experiences, information, and assessments of the services
Food and beverages supply based on a zero kilometer policy	(1) Information on the origin and quality of the products offered, and on their added value in comparison to traditional products
	(2) Product purchasing
	(3) Dropbox rental for delivery or reception of purchased goods
	(4) Real-time monitoring of consignments
	(5) Outdoor and indoor navigation for users, also considering the different kinds of disability
	(6) User sharing of experiences, information, and assessments of the services
Info-Expo for inhabitants and temporary users (*integration of UDN services within the E015 Digital Ecosystem*[a] *in order to promote a real and wider-scale spatial integration of the event*)	Integrated ICT services (web, totems, apps) outside the Expo Site in order to host visitors within the entire Milan metropolitan area (culture, events and news, Expo, mobility, Made in Italy, accommodation) during both the event and the post-event (by sharing technological standards and referring to common rules)
Information for the welcoming and accommodation of tourists and city users	(1) Announcements about accommodation supply and demand

(continued)

Table 3.7 (continued)

QT8 UDN functional components	Potential location-based and site-specific digital services
	(2) Information on accommodation solutions and their urban context
	(3) Information about services, events, activities and leisure within the city
	(4) User reporting of information by the promoters of services and initiatives
	(5) Reservation of services and activities
	(6) Outdoor navigation for users, also considering the different kinds of disability
	(7) User reporting, as well as the sharing of experiences, information and assessments of the facilities and services
Public transport info-point	(1) User reporting of real-time information on traffic and public transport
	(2) Assessment of different transport times and costs in relation to real-time mobility conditions
	(3) Real-time checks on the availability, times and costs of taxis and their reservation and payment
	(4) Real-time checks on the availability, times and costs of carpooling services and their reservation and payment
Green vehicle rental (*bike sharing, folding bike sharing, electric car sharing*)[b]	(1) Real-time checks on the endowment and availability of ecological mean of transports and their reservation
	(2) Outdoor navigation for users, also considering the different kinds of disability
	(3) Information on routes and places in the local and wider area
	(4) Real-time information on any inefficiencies and inconveniences
	(5) User drawing of routes and places to visit
	(6) Location tracking of parked vehicles and directions for their retrievall
	(7) User reporting, as well as the sharing of experiences, information and assessments of the services
Cycle Lab	(1) Information on the services offered
	(2) Real-time checks on the endowment and availability of the cycle lab and their reservation
	(3) Outdoor navigation for users, also considering the different kinds of disability
	(4) User sharing of information about and experiences of the services

(continued)

Table 3.7 (continued)

QT8 UDN functional components	Potential location-based and site-specific digital services
Fab-Lab (*specialized in the fabrication of products related to the UDN theme*)	(1) Real-time checks on the endowment and availability of fab-lab machines and their reservation
	(2) Outdoor and indoor navigation for users, also considering the different kinds of disability
	(3) User sharing of experiences, information, and assessments of fab-lab equipment
	(4) Running shoe customizer
Runner and biker Hotel (*low budget accommodation for students and visitors in relation to the UDN theme*)	(1) Real-time checks on the endowment and availability of rooms and their reservation
	(2) Announcements of demand for and supply of other low-cost and right-budget accommodation solutions
	(3) Information on accommodation solutions and their urban context
	(4) Outdoor navigation for users, also considering the different kinds of disability
	(5) User reporting and sharing of information about and assessments of facilities and services
Smart grid (*clean energy production and exchange with external networks*)	(1) Information on the technologies employed and monitoring of energy production and consumption levels by the UDN in order to raise awareness of sustainability
	(2) User sharing of experiences of and information about energy production and consumption
e-Nvironment Ecosystem Observatory (*environmental monitoring of the UDN urban context*)	(1) Monitoring of pollution levels within the UDN urban context
	(2) Information to users in order to suggest good behaviors
	(3) User sharing of experiences of and information about energy production and consumption
e-Nvironment Ecouser Observatory (*environmental monitoring of the user personal consumptions*)	(1) Monitoring of consumptions produced by single user activities
	(2) Monitoring of waste produced by single user activities
	(3) Allocation of credits (in terms of bonuses for UDN services) with a view to virtuous behavior awards (and therefore promotion)

[a]Website: http://www.e015.expo2015.org/

[b]Possible integrations with the *Digital Island* project (promoted by *Comune di Milano*, *Expo 2015 Spa* and *Telecom Italia*) or with the *Green Move* project (promoted by *Politecnico di Milano* and *Regione Lombardia*)

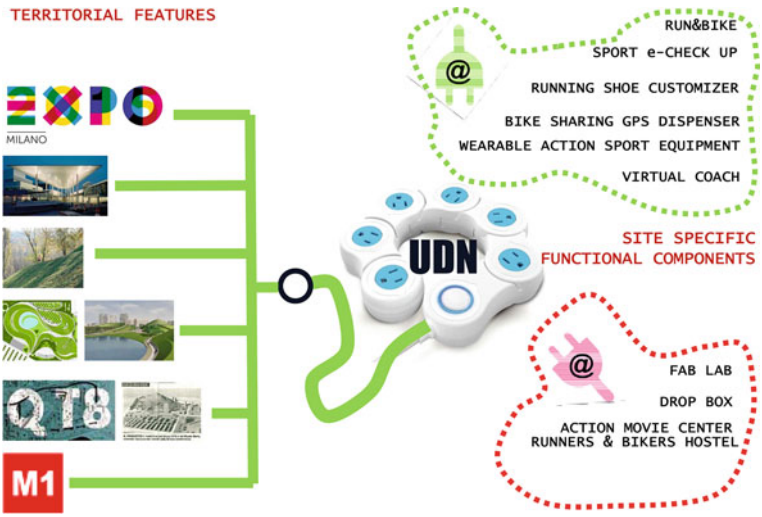

Fig. 3.13 A synthesis of the functional components proposed for the QT8 UDN. *Source* Rolando

Montestella Hill, as well as the exploitation and regeneration of an area now degraded despite its potentially high urban quality.

New flows of users could cross this node (in horizontal and vertical ways), which could re-direct and implement the already intensive uses made of the surrounding spatial context, as well as provide (thanks to its size) a real opportunity to develop a new hub for the development of research, trade and information. The QT8 UDN proposal is therefore focused on sport, leisure and wellbeing. Specific functional components are consequently suggested, as shown in the following table (Table 3.7), which sets out the QT8 UDN's functions in relation to the specific local features and indicates the relative potential APPs for mobile devices. This is a system of potential location-based and site-specific digital services which may lead to the development of this actual urban node into a future urban digital node (Fig. 3.13).

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Chapter 4
Reference Case Studies and Best Practices

Andrea Rolando and Stefano Di Vita

This chapter aims at describing the several case studies, which inspired the localization methodology and the functional components of the UDNs. The most significant of these different scale projects are: (i) at the local scale, the Living Lab in Malmö; (ii) at the urban scale, the Idea Store public libraries in London and the 22@Innovation District in Barcelona; (iii) at the regional scale, the smart city-regionalism plans in Seattle. These cases were selected with the purpose of concretely verifying: (i) if ICTs are really able to modify the uses, organization and planning of urban spaces and how they could concretely stimulate urban regeneration processes (as in Barcelona) and urban services innovation (as in London and Malmö); (ii) how the urban smartness concept can be extended to the regional scale (as in Seattle). From this perspective, these case studies consequently made it possible to compare the theoretical ICT potentialities for spatial change and innovation (Fig. 4.1) with their real outcomes (which do not always correspond to the original goals), as well as identify ways to improve current practices, also on the basis of the research pilot projects explained in Chap. 3.

C. Morandi et al., *From Smart City to Smart Region*,
PoliMI SpringerBriefs, DOI 10.1007/978-3-319-17338-2_4

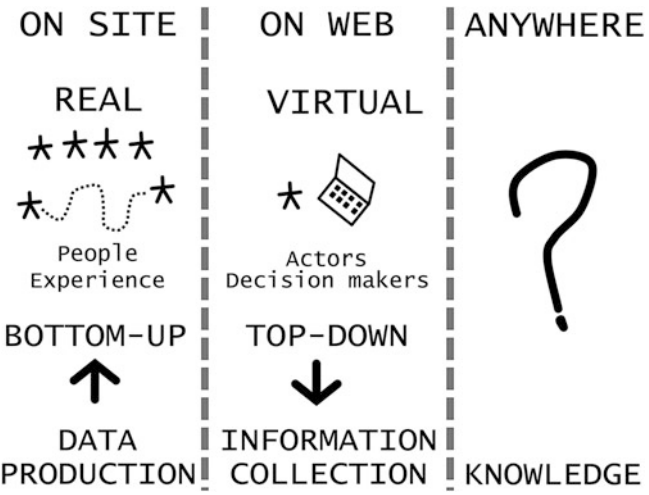

Fig. 4.1 The ICTs potentialities for spatial change and innovation (*Source* Rolando)

4.1 Multi-scalar Urban Digital Nodes References Within a Smart Region Perspective

The research outcomes, concerning development of the internet of places and the urban digital nodes concepts, derive partly from observation of several and heterogeneous case studies. These experiences are very different in both their scale and functions, but each of them has been selected for several reasons: on the one hand, because of their spatial scale and functional articulation; on the other, because of their experimentation of innovative solutions in location selection, delineation of functional mixes, and provision of single services (both physical and digital). From the perspective of the evolution of the smart city idea into a smart region one, the case studies are identified at different scales (local, urban and regional). In fact, a smart region should be considered not only in its overall extension (through the development of large-scale services, such as physical and digital infrastructures) but also in relation to its individual components (through the development of local-scale services such as public spaces and facilities directly integrated by ICTs) whose contents and methods could be applied to and declined in different spatial contexts. Because one of the main features of a smart region can therefore be identified in the multi-scalarity of its smart elements, the analysis of the case studies moves through three different steps.

At the local scale, the cases observed are:

- *Amsterdam Zonspot* in Amsterdam (The Netherlands),[1] a system of multi-media totems envisaged in public spaces within the Amsterdam Smart City programme; these provide information and support users of mobile devices (for instance, by furnishing charging points and free WiFi services).
- *A8ernA* in Zaanstad (The Netherlands),[2] an urban renewal project to transform an abandoned area located under a highway overpass into a system of multi-functional spaces by integrating sports facilities, retail outlets, public parking, public open spaces, and a new marina (Tamini 2011).
- *Cascina Cuccagna* in Milan (Italy),[3] a multi-functional center based on a socio-cultural participation initiative. It integrates spaces for events, meetings and associations, and hosts tourist and educational functions and activities, with the purpose of promoting innovative integration between city and countryside.
- *Living Lab* in Malmö (Sweden),[4] a city laboratory located in a huge waterfront transformation area. It offers spaces and integrates facilities aimed at inducing diverse stakeholders to involve themselves in the experimentation with and promotion of urban innovation solutions for improvement of the quality of the environment and life.

At the urban scale, the cases analyzed are:

- *Idea Stores* in London (UK),[5] a public library network in the borough of Tower Hamlets. These facilities have a recognizable design, located in places characterized by high accessibility and provided with different functions, also based on ICTs;
- *2012 World Design Capital* (*WDC*) in Helsinki (Finland),[6] a large event whose exhibition sites are distributed across the entire metropolitan area and integrate diverse functions, such as wellbeing facilities, catering spaces, and other services for users of mobile devices (for instance, charging points and free WiFi services useful for both inhabitants and city users).
- *22@Innovation District* in Barcelona (Spain),[7] a large urban plan to complete the waterfront transformation of the city. The aim is to encourage the economic, social and spatial regeneration of a former industrial district by promoting a system of services and businesses mainly based on ICTs.

[1]Website: http://www.amsterdamsmartcity.org/.
[2]Website: http://www.nlarchitects.nl/.
[3]Website: http://www.cuccagna.org/.
[4]Website: http://www.openlivinlabs.eu/.
[5]Website: http://www.ideastore.co.uk/.
[6]Website: http://www.wdchelsinki.fi/.
[7]Website: http://www.22barcelona.com/.

At the regional scale (which itself is declined in relation to spatial contexts characterized by different extensions, i.e. supra-municipal, regional, macro-regional, national or international), the cases considered are:

- *Comunità Montana Vallo di Diano* (Italy).[8] Comprising fourteen neighboring municipalities, it promotes an extensive system of smart policies and projects intended to improve local accessibility and mobility, economic productivity, territorial internationalization, and the sustainable management of environmental resources. It also seeks to enhance levels of education, culture and social inclusion, also through the organization of a cooperative smart governance process and an increasing ICT availability in order to support the public administrations and the fruition of tourist resources (Associazione Nazionale Comuni Italiani, Osservatorio Nazionale Smart City 2014).
- *Unione dei Comuni della Romagna Faentina* (Italy).[9] Formed by six neighboring municipalities, it promotes the development of an inclusive, intelligent and sustainable community based on a plan for energy and environment sustainability, the establishment of a science and technology park, and free WiFi, e-governance and open data (Associazione Nazionale Comuni Italiani, Osservatorio Nazionale Smart City 2014).
- *Mantova Smart Region* (Italy), a project launched in 2012 within the research doctorate programme in *Progetto e Tecnologie per la Valorizzazione dei Beni Culturali* at the *Politecnico di Milano*. It promotes application of the smartness concept to the entire Mantua provincial area through the experimental integration of digital infrastructures and services with the cultural, environmental and landscape heritage beginning with implementation of an innovative supra-municipal governance approach (Bolici and Mora 2012).
- *Interreg IIIB North Sea* projects, developed from 2002 to 2007 by cities and regions in some northern European countries.[10] Named *Bird*, *ICTs4SMEs* and *LoG-IN*, these projects promote e-services, e-learning and e-government through the implementation of broadband. They increase the ICT use by small and medium-sized enterprises, and provide local authorities with innovative digital tools and strategies, especially in order to overcome the disadvantages of rural areas.[11]
- *SmartRegions,*[12] a system of pilot projects promoted from 2010 to 2013 by agencies, research institutions and companies from eight European countries[13] and co-funded by the *European Commission Intelligent Energy Europe* (*IEE*) programme. The system is oriented to developing smart metering services in

[8]Website: http://osservatoriosmartcity.it/il-vademecum/.

[9]Website: http://osservatoriosmartcity.it/il-vademecum/.

[10]Such as Belgium, Germany, Denmark, The Netherlands, Sweden and the United Kingdom.

[11]Website: http://www.smartregions.eu/.

[12]Website: http://www.smartregions.net/.

[13]Such as Finland, Norway, Germany, Austria, The Netherlands, Poland, Romania and Spain.

various European regions in order to develop smart grids and to achieve the 2016 and 2020 energy efficiency targets of Europe (Laitinen 2013).
- *Seattle smart city-regionalism*, a system of plans intended to coordinate the development of transport corridors and nodes with containment policies for urban growth by intercepting US Federal programmes and grants, and by integrating regional and local planning systems.

Although all these multi-functional cases are differently significant in relation to the research concepts of smart region, internet of places, and urban digital nodes, most of them tend to unbalance their offer towards only one of the two dimensions that the research sought to integrate: that is, the dimensions of physical and digital services. Only in a few of them do these two components co-exist, although the relations between material space and cyber space, which they provide, are mainly based on a parallelism, rather than on real and effective integration:

- at the local scale, the best practice is the *Malmö Living Lab*;
- at the urban scale, the best practices are the *London Idea Stores* and the *Barcelona 22@Innovation District*;
- at the regional scale, the best practice is the *Seattle smart city-regionalism*.

4.2 The Local Scale: Malmö Living Lab

The Swedish city of Malmö is one of Europe's most active cities in the field of environmental and social sustainability. It has launched several projects: urban brownfield transformations considered as opportunities for experimentation with innovative settlement solutions; implementation of bicycle mobility; recycling of organic waste with the consequent production of biogas to power the urban bus fleet; serving of organic food in school and social care center canteens; organization of events based on low energy consumption; production of wind energy; increased green procurement in public services and commercial activities; encouragement of car pooling; testing of green roofs to reduce the problem of flooding in the event of adverse weather conditions.

In this context, the urban transformation of Malmö's Western Harbour, partially completed, has two purposes: (i) to regenerate an abandoned industrial and port area close to the historic center; and (ii) to develop an innovative neighborhood in terms of urban sustainability and ecologic spatial design, where in 1998 Malmö University opened one of its campuses. Within this transformation area, in 2007 the Media research center[14] of Malmö University established the Malmö Living Lab: (Fig. 4.2) this is a laboratory that hosts workshops, events and creative activities aimed at developing urban innovation solutions through the involvement and

[14]Medea is the design research center for collaborative media of Malmö University (Website: http://medea.mah.se/).

Fig. 4.2 Photo gallery of the Malmö Western Harbour transformation area where the Malmö Living Lab is located (*Source* Rolando)

participation of diverse stakeholders (researchers, citizens, companies, institutions, associations). These solutions are not oriented to the development of new commercial products, but rather to improvement of the quality of the environment and life. The laboratory's activities divide among three main thematic areas:

- the *Neighbourhood*, which experiments with shared projects of urban sustainability, especially in regard to the growth of social innovation opportunities;

- the *Stage*, which experiments with shared media services, place- and time-specific, for temporary events and permanent cultural activities;
- the *Fabriken*, which shares tools, new technologies, knowledge and skills for the prototyping of ideas, goods and services .

The Malmö Living Lab is part of an international network which now includes 330 similar laboratories all around the world. Especially, it belongs to the *European Network of Living Labs* (ENoLL[15]) created in 2006 in order to launch a dynamic system of innovation in Europe. Living Labs are therefore organizations both locally established and internationally networked, and whose goal is to capture the intuitions of users in order to develop solutions for the daily lives of citizens. Their innovative approach concerns, for instance:

- the central positioning of users within both the creative process and the final products or services;
- the aggregation of actors operating in the same place through a "public-private-people" partnership model (Colorni et al. 2014).

For these reasons, from a human smart city perspective, Living Labs (of which the Malmö Living Lab is one of the most significant examples) are important players which offer references and suggestions for the Urban Digital Nodes (UDNs) proposed by the research. Indeed, they are laboratories of innovation and experimentation, as well as platforms for the co-creation, co-design and co-production of goods and services by the users (Colorni et al. 2014).

4.3 The Urban Scale: London Idea Stores and Barcelona 22@Innovation District

Idea Stores is a public library network recently opened by the London Municipality of Tower Hamlets and now corresponding to a system of urban nodes characterized by high quality and social innovation capacity. The system now consists of five new venues that have determined the growth of the original network formed of three old and unattractive public libraries in a strongly degraded borough, with a high immigration rate. This new network has been created with the goal of increasing the number of library users, which was originally below the national average, by integrating different functions, not just cultural, but also social. The design of Idea Stores, developed with the support of citizens (for instance, through questionnaires or interviews), has sought to improve the attractiveness of traditional libraries by both focusing on their brand, marketing and digital services and carefully considering their locations. In this regard, proximity to existing urban centralities and infrastructural nodes (which gather huge flows of potential users) have been especially taken into account (Table 4.1).

[15]Website: http://www.openlivinglabs.eu/.

Table 4.1 The London Idea Stores: locations, types and services (*Source* http://www.ideastore.co.uk/)

London Idea Stores			
Service type		Public Library	
Urban location		Tower Hamlets (total surface: 1,980 ha; population: 254,100 inh.)	
Funds		Public-private co-funding:	
		1. Public funding by Tower Hamlets Council, Learning and Skills Council, London Development Agency, London Metropolitan University, European Regional Development Fund and Tower Hamlets College	
		2. Private funding by UK Online, Bow People's Trust, Leaside Regeneration, Lloyds of London Charities Trust, Sure Start Partnership, Cityside Regeneration, Sainsburys Families Charitable Trust, Canary Wharf Group, Barclays and Big Lottery	
Goals		Knowledge dissemination, social integration, and economic regeneration	
Services		Library and Media Library, e-Library, organization of events (exhibitions, concerts, film screenings), organization of reading groups, courses and workshops for adults and children (more than 900 initiatives per year concerning education, language, yoga, dance, poetry), kindergarten, elderly club, Internet navigation facilities, digital devices for disabled persons, coffee shop, Idea Store Mobile APP, Idea Store Business (online service), Idea Store Employment Advice (face-to-face and online service), Idea Store Law (face-to-face and online service)	
Accessibility		Their location is mainly related to the London Underground and Docklands Light Railway (DLR) stations, to bus stops and to the cycle-paths, rather than to car parking availability	
1. Idea Store Bow (2002)			
Local context	Peripheral and multiethnic residential area with local average income below the national one	Material services	Laptop workstations and computer terminals
			Study and course rooms
			Meeting rooms
			Film screening and exhibition spaces
			Bar

(continued)

Table 4.1 (continued)

London Idea Stores			
	Main commercial road of the neighborhood, located between two public parks and two infrastructural barriers		Baby changing tables
			Self-service fax and photocopying
Building type	Medium-sized library (1,125 m^2)	Digital services	Internet
	Re-use of existing building		RFID and WiFi
2. Idea Store Canary Wharf (2006)			
Local context	Canary Wharf international business district with local average income higher than national one	Material services	Laptop workstations and computer terminals
			Study and course rooms
			Multimedia and audiovisual spaces
			Association spaces
			Baby changing tables
			Self-service fax and photocopying
Building type	Small-sized library (960 m^2)	Digital services	Internet
	Re-use of the car park in the mall where the library is located		RFID and WiFi
			Information displays
3. Idea Store Chrisp Street (2004)			
Local context	Peripheral and multiethnic residential area with local average income below the national one	Material services	Laptop workstations and computer terminals
			Study and course rooms
	Public space delimited by commercial fronts and adjacent to one of the main urban penetration axes, the *East India Dock Road*		Film screening and exhibition spaces
			Multimedia and audiovisual spaces
			Association spaces
			Baby changing tables
	Close to the DLR *All Saints* station		Self-service fax and photocopying
Building type	Medium-sized library (1,033 m^2)	Digital services	Internet
	Newly-constructed transparent building		RFID and WiFi
			Information displays
4. Idea Store Whitechapel (2005)			
Local context	Commercial road connecting the City with the 2012 Olympic Park and complemented by several urban functions (hospitals, universities, schools)	Material services	Laptop workstations and computer terminals
			Study and course rooms
			Film screening and exhibition spaces

(continued)

Table 4.1 (continued)

London Idea Stores			
			Multimedia and audiovisual spaces
			Association spaces
			Dancing spaces
			Therapies spaces
			Kindergarten
	Close to the District Line *Whitechapel* station		Bar
			Baby changing tables
			Self-service fax and photocopying
Building types	Large-sized library (3,400 m^2)	Digital services	Internet
	Newly-constructed transparent building		RFID and WiFi
			Information displays
5. Idea Store Watney Market (2013)			
Local context	Watney Market area, along one of the main urban penetration axes, the *East India Dock Road*, complemented by several urban functions (hospitals, universities, schools)	Material services	Laptop workstations and computer terminals
			Study and course rooms
			Spaces for leisure time activities
			One Stop Shop where residents can access council services (concerning municipal subsidies and taxes, or public housing)
			Self-service fax and photocopying
Building type	Large-sized library	Digital services	Internet
	Newly-constructed transparent building		RFID and WiFi
			Information displays

Three other Idea Stores are located in the original Tower Hamlets public libraries, suitably renovated: Bethnal Green Library, Cubitt Town Library and Local History Library and Archives (*Source* http://www.ideastore.co.uk/)

The case of Idea Stores—which has been followed by similar schemes in other countries (for example, the *Anythink* library system in Denver, US; the *Idea Soest* in Amsterdam, The Netherlands; the *Il Multiplo* culture center in Cavriago, Italy)—is interesting for several reasons:

- the integration of physical and digital services (even though limited to free internet access through RFID and WiFi networks; the availability of information displays; the development of a smartphone application for the use of library services; the provision of various online consultancy services), which resembles the urban digital nodes concept;

- their spatial location near the site of the London Summer Olympics 2012, providing useful suggestions for the Milan Expo 2015 site future dynamics;
- their social destination, mainly oriented to the inhabitants of Tower Hamlets (which is one of the poorest and highest immigration rate districts in UK), corresponding to the approach adopted by the research of focusing on users and service categories (social and cultural) where the uses of digital services is lower (Fig. 4.3).

Fig. 4.3 Photo gallery of *London Idea Stores* (*Source* Di Vita)

As regards the relationships among university campuses, ICTs, and extensive urban regeneration projects, a significant example is provided by the 22@Innovation District promoted by the municipality of Barcelona (Spain). This project aims to transform the eastern district of the city, for years characterized by brownfield sites or degraded areas: large industrial enclaves, abandoned since the 1960s and gradually replaced by logistics and transport companies and by art and craft laboratories in an urban context strongly penalized by very low spatial and social quality. The 22@Innovation District is part of a system of interventions undertaken by the municipality at the end of the 1990s to renew the process of the city's urban regeneration and global repositioning which had begun in the 1980s and was exponentially accelerated by the Summer Olympics of 1992. The 22@urban plan, which is integrated with the new centralities of Plaça de les Glories (to the west) and the exhibition center and conference hall of the Unesco Forum of Culture 2004 (to the east), is connected to the extension of Avenida Diagonal to the sea. The plan aims at completing the typical nineteenth-century road structure of the Barcelona Eixample (Plan Cerdà 1859) in the eastern sector of the city, which was planned but never built (Di Vita 2015). In this regard, the 22@urban plan, whose first version was launched in 1998, defines the rules for the district's urban transformation by promoting the development of new economic activities with a high capacity for innovation (Delbene and Scarnato 2007): that is, more qualified and efficient activities, also related to ICT growth, within the innovative sectors of creative, knowledge-based, and new manufacturing economies.

The plan, sponsored by the municipality through the collaboration of the Departament de Urbanism (responsible for planning and urban design) and the public company BarcelonActiva (responsible for the promotion of economic activities and urban marketing), is included in the Barcelona Smart City programme coordinated by the Institut Municipal d'Informàtica—Habitat Urba. It is one of the most ambitious programmes of urban smartness in Europe: the Barcelona municipality has invested in it with the purpose of encouraging new conditions for the city's spatial, economic, and social regeneration, beginning with the yearly organization of the Smart City Expo World Congress and the participation in several other initiatives (European Parliament, DG for Internal Policies 2014). Indeed, it is based on the promotion of projects and activities with a high capacity for innovation, also in relation to the growth of ICTs and their application to the urban space (Ayuntament de Barcelona 2012a, b, 2013). Specifically, this strategy aims at diversifying an urban development model that, since the 1992 Olympics, has been mainly oriented towards the city's repositioning as a tourist and leisure destination, often criticized for having radically replaced the traditional economic system of the former main industrial pole in Spain. On the one hand, it has resulted in an overall improvement of urban quality; on the other, it has however fueled the speculation and real estate crisis of recent years (Pizza de Nanno 2007; Bertelli 2009). Although the *Barcelona Smart City* programme is sometimes criticized for being considered another urban marketing step after the mega-events of the last years—from the 1992 Olympics to the 2004 Unesco Forum of Culture (Di Vita 2015)—with its urban smartness strategy the municipal administration has confirmed its capacity to

promote long-perspective urban visions, which has already been proved since the 1980s (Colorni et al. 2014).

With the goal of promoting the city as an urban laboratory, together with the various initiatives launched by the urban smartness programme[16] with the participation of different stakeholders (research centres, private companies, public authorities, citizens) and the support of several Living Labs[17] (Colorni et al. 2014), the 22@ plan (currently under construction, although recently slowed by the financial and economic crisis) aims at the physical transformation of a degraded area of the city (total area about 200 ha, including 115 of the 498 city blocks of the entire Barcelona Eixample) through the establishment of a differentiated system of functions (housing, commerce, offices, accommodation, manufacturing) (Guallart 2012) (Fig. 4.4). At the same time, it intends to use this opportunity as a chance to establish an innovation district in which the Barcelona Smart City programme is physically implemented (Di Vita 2015).

The *22@* plan—that is one of the most important interventions currently ongoing in the Catalan city and features high potential for real estate development—is based on a public investment in infrastructures of 180 million euros (beginning with transports and telecommunications). It comprises a system of projects to strengthen public parks and community facilities; to protect and re-use historic industrial buildings; to establish productive activities with a high level of innovation; and to integrate them with social housing. In particular, the *22@* plan rules provide for an increase of building density in relation to the development of spaces for productive activities with a high level of innovation and for social housing. By 2012, 70 % of the plan had been completed through the approval and execution of 117 projects (78 private and 39 public) leading to the establishment of 1,500 companies and institutions within the district (Ayuntament de Barcelona 2012b).

As regards economic activities, the project specifically provides for the development of thematic clusters with high technological content by involving institutions, universities, companies and organizations (local and international): Media, ICTs, Medical Technology, Design and Energy. According to the Triple Helix model, this innovation district integrates the public administration, private firms and universities according to functions of three different types: spin-offs, open data and living labs. Hence, the project has also been named *22@UrbanLab* because it converts the process of the district's spatial, economic and social regeneration into a sort of urban laboratory with multiple purposes: increasing the city's attractiveness on a global scale; improving the quality of life for citizens; offering companies opportunities to trial their technological innovations through pilot projects applied to the local area (Ayuntament de Barcelona 2012a, b, 2013; Di Vita 2015) (Table 4.2).

[16]For instance, projects related to intelligent mobility, buildings and grids, free WiFi, energy efficiency, public lighting and services, as well as open data (Colorni et al. 2014).

[17]Such as LIVE, BDigital Cluster, TIC Living Lab, i2Cat Living Lab, FABLab and HANGAR (Colorni et al. 2014).

Table 4.2 The players and functions in the five clusters of the 22@*Innovation District* in Barcelona (*Source* Ayuntament de Barcelona 2012a, b, 2013)

	Media	ICTs	Medical Tech.	Design	Energy
Companies	MediaPro	T-Systems	Matachana	G-Star Raw	Endesa
	Lavinia	Indra	Gaes	ADD	
	Cromosoma	Telefonica	Sanofi Aventis	Node	Ecotecnica
	Yahoo R&D		Isdin	Estudi Arola Ruiz+ Company	
			Telemedicine		Agbar
				Morera design	
Institutions	RNE	CMT	CatSalut	BCD	ITER
	CAC	FBD	Blood and tissues bank		Climate Catalan Institute (IC3)
	Barcelona TV	Localret			CETAQUA
Specialized spaces	Audiovisual production centre (PBM)	Interface Building	Health Building BIO	Palo Alto	Interuniversity
				PBM	
		Media-TIC building	Enterprise Park	Hub	Campus of Besòs
				Design	
Universities[a]	UPF	UB	UB	University of Vic	UB
	UB	UPC	UPC	UPC	UPC
	UOC	La Salle	Official Nursing College	IAAC	
Technological centers	Barcelona Media-Innovation Centre	Technological ICT Centre	22@ MedTech Laboratory	Centre de Innovació Barcelona Media	IREC
Incubators	Media-TIC building	Media-TIC building	Health building	Media-TIC Building Projecte Bressol	b_TEC incubator
Residential neighborhood	Melon district	Melon district	Nido	Melon District Ciutadella	b_TEC residence
	Ciutadella				
Spaces for dissemination	Media factory	ICT house	Health building	Hub design	Interuniversity Campus of Besòs

[a]*UPF* Universitat Pompeo Fabra; *UB* Universitat de Barcelona; *UOC* Universitat Obierta de Catalunya; *UPC* Universitat Politecnica de Catalunya; *IAAC* Institute for Advanced Architecture of Catalonia

Among the most interesting detailed projects promoted by the *22@* plan are the following:

- the development of *Media TIC*, a technological and sustainable building that hosts a business incubator, research centers and institutions operating in the fields of ICTs and media (for instance, the Barcelona Digital Technological Centre, the Cibernàrium computer training center for professionals and businesses, the online Universitat Oberta de Catalunya), as well as showrooms dedicated to ICTs and an auditorium for dissemination activities;
- the opening of the *Fab-Lab Barcelona*, a laboratory of the Institute for Advanced Architecture of Catalonia (IAAC), connected to the worldwide Fab Lab network and provided with machineries and technologies for digital manufacturing,[18] which has recently promoted experimentation with a self-sufficient house and a self-sufficient urban block;
- the activation of a smart service delivery platform, that is a public-private platform for sharing data stored by different sensor systems, thus providing useful information to citizens, administrators, operators and professionals;
- the activation of the *LIVE Barcelona* (*Logistics for the Implementation of Electric Vehicles*) project, that is a public-private platform for promoting the use of electric vehicles, beginning with the installation of 240 charging stations throughout the city, the first of them within the 22@Innovation District itself;
- the construction of the *ME Hotel*, included within the Mobec Hotel circuit (mobility sharing system for tourists and city visitors with electric motorbikes) promoted by the municipal administration and the local hoteliers association, and based on the installation of a charging station network for electric motorcycles available for customers in front of the hotels participating in the initiative;
- the development of e-government services to improve the accessibility, efficiency and transparency of public services: from online procedures and public open data to the *Quiosc PuntBCN*. The latter is a network of kiosks (located at the eleven traditional Oficines of Atenció Ciudadana, but also at shopping centers, libraries and civic centers) which provide information on administrative procedures for citizens, both face-to-face and online (Ayuntament de Barcelona 2012a, b, 2013).

For research purposes, of particular interest is the role of universities in the definition and activation of the *22@* plan. A system of campuses belonging to different universities extends across the urban fabric after the transformation of former brownfields, and it hosts faculties and departments mainly dedicated to the ICT sector. For this reason, the campuses may be considered nodes of an immaterial knowledge network and drivers of innovative conditions for urban development.

From the perspective of smart city development, however, several weaknesses are apparent in these nodes or drivers. First, their predominant orientation to specific categories of users (belonging to the academic context or to the business

[18]For instance, laser cutters, 3D printers, milling machines and a platform for manufacturing electronic boards (Ayuntament de Barcelona 2012a, b, 2013).

Fig. 4.4 Photo gallery of the *22@Innovation District* in Barcelona (fonte: Di Vita)

system) restricts access by other possible users (for example, residents or visitors). Second, the lack of digital contents in their surrounding urban spaces largely reduces the potential for wider smart city development to a spatial regeneration connected only to the establishment of innovative economic and cultural activities, and to the activation of services for a sustainable mobility. Thus neglected has been promotion of a more composite network of digital services oriented to different categories of users in order to achieve broader improvement of the urban quality.

4.4 The Regional Scale: Seattle Smart City-Regionalism

Seattle is one of the few and most innovative US smart cities. On the one hand, it has achieved containment goals, such as the reduction of soil consumption and the development of transit-oriented corridors connecting mixed-use, walkable and human scaled nodes (Dierwechter 2013). On the other, it has activated projects for urban energy efficiency and environmental sustainability, beginning with: the *Seattle Climate Action Now 2007* programme and the *Action Plan 2008–2012*; the projects promoted by the municipal energy company Seattle City Light, also in partnership with Microsoft and with the Washington State University; the promotion of the *US Conference of Mayor's Climate Protection Agreement* (Colorni et al. 2014).

In relation to the smart region perspective proposed by the present study, the Seattle experience is interesting because of the implementation of a smart city-regionalism system of initiatives aimed at promoting the smart growth of a four-county city-region. While rescaling urban management institutions and promoting redistribution policies, Greater Seattle is improving both urban sustainability and competitiveness beginning with the development of transport plans integrated with containment policies to reshape urban growth into denser, functionally mixed, transit-supportive, financially responsible, and (ecologically, economically and socially) sustainable urban poles (Dierwechter 2013). Governance of the Seattle smart city-region divides among:

- at the local scale, municipalities and counties, which coordinate their local plans with general plans and strategies;
- at the wider scale, the Washington State, which approves official Acts and, consequently, defines strategic goals;
- in-between, at the city-regional scale, the Puget Sound Regional Council (PSRC), who has the capacity to integrate land-use, transportation, environmental and economic policies.

During the current Obama administration of the US federal government, city regionalism has been addressed by policies aimed at integrating economic development, land use, and transportation investments within the US city-regions, beginning with the *Sustainable Regional Planning Grant* programme. The PSRC received a grant under this programme because of its Vision 2040 for the Seattle city-region and other coordinated city-regional plans, such as the Transportation

2040 Plan. The latter promotes investments for the improvement of bus services, extension of the light rail system, and the development of transit communities in proximity to strategic nodes along the transit corridors. In a context of efficient coordination among all government levels (federal, state, city-regional and local), however, the Seattle public transit investments are still rewarding the city-regional economic centers generally populated by social élites. This means that, although Seattle's efforts are unusual in the USA, and although the PSRC's goals are oriented to social equity and environmental sustainability, the ongoing city-regional smart growth is still politically fragile (Dierwechter 2013).

Despite this weakness of the Seattle city-region in promoting real smart growth (based on the integration between land use and transport through the development of transit nodes) compared with other recent strategic planning visions worldwide[19] (Dierwechter 2013), and although this smart city-regionalism based on relations between mobility and the physical space does not seem to exploit the most advanced potentialities offered by ICTs, from the methodological point of view the regional perspective of this proposal makes it an interesting strategy, which may be able to stimulate a wide-area rescaling of urban smartness in accordance with the research presented in this book.

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[19]For instance, the *Greater Geelong* in Victoria (Australia), the *Archipelago City* in Rennes (France), as well as the post-apartheid *Unicities* in South Africa and the *Urban Renaissance* in the UK (Dierwechter 2013).

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Chapter 5
Looking at the Future?

Corinna Morandi, Andrea Rolando and Stefano Di Vita

This final chapter aims at presenting the issues which could be investigated through the future development of the research. On the one hand, the proposed Urban Digital Nodes might be integrated with other kinds of innovative workplaces related to the current boom in knowledge-based, new manufacturing and sharing economy (and society) favoured by ICT development: that is, the new phenomenon of co-working spaces and fab-labs, based on the integration of physical spaces and ICTs, which needs to be in-depth explored. On the other hand, after experimentation of the internet of places and the urban digital nodes concepts on the urban scale, the potential application of the research outcomes in terms of methodology and contents at the regional scale should be tested (Fig. 5.1). Whilst a smart region should be considered both in relation to its single components (through the development of local-scale services, such as public spaces and facilities directly integrated and empowered by ICTs) and in its overall extension (through the development of large-scale services, such as physical and digital infrastructures at the overall regional level), methods and contents should be therefore applied to and articulated into spatial contexts which can differ in their location and/or their scale.

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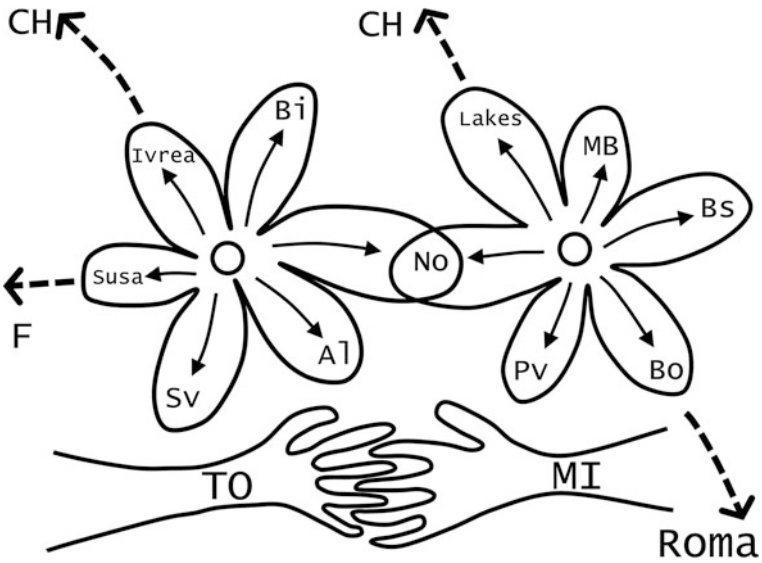

Fig. 5.1 After experimentation of the internet of places and the urban digital nodes concepts on the urban scale, the potential application of the research outcomes in terms of methodology and contents at the regional scale should be tested (*Source* Rolando)

5.1 New Networks, New Functions: Innovative Workplaces in the Smart Region Between Milan and Turin

One of the research outcomes is the experimental application of the new concepts of internet of places and urban digital nodes to a physical place located in Milan's north-western sector[1]: that is, the city district situated along the infrastructural bundle to Turin. In very recent years in Milan and in Turin (as in other European and world cities) a system of innovative workplaces has been rapidly growing, also in relation to ICT development (Micelli 2011; Rifkin 2011; Anderson 2012): co-working spaces and fab-labs,[2] for which Italy is now one of the most innovative countries in the world (Menicchinelli 2015), and which are monitored and often supported and promoted by the Milan and Turin municipalities themselves, according to their economic and social innovation potentialities.[3]

[1]See Sects. 3.3 and 3.4.

[2]See Sect. 2.2.

[3]For more information, useful websites are Co-Wo (http://www.coworkingproject.com), Fondazione Make in Italy CDB (http://makeinitaly.foundation/wiki/FabLab_Map), Make in Italy (http://www.makeinitaly.org) and Riusiamo l'Italia (http://www.riusiamolitalia.it).

The integration of diverse economic and social functions and the high digital technology endowment of these innovative workplaces may suggest their potential integration with the urban digital nodes concept proposed by this study.[4] An example of this potential development is once again provided by Barcelona, which—within its traditionally articulated city marketing and innovation strategies—is promoting itself as a *Fab-Lab Smart City* or as a *Fab-City*, beginning with the proposal of a system of fab-labs in various urban neighborhoods (Guallart 2012; Sterling 2012). In Western countries, the crisis of traditional manufacturing in the 1970s, on the one hand, and the recent and ongoing effects of the world financial crisis and global economic downturn, on the other, are stimulating the growth of innovative knowledge-based, creative and new manufacturing economies, for which ICT development is a fundamental requirement. These activities and these technologies are the bases for the current expansion of the information society and sharing economy sometimes reflected in the exponential growth of co-working spaces and fab-labs.

These new types of workplaces are largely based on the re-use of abandoned buildings (mainly industrial) which are widespread within advanced urban and metropolitan contexts, and they generally host and offer new kinds of businesses and services, such as shared working spaces, 3-D printers, meeting rooms for workshops and events, social facilities, commercial and restoration activities, and so on. This means that they contribute to the development of broad urban regeneration processes by integrating hybrid activities of production and consumption of goods and services which are now difficult to distinguish. While, on the one hand, these facilities and activities are based on the development of digital technologies which favour increasing multi-locality and space use flexibility (Bizzarri 2009; Lapintie and Di Marino 2014), on the other, they confirm the importance of spatial proximity and face-to-face relationships (McCann 2008).

All these components simultaneously characterize the growing information society and sharing economy and, within this context, co-working spaces and fab-labs. Hence, these innovative workplaces can be considered smart spaces; that is, potential Urban Digital Nodes by merging different user flows, exploiting existing resources, and offering site-specific services (physical and digital). From this perspective, Milan—which is an urban node of macro-regional and world networks, and represents the core of the Italian knowledge-based, creative and new manufacturing economies, as well as one of the most significant European spatial supports for ongoing economic and social innovations—is undergoing profound urban regeneration processes, both top-down and bottom-up. This is a metamorphosis of the city based on the transformation of its socio-economic frameworks, in which the current municipal administration is mainly investing in order to improve the city's urban sustainability and world positioning, beginning with approval of the *Milan Smart City Guidelines* and the *Milan Sharing City Guidelines*. These guidelines highlight the importance of ICTs as engines of urban change and the significance of cooperation and the sharing economy for future urban development:

[4]See Sects. 1.3 and 3.3.

on the one hand, by mixing and modifying the traditional habits of producers and consumers of goods and services; on the other, by producing innovations in terms of economic growth, social inclusion, education and training, technological development and spatial regeneration (Comune di Milano 2014a, b). Also the Expo 2015 itself is stimulating this process by accelerating the increasing demand for new products and services, and the growth of new sharing activities which will be part of the event's immaterial legacy (Sharexpo 2014).

The Turin municipal administration is working in the same direction, sometimes anticipating Milan. In recent years, Turin's post-Fordist transformation has been indeed much more supported by the local public administration than that of Milan, because Turin is traditionally less internationally oriented and economically powerful than Milan, whose urban regeneration process (socio-economic and spatial) is spontaneously more dynamic, independently by its public policies (De Magistris and Rolando 2011). For these reasons, since the end of the 2006 Winter Olympic Games, the Turin municipality has promoted the city as one of the first and most innovative Italian smart cities.

In Milan, on the one hand, the current municipal administration has recently introduced a voucher system to provide economic support for private initiatives aimed at developing co-working and fab-lab spaces; and it has recently promoted calls in order to allocate abandoned public buildings to private operators for the development of innovative workplaces; on the other hand, it is constantly mapping the growth of the phenomenon within the municipal area.

In recent years, the development of co-working and fab-lab spaces has been exponential, so that it is difficult to quantify the phenomenon. In Italy, they are prevalently concentrated in regions where levels of urbanization are higher, such as Lombardy, Veneto, Emilia Romagna, Lazio, Tuscany and Piedmont. Furthermore, in these regions they are mainly located in bigger cities, such as Milan in the case of Lombardy (where 59 of the 87 co-workings in the region are located) or Turin in the case of Piedmont (16 of the 21 co-workings of the region) (Benna 2015). Research and public policies should now concentrate on analyzing, monitoring, supporting and promoting the growth of these innovative workplaces not only in the inner cities but also in their surroundings—beginning with the entire areas of the new Milan and Turin Metropolitan Cities recently established by the Italian National Government,[5] as well as the wider metropolitan region between the two main urban poles: that is, in peripheral, peri-urban or intermediate places, which are generally less attractive for these kinds of initiatives but where the development of co-working and fab-lab spaces could strongly contribute to the growth of real regional smartness.

Despite the new concern of policy makers with these innovative workplaces, as well as the close attention paid to them by the media, it is not possible to consider their outcomes as obvious and risk-free. Consequently, new and multidisciplinary

[5]The Italian National Law no. 56/2014 *Disposizioni sulle città metropolitane, sulle province, sulle unioni e fusioni di comuni*.

research is still necessary in order to understand a phenomenon which is expanding very rapidly. For instance, it is necessary to determine:

- where and why these places are exactly located;
- how they are physically and digitally equipped and what kinds of facilities and activities they offer;
- what kinds of digital services and productions they need and offer at the same time;
- how they drive economic and social innovation;
- what their effects are on the spatial context in which they are embedded;
- what kinds of urban plans and policies can support or stimulate their development;
- in a smart region perspective, how co-working and fab-lab spaces can diversify (internally and in relation to their spatial context) according to their different possible locations (i.e. in inner cities, peri-urban areas or the countryside).[6]

5.2 ICTs Spatial Effects: From the Urban Perspective to the Regional One

This study makes an innovative contribution to the development of urban smartness policies and projects because of its spatial reference to the scale of the metropolitan region, which extends beyond traditional administrative borders and competences[7]; because of the contents of its pilot projects, which were based on the simultaneity of physical and digital services (according to the internet of places and the urban digital nodes concepts) and which were strictly related to place components by providing location-based and site-specific services[8]; and because of the methodology of the pilot projects themselves, which is systematic and repeatable in different situations (such as, wider-scale networks). To sum up the research results by considering both the theoretical framework and the innovative concepts, as well as the pilot projects, this study has raised the following issues and reached the following conclusions.

- It has endorsed criticisms about the media-smart city concept, heavily abused and frequently accompanied by rhetoric with which traditional real estate projects or fragmented and sectoral technological innovation are defined; that is, about the risks of excessively technocratic and market-oriented approach to city management and planning, as well as increasing social segregation in city use.

[6]These research questions have been partially shared within the new Research Hub *Innovation, Productions and Urban Space* of the Politecnico di Milano, Dipartimento di Architettura e Studi Urbani.

[7]See Sect. 3.1.

[8]See Sects. 3.2 and 3.3.

- At the same time, it has highlighted the potential for urban and regional development offered by the smart approach, such as spatial regeneration, socio-economic innovation, and environmental sustainability improvement, beginning with a rethinking of urban and regional space development, which should be based on the contributions of citizens, and not solely on the rational use of resources or on the improvement of service efficiency through the application of technology.
- The study has stressed the need for technological innovation to be embedded in a wider and strategic vision for urban and regional development, that requires multidisciplinary skills and actions often beyond the capacity of local administrators. This means not only including technology within the city but integrating technology and the city together; not considering technology as a goal but as a tool for the development of a more and truly sustainable and competitive urban and regional space.
- From this smart city perspective, the study has emphasised the importance of combining the technological dimension and the commercial repercussions of related projects with greater sensitivity and responsibility towards people's needs and services.
- At the same time, it has underlined the importance of location-based and site-specific services in shifting the traditional growth of a virtual, completely spaceless, city dimension towards the concrete transfer of digital information to physical places, thereby favouring interaction among users in physical proximity instead of their retrieving information or accessing services individually.
- The study has shown the importance of ICTs in improving people's behavior (for instance, by encouraging the sharing of activities, interests, goods or services, and by increasing environmental sustainability awareness), as well as in supporting processes of socio-economic innovation and spatial transformation and integration (for instance, by increasing accessibility to places or by providing new tools and useful real-time data for spatial organization and planning) in order to enhance urban attractiveness and sustainability.
- In particular, it has demonstrated the importance of ICTs and, more specifically, mobile devices for optimizing access to university and urban services (for instance, by increasing their spatial quality and social value) through experimentation with tracking technologies and technological interfaces among users, objects and places (such as NFC tags or QR codes).
- The study has recommended adoption of a social perspective exploiting the potentialities of ICTs and, more specifically, mobile devices in order to supersede the traditional relationships between users and services by favouring their immediate accessibility, information sharing and flexible use; that is, in order to strengthen the relationships between people and places as interpreted by the new internet of places concept introduced by the research itself.
- The study has related the internet of places concept to the analogy between immaterial internet networks and material infrastructural ones that could modify space uses, organization and planning.

- It has contributed to enlargement of the traditional community services concept, which now integrates cultural, educational or social community services with commercial and leisure activities, with accommodation and social housing, as well as with other hybrid functions (by mixing innovative economic and social activities).
- The study has identified the locational and functional opportunities of these innovative services for the development of real smart spaces, as interpreted by the new urban digital nodes concept introduced by the research itself. These are places characterized by high levels of user flows and attractiveness, and they are shared by people through their simultaneous physical and digital components.
- The study has proposed overcoming the excessive fragmentation of technologies and the continuous overlaps among digital infrastructures through the coordination and integration of several service platforms within the new Urban Digital Nodes (UDNs), which could be implemented through advanced forms of public-private partnerships.
- The study has recommended the integration of top-down and bottom-up approaches by, on the one hand, developing traditional design processes (few to many or looking from above) and, on the other, by giving an important role to final users through focus groups, questionnaires or tracking activities (many to many or walking through).
- The research outcomes are oriented to diverse stakeholders: on the one hand, service and facility providers (for instance, universities or municipalities), according to which a system of smart spaces (consisting of physical and digital site-specific and location-based services for different users) is promoted; on the other hand, citizens and city-users, according to which a system of UDNs is suggested in order to furnish short-time solutions for outsiders (such as students or tourists), as well as long-term benefits for insiders (such as inhabitants and commuters).
- The study has advocated the empowerment of different scale development potentials included within the urban digital nodes concept in relation to the current urban space extension to the metropolitan and regional scales (known as 'city regionalism') and to an urbanity dimension referred not only to physical features but also to use and relation intensities (strengthened by the digital components).
- Within this perspective, the study has highlighted the multi-scalarity concerning Expo 2015 and post Expo, which was adopted as one of the research project's reference scenarios because of its innovation potentialities and its ICT projects, and also because of its direct relations with the metropolitan region between Milan and Turin; for instance, beginning with the different scale of smart city projects related to the event—such as the *Digital Smart City Expo* within the Expo Site, the *Expo Digital Islands* within the Milan inner city, as well as the *E015 Digital Ecosystem* and other collateral initiatives (*Explora*, *Expo in Città*,

Fondazione Triulza, *Sharexpo*)[9] within the Milan metropolitan city and the entire city-regional area of the Northern Italy city-region (Morandi et al. 2013); that is, a system of projects which in various ways have inspired or could decline the smart region, internet of places, and urban digital nodes concepts, going beyond the Expo 2015 celebration and referring to the post-event phase.

The research reported was an experimental opportunity to test a working method on a local scale, and (consequently) to suggest its repetition on a wider scale in order to support the development of a smart region. The current definition of a Northern Italy city-region, that is indifferent to traditional administrative boundaries and that stretches from Milan to the entire Po Valley, necessarily requires enlargement of the theoretical reference space from the smart city concept to that of the smart city-region (Rete Consultiva per Milano Glocal City 2013), or to that of a simply smart region.[10] Similarly, identification of a metropolitan region between Milan and Turin suggests a useful expansion of the smart city concept to that of a smart metropolitan region, or once again to that of a simply smart region. Certainly, this new scale requires particular attention to be paid not only to the main urban centers but also (and especially) to the peri-urban and intra-urban areas and to the small cities in peripheral regions, seeking to remedy their marginality with respect to stronger nodes.[11]

The extension of smart city programmes to the regional scale, which could be particularly useful in territorial contexts consisting of dense networks of small urban poles as in Italy and Europe, has already been suggested by the European Union and by the Italian government (Bolici and Mora 2012), although examples of its actual and non-banal implementation are difficult to find. The potentialities of wider-scale smart programmes and projects might relate to the possible involvement of marginal areas (often penalized by high levels of digital divide) within socio-economic innovation processes and within spatial and environmental regeneration plans, also because of an improvement of ICT networks and nodes. Overall, the conceptual transition from smart city to smart region implies not only the necessary reference to a new spatial scale but also the transfer of methodology and contents to low-density (and sometimes low-digital) areas.

After experimentation of the internet of places and the urban digital nodes concepts on the urban scale, the research is now aiming at returning to its original regional context. Through a multi-scale approach, the research future objective is therefore to consider potential application of its outcomes in terms of methodology and contents at the regional scale, beginning with suggestions for the enhancement of existing physical networks and nodes: for instance, by providing them with digital services, as if they were hypertextual references that favour the immaterial enlargement of physical places; that is, by highlighting the analogy between physical networks (made by urban and regional infrastructures) and digital

[9]See Sect. 2.3.

[10]See Sect. 2.1.

[11]See Sect. 1.3.

networks (represented by the Internet), beginning with nodes of immaterial knowledge networks such as university campuses, and nodes of infrastructural networks (roads or railways) such as rest stops, motorway tollhouses, or railway stations.

Both these kinds of nodes may be considered points of intersection between local and global scales and, therefore, as fundamental resources for small and large-scale socio-economic and spatial development. Such nodes may be also located outside cities, in-between the main urban poles, in low density regions, where ICT services are less used and where the positive and effective changes, to date tested, could be specifically transferred and enhanced in subsequent phases of the research itself. At the same time, these are nodes upon which a new regional smartness plan (concretely related to local needs) may be developed, potentially affecting user flows as well as spatial uses, organization and planning; that is, by contributing to a rebalance of the differences between major urban centers and intermediate places.

A conceptual milestone of the Urban Digital Nodes (UDNs) proposal is their replicability as regards goals, targets and basic components, as well as the possible adaptation of these smart spaces to different physical and socio-economic contexts. The meta-project on a specific spatial context may be repeated in relation to the specificities of other areas in the Milan-Turin smart region. From this perspective, a potential multi-scalar dimension may be also assigned to the UDNs themselves, which can therefore adopt different sizes: from services in neighborhoods (such as, single buildings or open spaces) and from main functions in cities and metropolitan areas (such as, systems of buildings or open spaces), to urban poles in regional and macro-regional systems and to territorial platforms formed by metropolitan regions in the global space (expanding them to the entire urban fabric and eventually further).[12] Consequently, a smart region should be considered both in relation to its single components (through the development of local-scale services, such as public spaces and facilities directly integrated and empowered by ICTs) and in its overall extension (through the development of large-scale services, such as physical and digital infrastructures at the overall regional level). Contents and methods should be therefore applied to and articulated into spatial contexts which can differ in their location and/or their scale.[13]

Whilst the *urban digital nodes* concept has thus far concerned static relations among people located in space, as in intermodal mobility junctions, and places, a new challenge might refer to a *regional digital networks* concept concerning dynamic relations among people moving in space, for instance on different means of transport, and places. This is a new challenge that might be met by considering once again the social aspects of smartness within the relationships between people and services, as well as the different kinds of interface, fixed and mobile, personal and collective.

[12]See Sect. 1.3.

[13]See Sect. 4.1.

As with the 2003 *New Charter of Athens* the *European Council of Town Planners (ECTP)* proposed a vision for the European cities in the twenty-first century—called *The Connected City* with reference to the development of European polycentric urban networks totally indifferent to traditional national borders (Fernández Maldonado 2012)—so a smart region might be organized as a local polycentric urban network. From a similar perspective, in 2013 the Milan and Turin municipalities, together with the Genoa municipality, signed a memorandum of understanding to promote a shared process of smart city transformation. This is a first step towards increasing the attractiveness of each of these three Northern Italy big cities, although it is still weak. In order to exploit the potentialities of this agreement, it might be strengthened by the development of a real and shared smart region vision comprising different scale actions according to the variable geometry principle and indifferent to local administrative borders, as well as involving the areas located in-between the main urban poles: areas which are generally marginal and characterized by an ICT infrastructural divide. This is a necessary strategy:

- that should be based on the collaboration of private operators providing ICT infrastructures and on the contribution of users (both insiders and outsiders) in order to reduce the traditional territorial imbalances recently reinforced by the economic crisis;
- that should be flexible and differently declined according to both the different categories of users and to the local physical and digital specificities which distinguish big cities and rural areas, as well as inner cities and their suburbs.

While current smart city projects and programmes mainly ignore or neglect urban form features (Paris 2014),[14] wider-scale smartness requires a new planning approach able to overcome the usual localistic reasons and trends (Bonomi and Masiero 2014). Whereas China is implementing a new plan in order to promote an integrated development of large cities such as Bejing and Tianjin with the Hebei province and, consequently, to establish a new megalopolis of 120 million inhabitants through the construction of new transport infrastructures and satellite cities to which people, services and businesses will be relocated (Paris 2014), a similar model is not applicable in Western countries. In particular in Europe, territorial rebalancing within a regional smartness perspective might be better achieved by improving efficiency in the management of local resources and in the supply of services by exploiting the ICT innovation potentialities (software), and not by physically implementing new transport corridors and urban settlements (hardware).

[14]See Sect. 1.1.

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