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Valorizzazione delle risorse primarie e secondarie

"Smart Cities, Analysis of a Strategic Plan"

CANDIDATO

Saverio Ferraro

RELATORE:

Chiar.mo Prof.

Alessandra Bonoli

CORRELATORE:

Doct. Markus Helfert

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Abstract (English)

Cities nowadays face complex challenges to meet objectives regarding socio-economic development and quality of life. The concept of "smart city" is a response to these challenges.
Although common practices are being developed all over the world, different priorities are defined and different architectures are followed. In this master thesis I focuses on the applied architecture of Riverside's case study, through a progression model that underline the main steps that moves the city from a situation of crisis, to be appointed "Intelligent Community" of the 2012 by Intelligent Community Forum.
I discuss the problem of integration among the physical, institutional and digital dimension of smart cities and the "bridges" that connect these three spatialities. Riverside's progression model takes as a reference a comprehensive framework made unifying the keys component of the three most quoted framework in this field: a technology-oriented vision (strongly promoted by IBM [Dirks et al. 2009]), an approach-oriented one [Schaffers et al. 2011] that is sponsored by many initiatives within the European Commission, and a purely service-oriented one [Giffinger et al. 2007][Toppeta, 2010].

Abstract (ITALIAN)

Le città stanno cambiando. Per la prima volta nella storia, più del 50% della popolazione mondiale vive nelle città (*United Nations World Urbanization Prospects*), e ci si aspetta addirittura un incremento nei prossimi anni. Le città stanno assumendo un ruolo sempre più importante nel ventunesimo secolo, sia da un punto di vista economico, ma anche politico e tecnologico, basti pensare che i cento conglomerati urbani più importanti attualmente incidono per il 25% sull'intero prodotto interno lordo globale (GDP). Questi dati portano con se delle conseguenze che sarebbe irresponsabile sottovalutare, è stimato infatti che le città sono responsabili di circa il 70% del consumo totale di energia primaria, e per l'80% delle emissioni totali di CO2 [*IEA: Energy Information Administration, US*], e anche queste cifre sono destinate a salire se non si interviene a invertire questa rotta autolesionista. Inoltre anche la struttura demografica è in forte cambiamento, nella prossima decade infatti le persone con più di 65 anni passeranno dal 7al 13 % rispetto al totale. Anche questo dato cela delle ripercussioni che bisognerebbe prendere in considerazione, basti pensare al settore sanitario, che tenderà ad essere sempre più stressato. Da un'altra prospettiva invece, le città sono al centro di una rivoluzione tecnologica senza precedenti, che vede nell'*Information and Communication Technology* (ICT) un mezzo per trasformare i problemi elencati sopra in opportunità. Mai come in questo momento, infatti, è disponibile una mole di informazioni in tempo reale, che sfruttate nel modo giusto, possono migliorare la qualità della vita dei cittadini. Più di due miliardi di persone utilizzano internet, più di 5 miliardi utilizzano un telefono cellulare [Int'l Teleommunication Union] e ci sono più di 30 miliardi di RFID tags (*Radio Frequency IDentification*) capaci di scambiare informazioni in real-time. Una Smart City cerca di sfruttare l'ICT per snellire e migliorare ogni aspetto critico della città, dai trasporti all'energia, dall'economia all' ambiente. Malgrado non ci sia una definizione universalmente riconosciuta di Smart City , attraverso una revisione della letteratura (chapter 2) sono emerse tre correnti principali: la prima si focalizza maggiormente sull'aspetto tecnologico (lanciata da IBM,[Dirks et al. 2009]), la seconda si dedica all'approccio con cui i principali "attori" delle città (governo, imprese, infrastruttura sociale) devono interagire e sugli strumenti che agevolano questa cooperazione [Schaffers et al. 2011] e la terza si concentra sulle parti critiche di una città in cui erogare nuovi servizi per migliorare la qualità della vita dei cittadini [Giffinger et al.2007][Toppeta, 2010]. Il passo successivo è stato quello di creare una definizione generale di Smart City e un framework capace di unificare gli aspetti chiave delle tre correnti principali sopra elencate (chapter 4), in modo da avere un quadro di riferimento sui principali aspetti da tenere in considerazione per intraprendere un "percorso" verso una visione più intelligente (Smart) di città. Una volta formato il quadro teorico di riferimento, seguendo la *Design Science Research Methodology* [Peffers, 2007],

linea guida di questo lavoro (cap 3), si passa alla parte centrale della tesi, che consiste nell'analisi di un caso reale che ho scelto come riferimento. Nel capitolo 5 infatti ho cercato di mappare all'interno di un progression model (usando il framework creato come struttura portante dell'analisi), le iniziative più importanti che hanno portato Riverside, una città californiana di 300 mila abitanti, a passare da una situazione di crisi nel 2004 (fuga di talenti e bassa appetibilità da parte delle gradi aziende), all'essere premiata nel 2012 "Intelligent Community of the year" dall'Intelligent Community Forum ed essere universalmente riconosciuta come una delle più virtuose Smart City degli Stati Uniti. La parte finale di questo lavoro consiste nella descrizione dei servizi (*ICT services*) erogati a Riverside egli ultimi 8 anni e suddividerli all'interno delle categorie di appartenenza, in modo da avere una schema di riferimento che evidenzi come una seria strategia a lungo termine , in cui tutte le parti chiave di una città sono coinvolte (*public, private, people*), possa portare a un miglioramento non soltanto dal punto di vista economico, ma soprattutto sociale ed ambientale.

Acknowledgement:

This master thesis would not have been possible without the help of several people. First, I wish to thank my family, that has always been close to me in every single day, and mostly during these last five months that I spent in Dublin. I'm proud of them. Furthermore, I need to thank also all the people that supported me during my University journey in Bologna. It wouldn't be enough space here to list everybody, but I want to particularly mention Gabriella, Ugo, Mimì, Domenico, Fabrizio, Daniele, Gianloca, Marcello. Then, thanks to Dr. Markus Helfert, my supervisor, for his professional guidance, time and constructive ongoing criticisms. Again, thanks to Prof. Alessandra Bonoli, that followed me step by step and gave me fundamental insights for the development of this document, from Università di Bologna. Finally thanks to the overall B.I.G. Group of Dublin City University, Martin Meyer, Shuyan Xie, Lukasz Ostrowski, Plamen Petkov, and particuary to my friend Ing. Giovanni Maccani; his collaboration within the Smart Cities' domain has been very important for the development of this research project.

Thank all you very much.

Dublin, March 2013.

Saverio Ferraro.

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Chapter 1:

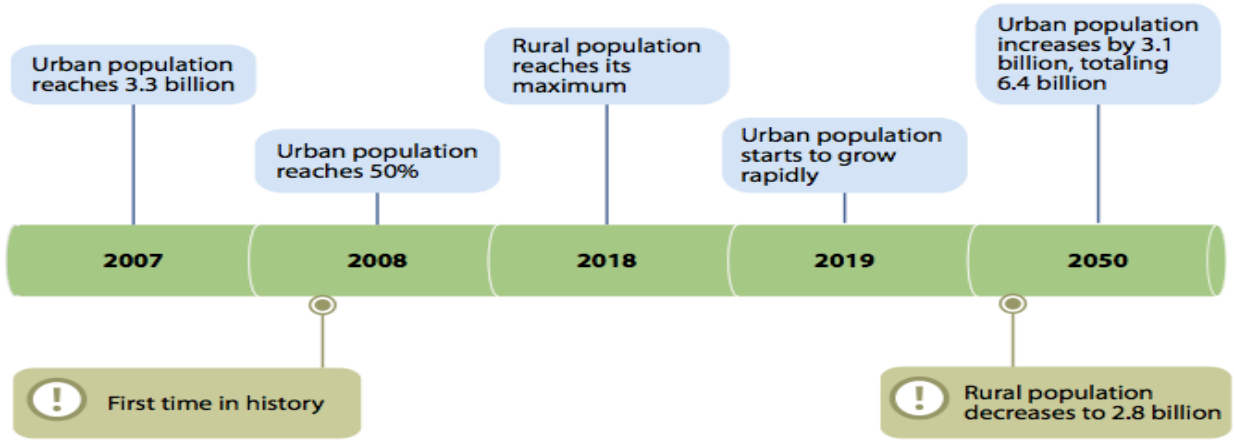
INTRODUCTION

"We are passing through a revolutionary period. The United Nations estimates that at some time between 2008 and 2009, the world's urban and rural populations became equal" [The United Nations , February 2008].

This first chapter is meant to explain which were the main currents and strands that "force" researchers, businesses, and governments to introduce the concept of Smart City. Since the Copenhagen summit (2009), there is a growing perspective that "nations talk, cities act". Cities are more and more characterized by "mega-trends" that are going to crash their balances [Kanter et al. 2009]. Generally, three main currents can be identified as arising issues that are pushing cities towards smarter approaches and radical reactions: urbanization, demographic change and cities' carbon footprint. In the 18th century less than 5% of the global population lived in cities and the vast majority of people was engaged in simply generating enough food to live. Today, more than 50% of the worldwide population lives in urban environments. According with a report released in 2008 by the United Nations World Urbanization Prospects, the 2008 marked the year when more than 50 percent of all people, corresponding to 3.3 billion inhabitants. However, this trend is prospected to grow, passing from 3.3 billion in 2007 to 6.4 billion by 2050 [www.unfpa.org].

As a summary it is provided in the following figure how Forrester is expecting urbanisation process.

Figure 1: Urbanization trend 2007-2050; Source: Forrester (2008)



As an immediate consequence cities' core systems become stressed and it becomes clear that the status quo is no longer a viable option. Particularly, the urbanization process brings together many problems ranging across all the city's critical systems and capabilities, for instance from any kind of natural resources supply; for example, domestic demands on water will rise quickly. Under a business-as-usual scenario, total domestic consumption will increase 75% from 1995 to 2025 (90% of which will be in developing countries) [Rosegrant et al, 2002]. Another instance is referred to the healthcare sector, and again the educational sector has to be adapted to this trend as well as the transportation one, and many others are included (a deeper analysis will be proposed later in this document). So, we can definitely consider the urbanization trend as an issue that has to be tackled at the city's scale.

The second main issue, from some points of view linked to the growing of cities' inhabitants, refers to cities impact on the environment. In a global context of a world marketed energy consumption that is expected to increase by 44% from 2006 to 2030, (by 73 % from BRIC countries)[IEA: Energy Information Administration, US], within the European Union, cities are now responsible for about 70% of the overall primary energy consumption, and this share is expected to increase to 75% by 2030. From a research conducted in 2009 by the U.S. Environmental Protection Agency (EPA) emission from electricity generation accounted for the largest portion of Greenhouse Gases (GHG) emissions (about 29%). Transportation activities accounted for the second (27%) and the emissions from industry made up the third largest portion. Hence, cities are now responsible for 80% of the global carbon footprint, and a big component is referred to energy consumption. An overview of the comparison between urban and non-urban energy consumption is provided in the next figure.

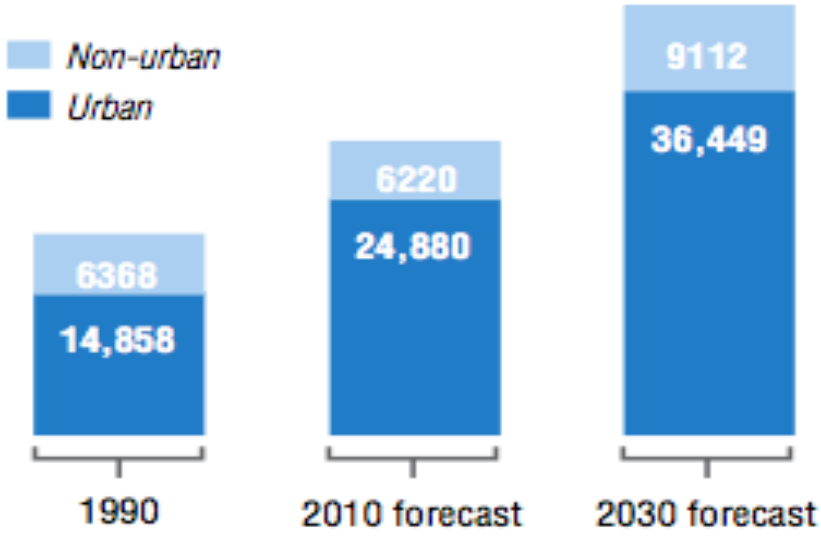


Figure 2: Comparison urban/non-urban energy consumption; source: EIA, 2008.

Unit: tCO_2e; the ecological footprint refers to the six greenhouse gases defined under the Kyoto Protocol (adopted in 1997 and entered into force in 2005): Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydro-fluorocarbons (HFCs), Per-fluorocarbons (PFCs) and Sulphur hexafluoride (SF_6). A carbon footprint is measured in tonnes of carbon dioxide equivalent (tCO_2e). The carbon dioxide equivalent (CO_2e) allows the different greenhouse gases to be compared on a like-for-like basis relative to one unit of CO_2. CO_2e is calculated by multiplying the emissions of each of the six greenhouse gases by its 100 year Global Warming Potential (GWP). In particular, the Carbon dioxide is the easiest gas to measure.

Large urban populations are a major driver for this trend, and cities often struggle to adequately meet demand due to a lack of supply as well as inefficient transmission and distribution systems to the end customer. Price increases and instability are regular occurrences and are caused by: 1) high capital costs to develop new-generation capabilities; 2) mandates for more sources of renewable forms of energy - which are often more costly; and 3) the tendency for nations to import energy, oil in particular. Thus, cities need both to increase efficiency within the energy sector (for example through Smart Grids), and decrease its environmental impact (for example through the integration of renewable resources). Other concerns referred to the cities' impact on the environment are related to wastes, that are more and more responsible for the contamination of earth's soil and water. So, new solutions are extremely needed in terms of improving the so called "3Rs" approach ("Reduce, Reuse, Recycle") and introducing innovative solutions in this field. Furthermore, the EPA (Environmental Protection Agency), expects climate change to contribute to air quality problems: "*Respiratory disorders may be exacerbated by warming-induced increases in the frequency of smog (ground-level ozone) events and particulate air pollution. Ground-level ozone can damage lung*

tissue, and is especially harmful for those with asthma and other chronic lung diseases" [US Environmental Protection Agency].

As a third "mega-trend" that is going (in some places already does) to crash cities capabilities is referred to the demographic change strand. Particularly, it is expected that worldwide within the next decade the over-65 years old generation will almost double, from 7% to 13%. This means that many infrastructural aspects need to be adapted. A huge impact in this way is expected to be seen in the health-care sector and in the elderly-care one. Here again new solutions are extremely needed for cities that aim at increasing (or at least maintaining) their inhabitants' overall quality of life.

It could be argued here, why should be cities that need to react to these issues, rather than countries or even the entire world. Well, cities have assumed a central role in the developed world of the 21st century. The top 100 urban conglomerations currently account for 25% of the worldwide Gross Domestic Product (GDP). Even though they have always had a central role in economic development, the rapid grow in both numbers and population poses the cities on the world's central stage, with more economic, political and technological power than ever before. Economically, they are becoming the hubs of a globally integrated and services-based society, with greater influence but also greater responsibility. Moreover, the need for an innovative approach for cities is an urgent imperative because of the biggest global economic crisis. Unemployment in the EU zone (27 countries) increased by 18% from april 2011 to October 2012 (source: Eurostat). Experts project that those numbers could continue to grow, bringing with them a wide range of needs for the families of those who have lost their jobs and for the communities where they reside in 2011, 119.6 million people, or 24.2% of the population, in the EU27 were at risk of poverty or social exclusion, compared with 23.4% in 2010 and 23.5% in 2008. This means that they were at least in one of the following three conditions: at-risk-of-poverty severely materially deprived or living in households with very low work intensity. In this way, the urgency of current economic crisis can provide the proper impetus to overcome the resistance to change, turning the problems into opportunities.
Despite these problems, our world is rapidly evolving from the technological and social point of view. In particular on one side the innovation within the Information and Communication Technologies (ICTs) field has led to excellent results. The development of the so called "ubiquitous computing" [Greenfield, 2006] principles, together with the Internet of Things (IoT) [Ashton, 1999] (and the related concept of Semantic Web [Bernerslee, 1999]), and again new forms of artificial intelligence and cooperative distributed problem solving capabilities [Chen Ritzo, 2009], has turned the concerns that are affecting cities, into potential opportunities. It is now possible to think about our cities as "data providers" across their critical parts and systems involved, in order to give the

chance of real-time informations, complex networked analysis and, more generally, take more informed decisions.

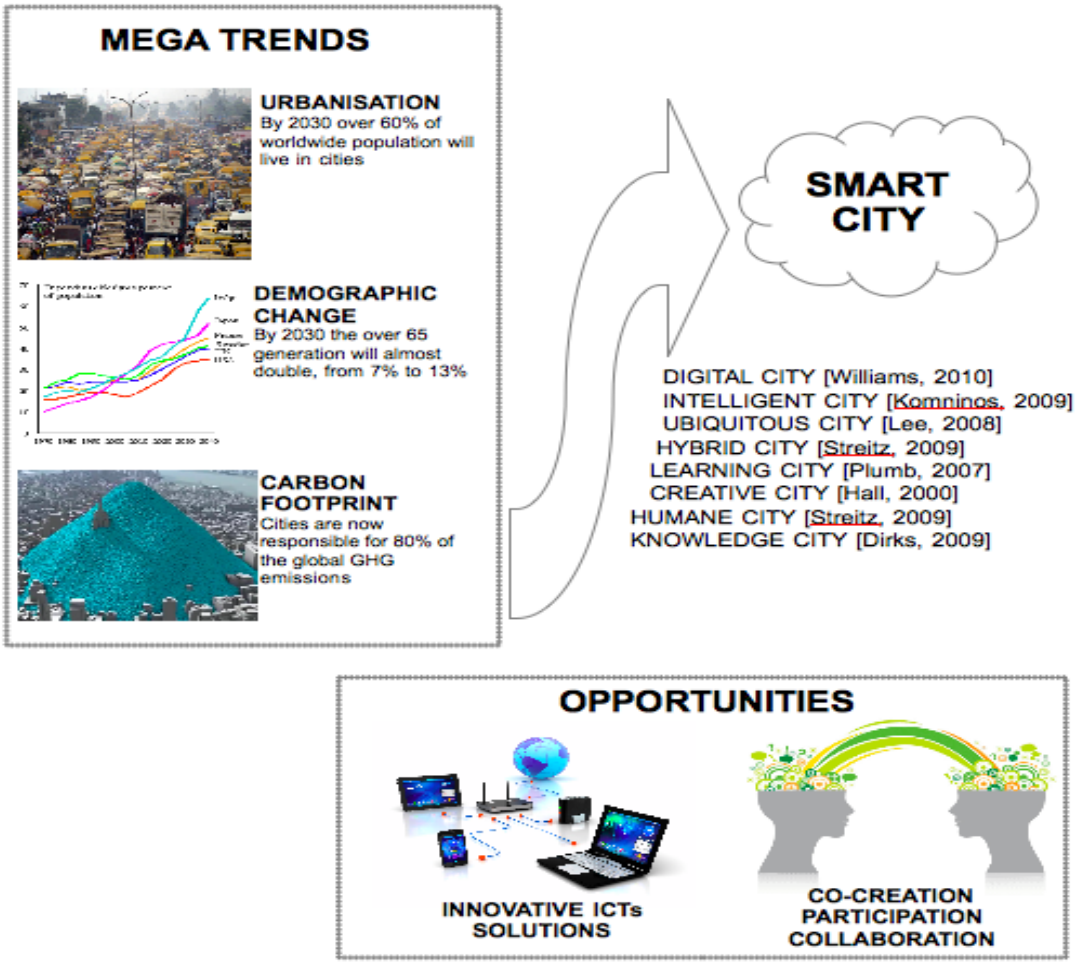
Before going on, another factor that has led to the introduction of the Smart City initiative must be mentioned. It refers to the innovative business models that are characterising many business and public sectors with words like “collaboration”, “end-users co-creation”, “participation”, and “user-driven”, that are more and more becoming key words for implementing innovative strategies. This aspect will be deeply described later in this dissertation, but it has to be introduced here as an important current towards the development of new scenarios for cities.

Within the last few years new city-related concepts were introduced in literature as attempts to solve singularly (or in a not-embedded manner) the problems described here, through the innovative usage of these ICTs. Some examples are “Digital City” [Besselaar et al. 2005], “Intelligent City” [Komninos, 2008], “Creative City” [Hall, 2000], “Knowledge City” [Dirks, 2009], “Ubiquitous City” [Lee, 2008], “Smart Communities” [Kanter et al. 2009], and more (an overview of these “Smart City's Relatives” will be provided within the next chapter).

At this stage we can state that the Smart City concept can be seen in first approximation as an emerging way to tackle and solve the problems arising from these mega-trends, exploiting the usage of innovative ICTs and approaches. The term Smart City is generally understood as a certain intellectual ability that addresses several innovative socio-technical and socio-economic aspects of growth [Zygiaris, 2012].

The next figure here will help to summarize what has been said in this introductory part. In particular it shows how the Smart City was introduced in literature as a mean to solve the three main concerns through the exploiting of the two main opportunities.

Figure 3 : Mega Trends and Opportunities



However, despite researchers, multinational companies as well as governments are strongly pushing towards smarter approaches for cities, it is still missing a common understanding and an embedded well acknowledged definition of such initiative [Caragliu et al. 2011].

Within the next chapter the literature will be carefully analysed in order to collect all of the informations available on journal and conference papers, as well as corporate reports, in order to be able to propose an embedded definition of Smart Cities.

Chapter 2 :

LITERATURE REVIEW

In this chapter the main objective is conduct a review of the existing literature around Smart Cities, aiming at develop a theoretical background for the subsequent analysis. Particularly it will be presented here how many different views are associated to this field. In detail, it could be argued that so far most of the definitions provided for Smart Cities were developed in relation to the research need or prospective of the corresponding author [Abdulrahman et al. 2012].

2.1 SMART CITY'S "RELATIVES"

As written in the very first chapter of this document, the Smart City concept is emerging as a way to tackle and solve the problems arising from thee three mega- trends that are crashing cities' balances (i.e. urbanisation, demographic change and carbon footprint). Although there is no generally accepted and well acknowledged definition of Smart City, it must be clear that we're inside an holistic vision, and every part of city's structure has to be involved - citizens, business, transport, energy, water, communications, city services and, most recently, information technology. Information systems in particular have many roles to play, not least the thread that leads to a closer integration among these communities [Harison et al, 2011]. Analysing the Smart Vision from different dimension, we need to take a close look at many conceptual “Relatives” of Smart City and trace the roots of the terms popularly used. This variety of "labels" (presented in the next table) can be largely categorized into three dimensions: technology, human and institutional [Nam et al., 2011].

Table 1 : Smart City's Relatives

Dimensions	*Relatives*
Technology	Digital City [Yovanof et al, 2009]. Intelligent City [Komninos, 2008], [Malek,2009] Ubiquitous City [Anthopoulos et al,

	2010];[Lee, 2008].
Human	Creative City [Landry,2000]. Knowledge City [Dirks, 2009]. Learning City [Campbell,2009].
Institutional	Smart Communities [Kanter et al. 2009].

2.1.1 Technological Dimension

Digital City

A digital city refers to a "connected community that combines broadband communications infrastructure; a flexible, service-oriented computing infrastructure based on open industry standards; and, innovative services to meet the needs of governments and their employees, citizens and businesses" [Yovanof et al, 2009]. It's goal is to crate an environment for information sharing, collaboration, interoperability and seamless experiences for all inhabitants anywhere in the city.

Intelligent City

[Malek ,2009] define and intelligent city as a city that has all the infrastructure and info-structure of information technology, the latest technology in telecommunications, electronic and mechanical technology.

The distinctive characteristic of an intelligent city is the high performance in the field of innovation, because innovation and solving of new problems are main features of intelligence [Komninos, N. (2002) Intelligent Cities: Innovation, knowledge systems and digital spaces, London and New York, Routledge].

There is a conceptual and practical distinction between digital and intelligent cities. All intelligent cities are digital cities, but all digital cities are not intelligent (Komninos 2002, 195-201). The difference is in the problem solving capability of intelligent cities, while the ability of digital cities is in the provision of services via digital communication.

Ubiquitous City

A ubiquitous city (also known with the term of U-city) is a further extension of a digital city concept in term of ubiquitous accessibility and infrastructure [Anthopoulos et al, 2010]. It makes the ubiquitous computing available to the urban elements such as people, building, infrastructure and open space. Its aim is to create a built environment where any citizens can get any services anywhere and anytime through any devices [Lee, 2008].

2.1.2 Human Dimension

Creative City

In the Creative City it is not only artists and those involved in the innovative service-and ICT-based economy that represent the creativity, although they play an important role. Creativity can come from any source including anyone who addresses issues in an inventive way (and could be a social worker, a business person, a scientist or public servant). By encouraging legitimizing the use of imagination within the public, private and community spheres the ideas bank of possibilities and potential solutions to any urban problem will be broadened. Creative infrastructure is a combination of the hard and the soft one. To be a creative city the soft infrastructure includes: a highly skilled and flexible labour force, dynamic thinkers, creators and implementers. Creativity is not only about having ideas, but it is also reflected in the capacity to implement them. The Creative City identifies, nurtures, attracts and sustains talent so it is able mobilize ideas, talents and creative organizations [Landry, 2000].

Knowledge city

A Knowledge City may be defined as a city that nurtures knowledge, possesses an economy that is knowledge based, provides an environment that fosters knowledge creation and dissemination

[Edvinsson,2006]. The creation of a knowledge economy starts with reconstruction of cities and urban settlements which can act as knowledge hubs. This requires major revamping and strengthening of key constituents that make a knowledge city. A knowledge city instils a sense of ownership and attachment in the minds of people as it actively involves them in the developmental activities and allows for public articulation of thoughts and criticisms. In other words, the citizens of the city become active stakeholders in its development.

Learning City

A Learning Community is seen here as a city, town or region which mobilises all its resources in every sector to develop and enrich all its human potential for the fostering of personal growth, the maintenance of social cohesion, and the creation of prosperity [Longworth, 1999]. This concept is however highly related to the Knowledge City one. We mentioned here for completeness, even if it was not needed from a conceptual point of view.

2.1.3 Institutional Dimension

Smart Communities

A smart Community should be defined as a community broadly ranging from a small neighbourhood to a nation-wide community of common or shared interest, whose members, organizations and governing institutions are working in partnership to use IT to transform their circumstances in significant ways [Industry Canada. "Report of the planet on Smart Communities,1998].

The California Institutes for Smart Communities ["Smart Communities guide book", 2001] elaborated the following definition: "a community in which government, business, and resident understand the potential of information technology, and make a conscious decision to use that technology to transform life and work in their region in significant and positive ways". With a holistic view, a smart community is composed of not only a more integrated, collaborative, and inclusive "whole" but also as a multiple neighbourhoods and communities of interest and of kind [Kanter et al. 2009];

We've have seen here how and in which ways the Smart City's concept evolved in literature. Particularly, it can be said at this stage that initiatives have been implemented to tackle individually (one by one) the issues defined in chapter 1. In first approximation it can be argued that the Smart

City concept encompass all these views and can been be seen as their integration. It will be clearer with the analysis that will be presented within the next paragraph.

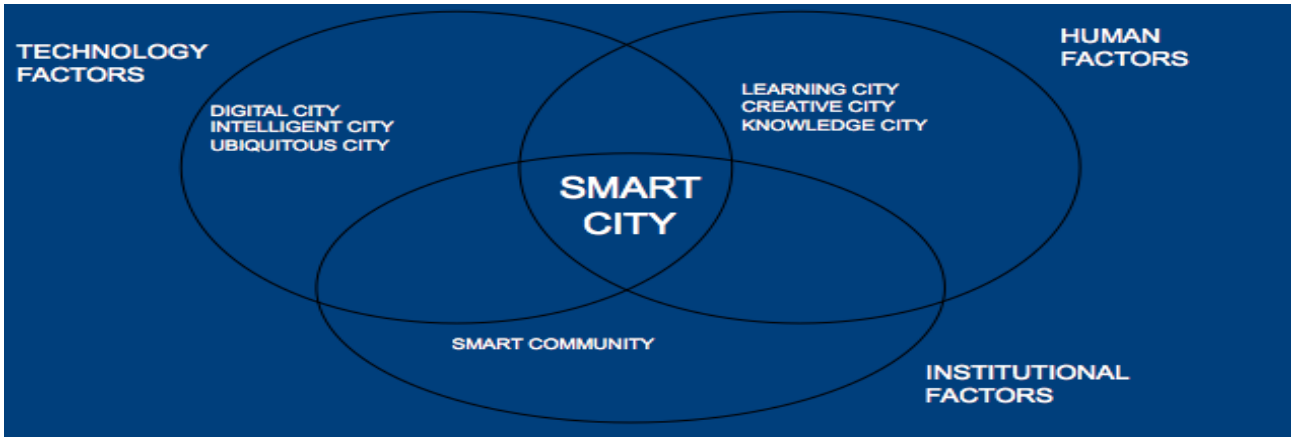


Figura 4 : The core factors for a successful smart city initiative [Nam et al. 2011].

2.2 MAIN FRAMEWORKS FOR SMART CITIES

In conducting this review of the literature all the contributions in term of developed frameworks have been considered. In other words, in order to provide a consistent definition of the domain of Smart Cities, journal as well as conference papers, and corporate reports were taken into account. The requirement for an article to be considered for this review was related to its content, and in particular all the papers that through the definition of homogeneous dimensions, aimed at deeply defining the Smart City concept, were collected. The immediate result of this research has led to an unequivocal conclusion: there are three main currents in defining Smart Cities: a technology-oriented vision (strongly promoted by IBM [Dirks et al. 2009]), an approach-oriented one [Schaffers et al. 2011] that is sponsored by many initiatives within the European Commission, and a purely service-oriented one [Giffinger et al. 2007][Toppeta, 2010]. In the next subparagraphs each of these main visions will be carefully described.

2.2.1 ICT-oriented Vision.

In [Dirks et al. 2009] is presented the study conducted by IBM, in which it is declared that cities are based on a number of core system composed of different networks, infrastructures and environments related to their key functions: city services, citizens, business, transport, communication, water and energy. This system, how mentioned above, are not discrete, they interconnect in a synergistic fashion that, ideally, promotes optimum performance and efficiency.

These interconnected core systems become a unique platform above the urban systems mentioned here and it is called "System of Systems" [Dirks et al, 2009]. Information and Communication technologies have to provide the capabilities to shape this "system of systems", through the instrumentation, interconnection and intelligence steps. These can be also interpreted as the main conceptual milestones in creating the technological background for such urban environments. The idea is to enable observation at a micro-level of these urban systems (sensing the city, and so developing the instrumentation step), than interconnecting them (going towards the development of the Digital City concept presented within the previous paragraph), and then adding the problem solving capabilities and so the intelligence. The idea is to develop a spatial intelligence if cities in which the digital city becomes a tool to structure the knowledge around the complex urban systems, and so allow the engineering of new solutions based on people and city's infrastructures' needs. [Dirks et al. 2009]'s vision is briefly explained in the following list:

- **instrumentation** on a city's system means that the workings of that system are turned into data points and the system is made to be measurable.
- **interconnection** means that different parts of a core system can be joined and " speak" to each other, turning data into information.
- **intelligence** refers to the ability to use the information created , model patterns of behaviours or likely outcomes and translate them into real knowledge , allowing informed actions [Harrison et al, 2009].

A concrete instance on how the integration of these systems through the usage of ICTs can lead to efficiency improvement can be seen from many points of view. Some examples are:

Territorial and administrative:

- Smaller territorial aggregations that share an optimization approach in energy usage for smart buildings with home automation , remote heating and management.
- Large, integrated, metropolitan areas resulting from merging towns or the role of fast trains

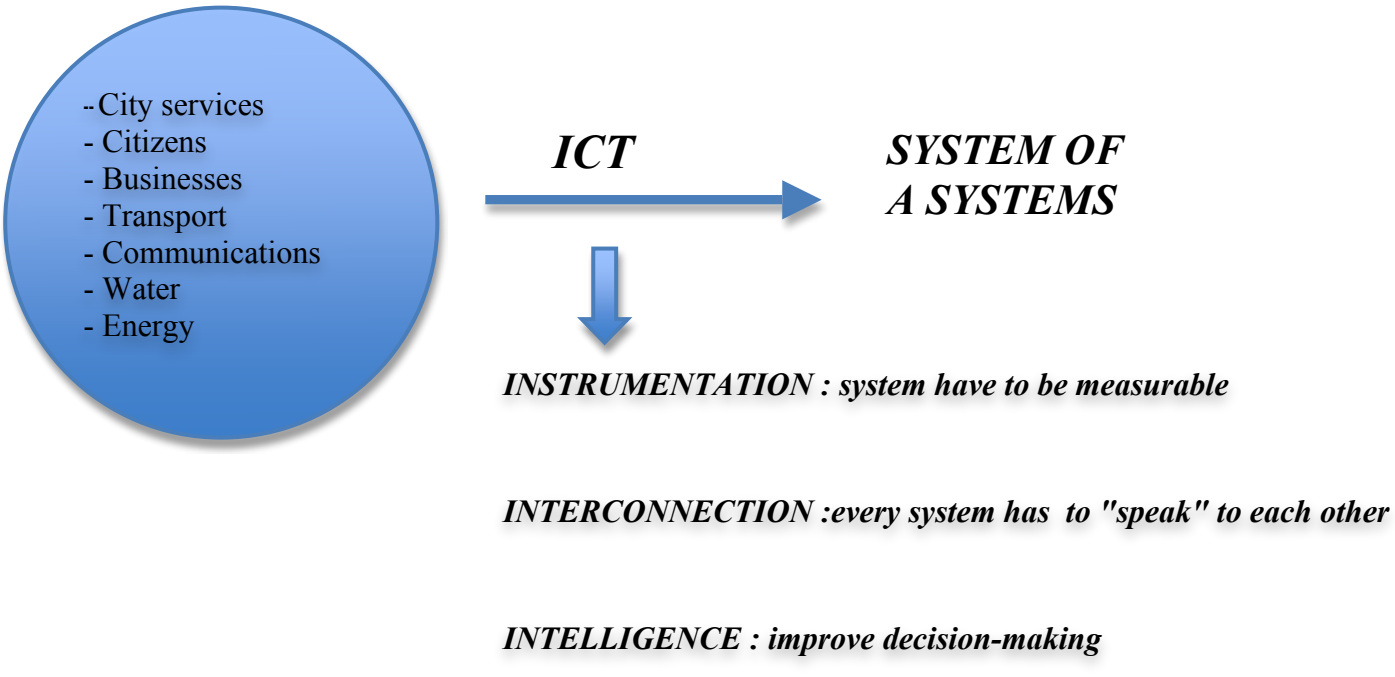
and high speed digital communications network that allow to lower the distance barriers for work and services .

Services and infrastructures, both physical and virtual

- Smart Utilities grids (not only the distributed electricity and gas grids with bidirectional flow in a distributed generation, that requires real time exchange of information , but also remote heating/cooling to leverage co/tri-generation, clean and grey water with detailed per user/usage billing that encourage collection and reuse , underground pipes for differentiated waste collection).
- Public transportation and road network that aim to manage the mobility needs with an appropriate Intelligent Transport System (ITS) that takes care of congestion charging, reduce pollution and accident rate, manage parking, car and bike sharing, reserved lanes, digital signing, integrated payments by vehicle pollution category, etc.
- ICT network that leverage high speed services, mobile advanced location based services, social networking and collaborative crowd sourcing, tele-working, remote assistance and medical surveillance for disabled or elderly people, etc.
- Integration of public local administrative services with central private ones, to improve coordination, information sharing, cooperation with not for profit sectors, etc.

Figure 5 : ICT Oriented Vision, IBM research [Dirks et al. 2009],[Harrison et al, 2010].

" A smart city is one that use technology to transform its core system and optimize the return frome largely finite resources " [Dirks et al. 2009]



2.2.2 Services-oriented Vision

Then, the second most quoted framework starts with the definitions of six core areas that are considered as the critical dimensions of Smart Cities. These areas are: Smart Economy, Smart Environment, Smart Governance, Smart People, Smart Mobility and Smart Living [Giffinger et al, 2007]. This article sees these six city dimensions as a roof for the further elaboration of smart cities which should incorporate the findings but also allow an inclusion of additional factor. In their opinion a Smart City is a city well performing in a forward-looking way in these six characteristics, built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens. In the next table each of the key dimensions is decomposed into its critical success factors from which in this work were derived the KPI to actually measure the "smartness" of cities in Europe. This will allow a better understanding of these core focus areas (a broader discussion will be conducted within the next chapter).

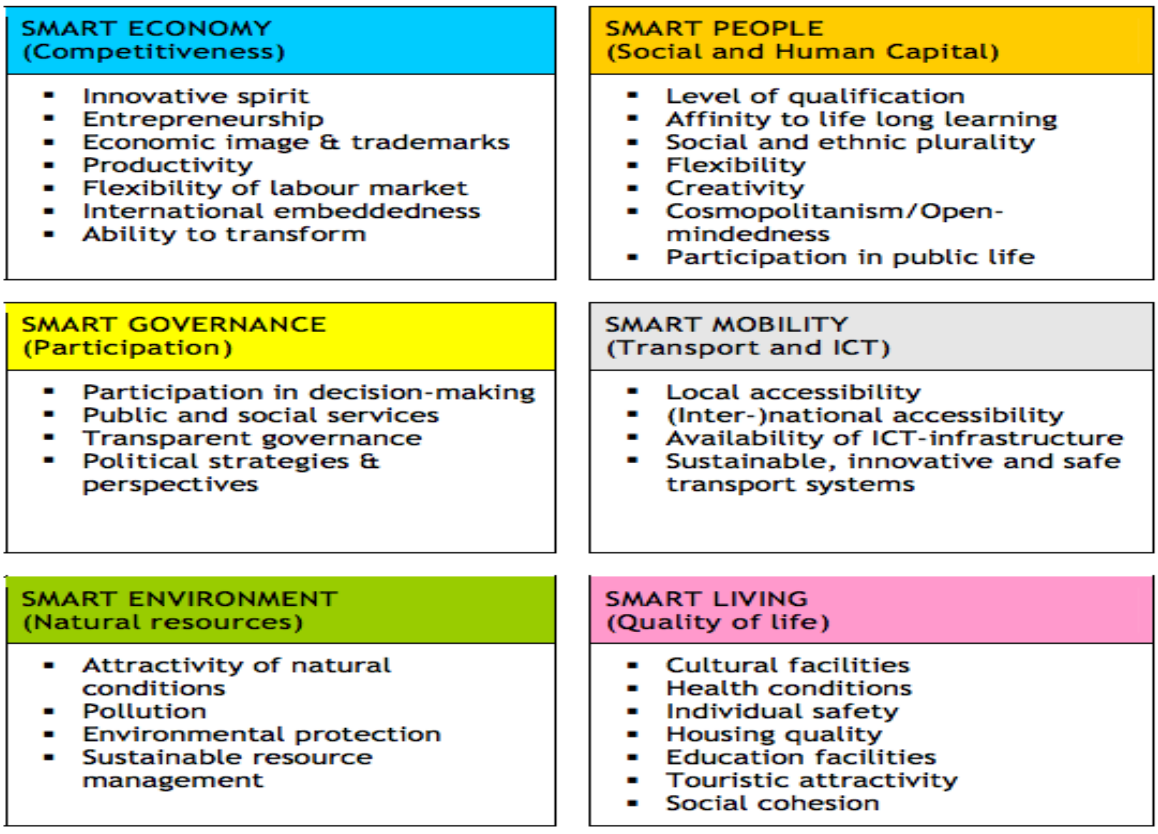


Figure 6: Dimension and factors of a Smart City

This route to define and conceptualize Smart Cities was followed also by three more works; the first in chronological order was [Toppeta,2010], and than, one year later, the same approach was used by [Caragliu et al, 2011] and [Lombardi et al,2011].

It's very interesting Toppeta's work, that for each one of this categories lists solutions and technologies that can be associated to each main entry of the ICT role in Smart City, since it keeps on evolving due to the innovation, plus some components that have broad impacts on several factors.

Table 2 : Smart City's Categories

Categories	Solutions and technologies
Smart Mobility	• Enhanced travellers information services (CRM integrated [1]): Searching, by smart-phone, mobile devices, touch screen and gesture interfaces, for stops, connections, destinations and estimated real time arrival time by public transport, bike sharing and car pooling availability, van sharing (for goods optimized loading and delivery path), events reservation and touristic monuments self guided tours, search for nearest bus / taxi, browse for local shops or restaurants, location based social community, games and services, etc. • Detection and analysis of traffic flows and intelligent management of signage, giving priority to emergency and public transport (taking into account their demand and delay), automatic detection of drive code violations and road danger (such as traffic lights failures, flooding, fog, explosions, etc.). Geo-location and automatic alarm in case of incident, reporting accidents to vehicles and signposts information, machine to machine communication. Geo-referenced driving charging by time shift, pollution, number of vehicle's passengers (pooling), integrated insurance, driving rules enforcements, service provided (goods smart delivery, health

[1] *Customer relationship management (CRM) is a model for managing a company's interactions with current and future customers. It involves using technology to organize, automate, and synchronize sales, marketing, customer service, and technical support [Shaw, Robert, Computer Aided Marketing & Selling (1991) Butterworth Heinemann].*

	assistance), etc. Business Intelligence for managing a growing amount of sensor based data that can provide insight by multi-modal, real time analysis.
Smart People	• Tele-medicine services,management of fire, flooding and anti-theft alarms (integrated with home automation), mobility assistance and prevention of social isolation or elderly, disabled and chronical illnesses. • Eco-tourism services, virtual museums, augmented reality, digital art and new media co-creation and enjoyment, custom guides, live assisted translation and cultural mediation, exploration games.
Smart Economy	• "Co-working" building (like "the Hub") with reservation of space and equipment rental, professional services provided in tele-work arrangements, support of "nomadic computing workers". • Modular decentralized offices (virtual satellite offices) with broadband access, equipped to support tele-work and able to provide ancillary services (e.g. secretary, regular mail, canteen or kitchen area) plus opportunities for socialization and training.
Smart Living	• WebGIS[2] systems for smart urban development planning, simulation and analysis, with services and balanced flow analysis of needs and risks (flood, earthquake, etc.), in order to manage densification and achieve a sustainable social, environmental and generational mix. • Integrated solutions for remote management, remote heating and cooling co/tri-generation and renewable energy integration, accounting for drinking water usage, groundwater management, charging by volume and categories of the waste collection with effective incentives to minimize packaging, increase reuse and recycle, energy (heat or bio-gas) extraction.
Smart Environment	• Smart traffic control systems to prioritize the traffic mobility by category and needs (e.g. quick, pleasant, and effective public and

[2] *Geographic information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data. The acronym GIS is sometimes used for geographical information science or geospatial information studies to refer to the academic discipline or career of working with geographic information systems ["Geographic Information Systems as an Integrating Technology: Context, Concepts, and Definitions". ESRI. Retrieved 9 June 2011].*

	emergency transportation, pedestrian and cycle safety, increased autonomy of the disabled, reduced traffic contribution to air and noise pollution, prevented traffic jams). • Transparent systems for monitoring and forecasting of the quality of air and water, noise and electromagnetic pollution, with internet based open reporting and citizens' feedback to identify potential leakage in the measurement system. • Smart grid[3] optimization of distributed generation from renewable sources and peak load management, energy trading benefits extended to end users (integration with home automation).
Smart Government	• Information sharing platforms based on cloud computing, common standards and automated workflow for solving cross-cutting issues and lower bureaucracy delay and transaction cost among city districts and agency boundaries. Systems of direct and secure access by internet to local information and public services. De-materialization of bureaucracy by privacy and legal validity of e-documents, automated workflow and business intelligence. • Ecosystem of caregivers working together, resulting in full, integrated electronic medical record about each patient for emergency, and increase the quality of care. Central smart reservation medical services with unique, automatic compatible donors, beds, analytical instruments and specialists, all while reducing costs. Emergency management and coordination of sanitary forces, epidemiology (better detect, track, prepare for and stay ahead of disease outbreaks also by Internet analytics).

[3] *A smart grid is an electrical grid that uses information and communications technology to gather and act on information, such as information about the behaviours of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity. [U.S. Department of Energy. "Smart Grid / Department of Energy". Retrieved 2012-06-18].*

2.2.3 Approach-oriented Vision

The third most quoted framework is defined by [Shaffers et al, 2011], which point out the importance of a sustainable partnership and cooperation strategies among the main stakeholders. Cities and urban areas are considered not only as the object of innovation but also as innovation ecosystem empowering the collective intelligence and co-creation capabilities of user/citizen communities for designing innovative living and working scenarios. Partnership and cooperation strategies among the main stakeholders are needed such as technology platforms, ICT tools, methodologies and know how.

To analyse this point of view, we start from the definition provided for Smart Cities. In their opinion, a city can be considered smart "when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory government" [Caragliu et al, 2009].

However, this work highlights the first gap between the technology orientation of “Future Internet” (meant as highly innovative technology) research and the needs and ambitions of cities. City policy makers, citizens and enterprises are primarily interested in concrete and short-term solutions, benefiting business creations, stimulation of SMEs and social participation. Future internet research and experimentation represents instead a technology-oriented and longer-term contribution to urban innovation ecosystem.

This gap is linked with the lack of a innovation ecosystem for smart cities, in terms of applications, services, financial engineering and partnership. A recent Forrester survey states that Smart Cities solutions are currently more vendor push that city-government pull based. The survey points out that "smart city solutions must start with the city not the smart" [Bellissent, 2010].

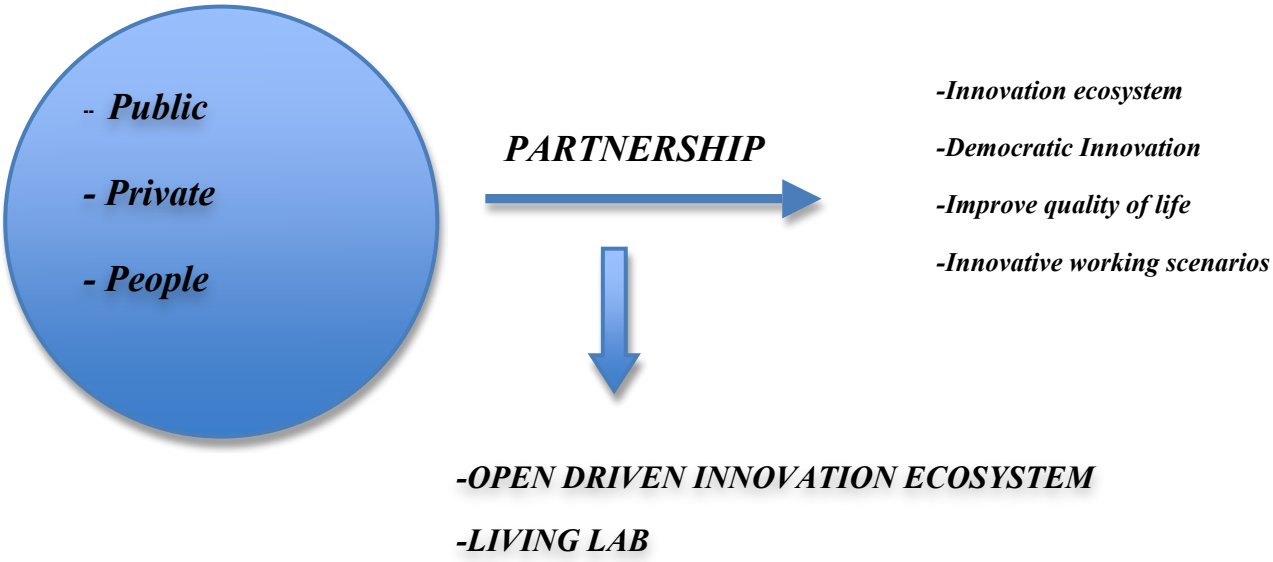
To overcome this gap, in this current is introduced the concept of Living-lab innovation ecosystem, which are close to the interest and needs of cities and their stakeholders, including citizens and businesses. Going deeper, in order to provide a better understanding for what actually Living-Labs are, we mention the definition given by [Gleman, 2006]: "Living Labs involve users at the earlier stage of the R&D process for co-creating value. A Living Lab is an open research and innovation ecosystem often based on a specific territory and involving a large diversity of stakeholders such as user communities (application pull), solution developers (technology push), research disciplines, local authorities and policy makers as well as investors. While the Living Lab ecosystem, through

openness, multicultural and multidisciplinary aspects, conveys the necessary level of diversity, in empowering user communities it stimulates the emergence of breakthrough ideas, concepts and scenarios leading to adoptable innovative solutions. It also allows enterprises, especially SMEs, and users/citizens either as entrepreneurs or as communities to get access to technology infrastructures as well as science and innovation services". The main objectives consist to co-create and explore new ideas and concepts, experiment new artefacts and evaluate breakthrough scenarios in a real life context that could be turned into successful innovations. The social dynamics of such Living Lab ecosystems ensures a wide and rapid spread of innovative solutions through mechanisms such as viral adoption and the socio-emotional intelligence.

So, in this study it is believed that the Living Lab innovation-ecosystem may evolve to constitute the core of "4P" (Public, Private, People, Partnership) ecosystem providing opportunities to citizens and business to co-create, explore, experiment and validate innovative scenarios based on technology platforms involving SMEs and large companies as well as stakeholders from different disciplines.

Figure 7: APPROACH-ORIENTED VISION [Shaffers et al. 2011].

" When investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a hight quality of life, with a wise management of natural resources, throught participatory government"[Shaffers et al.2011]



Oulu, a concrete example of LivingLab

To better understand from the practical point of view a Living Lab vision, I will do a brief reference of how city of Oulu has been able to create an open research and innovation ecosystem involving a large diversity of Stakeholders.

The city of Oulu has strongly emphasized the importance of its innovation ecosystem. In 2007, the city created a national level working group to draw up a regeneration proposal for the Oulu innovation ecosystem in order to better meet the challenges of internationalisation of business and innovation. The short term goal was to establish a strategic partnership, the "Oulu Innovation Alliance", including the City of Oulu, the University of Oulu, the Oulu University of Applied Sciences, the VTT Technical Research Centre of Finland and Technopolis.

Oulu has aggressively developed its infrastructure which forms the core of what can be called an urban living lab where real-life user-centric innovations flourish. Oulu's living lab offers an environment for sensing, testing an piloting technological and social innovations. One example how City of Oulu drives for the Living Lab approach to obtain user-driven innovations is development of test user community " PATIO" (www.patiolla.fi), that empowers ordinary people to experiment and contribute to development of new services or appliance. Among the living labs created in the Oulu environment are OULLabs (Oulu Living Labs, http://www.oullabs.fi/) and NorthRull (Northern Rural Urban Living Lab, http://www.northrull.fi/).

Figure 8: ULU hotspots

The applicability and benefits of Oulu's open ubiquitous city testbed has been demonstrated with many examples in collaborative industrial R&D and in engaging user communities. The main goal of Living Lab is to involve communities of users at an early stage of the innovation process. The confrontation of technology push and application pull in a Living Lab enables the emergence of breakthrough ideas, concepts and scenarios leading to adoptable innovative solutions [Shaffers et al, 2012].

In the following table what they believe to be the three fundamental perspectives for cities to undertake smarter approaches, are highlighted and related to the main actors, the priorities, the resources, and the policy context.

Table 3: Three perspective shaping the landscape of Future internet and City Development.

	Future Internet Research	Cities and Urban Development	User-driven Innovation Ecosystems
Actors	Researchers ICT companies National and EU actors	City policy actors Citizen platforms Business associations	Living Lab managers, citizens, governments, enterprises, researchers as co-creators
Priorities	Future Internet technical challenges (e.g. routing, scaling, mobility)	Urban development Essential infrastructures Business creation	User-driven open innovation Engagement of citizens
Resources	Experimental facilities Pilot environments Technologies	Urban policy framework Organisational assets Development plans	Living lab facilities: methodologies & tools, physical infrastructures
Policies	Creation of advanced and testbed facilities Federated cooperation Experimental research	City policies to stimulate innovation, business and urban development Innovative procurement	User-driven innovation projects Open, collaborative innovation

Source : "Smart Cities as innovation ecosystem Sustained by the future internet", Shaffers et al, 2011.

Creation of a common, community supported agenda or roadmap for urban innovation and economic development as enabled by ICTs and the Future Internet, supported by all stakeholders and addressing priorities of cities and citizens, may help finding consensus on both short term and longer term objectives. Stimulating social innovation, to benefit the creation of solutions to major social problems in cities using the technological opportunities of the Internet, should be in the heart of this effort.

In this research it is also included a roadmap process, that propose as a base for more elaborated smart cities action plans and planning processes. The three main steps are:

- Identify the emerging changes in the domain of Smart Cities
- Develop a scenario representing the future of Smart Cities
- Identify the challenges to realize the future vision

2.3 OTHERS SMART CITIES STUDIES

Another interesting contribution is the survey conducted by Abdulrahman from University of Malaysia. Here he categorized Smart Cities into seven smart system connected respectively to cities' critical activities and services. They are: Smart Grid, Smart Meter, Intelligent Transportation System, Smart Water, Smart Home, Smart Food, and Smart Healthcare [Abdulrahman et al, 2012]" Abdulrahman highlights the smart infrastructure that surround a Smart City, and ICT is the means to cover all areas on Smart City. "Making cities smarter is usually achieved through the use of ICT-intensive solutions. In fact, ICT is already at the heart of many current models for urban development". The tool on the base of the smart infrastructure is the wireless Sensor network (WSN), a group of large numbers of heterogeneous sensor devices spread over a large area, linked by wireless media "The smart city depends on building a smart infrastructure based on a wireless sensor network (WSN) which represents the backbone of the city depending on the global network".

[Washburn et al, 2010] defined the Smart City's dimensions in relation to the services offered. The categories that in his opinion build up the Smart City are: governance, education, healthcare, public safety, real estate, transportation and utilities. According to Washburn's research, the smart city is a collection of Smart Computing technologies applied to this seven critical infrastructure components and services. The use of Smart Computing technologies have the purpose to make components and services more intelligent, interconnected and efficient. Washburn, inspired to the 2009' report "Smart Computing Drives The New Era of IT Growth", defined Smart Computing as a "new generation of integrated hardware, software, and network technologies that provide IT system with real-time awareness of the real word and advanced analytics to help people make more intelligent decisions about alternatives and actions that will optimize business processes and business balance sheet results". What's very interesting in his paper is the analysis on how should be the optimal leadership. Particularly he defined a sort of maturity level (and the corresponding role) of the potential CIO of the city. He believes CIOs to be not just the unique decision-maker, but also to be actual enabler of Smart Cities.

[Nam et al, 2011a] has been developed another framework to conceptualize Smart Cities. In their opinion the key foctors are about technologies, humans, and institutions. A few months later they focused their work on the innovation component of Smart Cities [Nam et al, 2011 b]. Here again they had to tackle the topic defining which are the building blocks that enable Smart Cities, and the

dimensions they found were: technology (to serve as a tool for innovation), organization (to manage innovation) policy (to create an enabling environment) and the surrounding context.

[Zygiaris, 2012] try to answer two questions: could all conceptions and diverged policies and processes related to smart city planning be assembled into an inclusive and holistic smart city holistic framework? And how the framework would be assistive in identifying processes within the urban innovation ecosystem that compose a smart city's plan?

[Zygiaris]'s model includes several layers (step) in which a smart city have to evolve. The first one tackles on the social infrastructure, where it's needed a balance between op down governance approach and bottom up community participation. The second layer focuses on the smart city's environment, which have to be involved in a sustainability way "*In turn, technological breakthroughs, people, and innovation processes build upon green city to bring a sustainable future*". Layers 2 3 4 and 5 defines the technological approach, through these steps: *interconnection*, to develop a broadband economy; *instrumentation*, to ensure the "real time capability"; *open integration*, to provide an open integrated space, and *application*,to apply the previous layers to the real city life. The last layer, this have to be managed by city leaders to face future challenges in a Smart perspective.

Chapter 3:

THE APPROACH

3.1 DESIGN SCIENCE RESEARCH METHODOLOGY

In this chapter the approach used for the research will be discussed. The Design Science Research (DSR) Methodology has been taken as the guideline to develop this project. Before introducing the steps that have been followed for developing this dissertation, a step back must be taken.

What is critical in this master thesis is to identify the field in which it fits. In fact, for Smart Cities we could say that we're tackling the management side as well as the Information Systems field, and sociology can be considered also involved. This statement can be further demonstrated by the various journals (e.g. within the AIS Basket of 8, Journal of the European Urban Research Association, Regional Science and Urban Economics Journal, The European Journal of Social Science Research and so forth) in which articles on Smart Cities are published. As we've seen in our review of the literature there are three main currents in considering Smart Cities: the IBM's one [Dirks et al. 2009] (that can be considered highly technological oriented), the [Giffinger et al. 2007]'s one (that is linked also with management principles) and the [Schaffers et al. 2011/2012] (that includes sociological aspects as well). As a consequence it was a complex task to identify the most appropriate research methodology. It should be mentioned here also the arising concept of "Multidisciplinary Research Design" [Amoussou et al. 2006] as an idea revolving around DSR's concepts, with applications within inter-disciplinary research. This seems to be the right methodology to be followed. However, it is still lacking in standardisation and well acknowledged ontological definitions. Thus, it hasn't been possible to use it as a guideline for this project. As a consequence we need to go deeper into the Design Science concept.

Historically the Design Science Research (DSR) term was first introduced by Joan Ernst van Aken, Professor at Technische Universiteit Eindhoven, Netherlands [Van Aken, 2004]. However, the concepts on which the DSR field is based, are much older. In particular should be mentioned Herbert Simon and his "The Sciences of the Artificial" (1969), and, referring to the information systems, someone recognizes Joseph Walls (with Widemeyer and El Sawy) as the first pioneer, with the book "Building Information Systems Design Theory for Vigilant EIS" (1992).

Generally the mission of the Design Science is to "develop general knowledge which can be used in the field in question to design a solution to a specific problem" [Wikipedia]. In other words, the

DSR field aims to provide a pattern in order to generate knowledge to be used in designing solutions to solve problems. It can be already seen in first approximation, just from this general definitions, how the DSR method can be suitable for the topic that is being developed in this master thesis. For a greater understanding, it is good to deepen this discussion. In particular, DSR is made of:

- Research: it can be generally defined as "an activity that contributes to the understanding of a phenomenon" [Lakatos, 1978]. In the case of DSR, "all or part of the phenomenon may be created as opposed to natural occurring" [source: Association for Information Systems, "Design Science Research in Information Systems"].
- Design: it means "invent and bring into being" [source: Webster's Dictionary and Thesaurus, 1992]. So, it can be seen as an activity which goal is to create something new, that did not exist before.

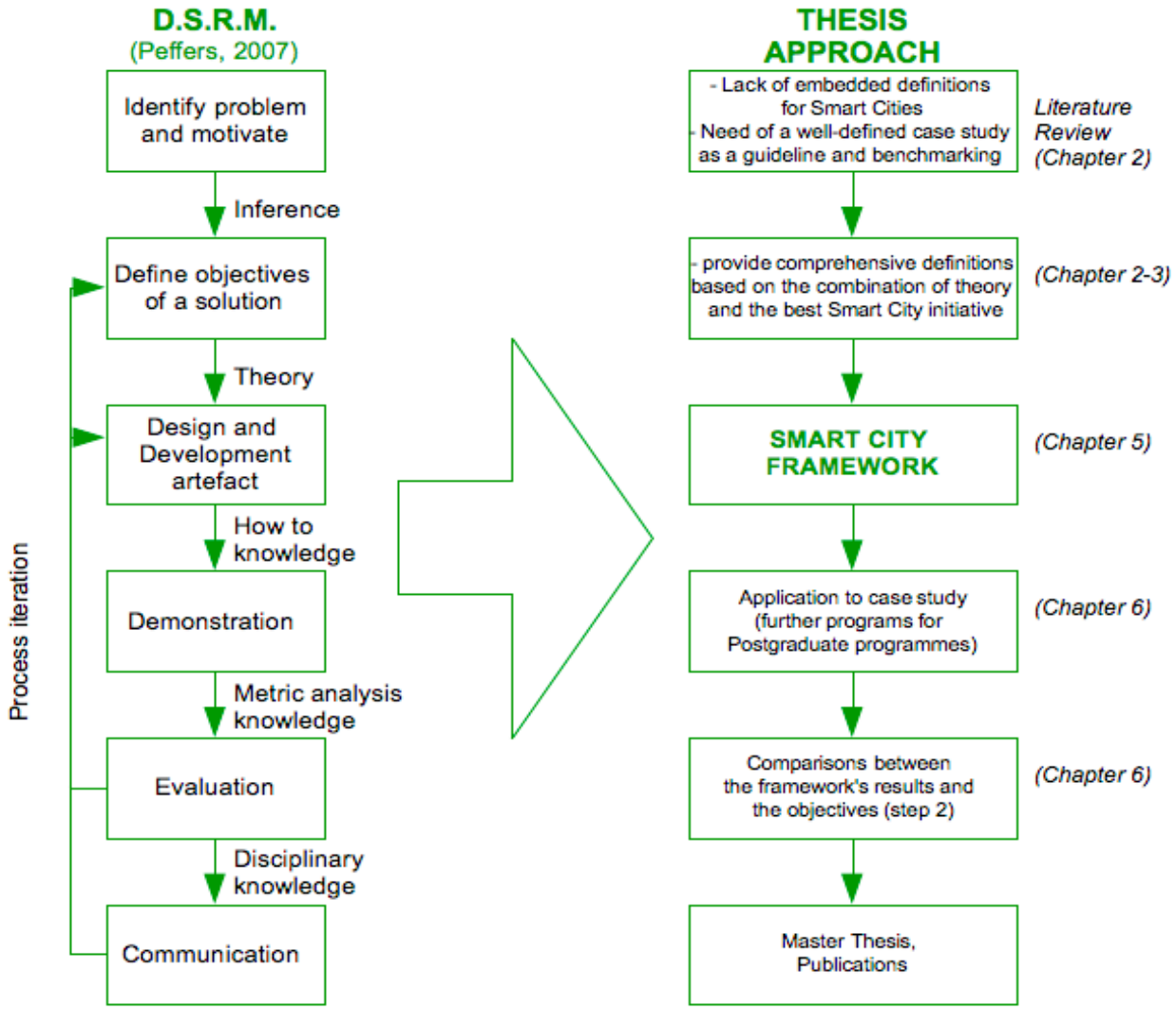
Contextualizing the concept in the IT field, "Design Science creates and evaluates IT artefacts intended to solve identified organizational problems" [Hevner et al. 2004]. What is necessary now is to make a comprehensive distinction between "natural science" and "design science". According with Herbert Simon, a natural science is defined as "a body of knowledge about some class of things in the world (nature or society) that describes and explains how they behave and interact with each other". A design science, on the other hand, "is a body of knowledge about artificial objects and phenomena designed to meet certain desired goals". So, "whereas natural sciences and social sciences try to understand reality, design science attempts to create things that serve human purposes" [Simon, 1969]. Then, the goal here was to use design science as a research approach and, in doing so, realize benefits from the practical applicability of research outcomes. In accordance again with [Hevner, 2004], "in recent years, several researches succeeded in bringing design research into the IS (Information Systems) research community, successfully making the case for the validity and value of design science as an IS paradigm, and actually integrating design as a major component of research". So, summarizing, the definition provided of DSR integrates any designed thing with an embedded solution to a clear problem. The most important practice rule identified by Hevner is that "the research must produce an artefact, created to address a problem". Furthermore he said that "the artefact should be relevant to the solution of an unsolved and

important business problem". For this master thesis, these were the key concepts that pushed us to consider the DSR as the proper approach within this field.
Going ahead, "the development of the artefact should be achieved from existing and proved theories and knowledge and should be a solution of a defined problem" [Peffers et al. 2007]. In his document Peffers identified six steps for implementing the design science process:

1. problem identification and motivation;
2. definition of the objectives for a solution;
3. design and development,
4. demonstration;
5. evaluation;
6. communication.

This steps are also known as DSRM (Design Science Research Methodology). In the next figure (left side) are graphically represented all of this steps, with their connections.

Figure 9 : Design Science Research Methodology; source: Peffers, 2007;



In this thesis, as a first approximation, it can be said that the problem refers to the issues identified in the review of literature presented in chapter 2, and particularly there are two main problems arising from this analysis. In first place, as underlined at the very end of chapter 2, it is still lacking a common and holistic definition of Smart Cities. So, I started asking myself: how can a useful analysis be conducted if there is not a common holistic understanding and both researchers and participants define Smart Cities for their own needs and perspectives? Secondly, maybe deriving from this first issue, it can be identified in literature the lack of guidelines, benchmarking initiatives (only attempts to measure the "city's smartness" were developed [Giffinger et. al 2007][Lombardi et al. 2011]), standardisations, and comparisons between theory and real cases implementations. So, a

solution is needed, and were defined the objectives for this solution. They are referred to provide a comprehensive definition of Smart Cities and a framework in which all the homogeneous dimensions that fully encompass all the enabler factors are defined. Secondly a real case study is wanted to be analysed. Then the artefact (i.e. the solution itself) is the Smart City Framework and its adoption into the real initiative. A summary is provided in the previous figure (right side).

Hence, in the next paragraphs all the steps of the Peffers methodology will be carefully explained and consistently contextualized to this research.

3.2 PROBLEM IDENTIFICATION AND MOTIVATION:

This is the first step in the DSRM. Here should be defined the specific research problem. Moreover the value of a solution must be justified. It is fundamental to define the problem in the right way, because this definition is the base of the artefact, that can effectively provide a solution to the problem itself. In this document this part can be found in the first two chapters. Summarizing the problems (still unsolved) from which this research have started are various, starting from the urbanization problem that is affecting cities, the demographic change trend that is crashing cities' balances, till the growing environmental impact that can be attributed to cities. Subsequently, the arising concept of Smart City as way to tackle these problems was introduced. Then the problem has been focused on the lacks that can be found in literature about the definitions related to Smart Cities, due to the novelty of this topic. So, in short, the problem is relevant and many authors highlighted the need of standardization in order to focus both research and actions towards the actual implementation of such kind of initiatives. A subsequent issue is the existing gap between theory and practice. Many cities have already implemented actions towards smarter approaches. Then suddenly a new theoretical wave came up. So, there is a fundamental need to reflect on this comparison.

3.3 DEFINITION OF THE OBJECTIVES FOR A SOLUTION:

Peffers affirmed that it consists in "infer the objective of a solution from the problem definition and knowledge of what is possible and feasible" [Peffers et al. 2007], and again, "the resources required for this include knowledge of the state of problems and current solutions, if any, and their efficacy". I tackled this issue transforming the problems into artefact's objectives. This kind of goals are called in literature "meta-requirements" [Walls et al. 1992], or simply "requirements" [Eekeleset al. 1991].

Generally these objectives can be:

- quantitative: it represents the situation in which "a desirable solution would be better than current ones" [Peffers et al. 2007], or
- qualitative, such as the description of "how a new artefact is expected to support solutions to problems not hitherto addressed" [Peffers et al. 2007].

In this step were then defined the objectives that are wanted to be achieved. So in first place an embedded definition of Smart Cities must be provided. It has to take into account every single aspect arising from the literature in order to be really useful, comprehensive and complete. The idea would be to join together all the key concepts (building blocks) into collectively exhaustive and mutually exclusive (it should be noted that this view allows the presence of interdependencies) dimensions that fully encompass all the Smart City's enabler factors. So, the main objective is make a big step forward towards a highly demanded and needed standardisation. This would allow consistent measurement initiatives and comparisons between different environments. So, here arise the second main goal that I want to achieve: fill the gap between theory and practice. In other words once the framework has been defined, it will be applied to a real case study (City of Riverside, California). So, the second objective can be seen as providing a consistent and embedded (rather than simplistic and fragmented) view on how the best Smart City worldwide [Intelligent Forum 2012] is performing if compared to the theory (the framework). On the other side this analysis aims at build a new "best practice" for cities that are going to implement similar initiatives based on literature, rather than individual prospectives.

3.4 DESIGN AND DEVELOPMENT:

In this step the goal is create the artefact. It is the core of this document: the development of the Smart City Framework applied to City of Riverside. In this section I will try to give an explanation of the steps of the approach used to build the structure of this artefact, and some usage descriptions.

I based on literature analysis to develop a comprehensive framework , trying to combine the three main quoted framework (paragraph 2.2) in a unique model able to represent the holistic vision of a city. The three most quoted framework focuses on different topics, IBM's research on the technological one, [Shaffers et al.] on the partnership between city's stakeholders, and [Giffinger et al.] on the critical component of a city and its ICT services. These three vision are linked by ICT, that is the core component of my framework, and constitutes the backbone of Riverside Progression Model (see paragraph 5.1). Next step was the transition from theory to practice, searcing and analysing all the initiatives considered important to the "Smart development" of Riverside(see paragraph 5.2) and put them in the Progression Model. Last step was the research of the main ICT services provided in Riverside , their selection within the critical city components and their connection (as far as possible) with city's ufficial statistics to highlights their incidence (see paragraph 5.4).

3.5 DEMONSTRATION:

This step consists in “demonstrate the use of the artefact to solve one or more instances of the problem” (Peffers, 2007). This could mean the usage of the artefact for experimentation, case study, or simply simulating it. This phase will not be fully implemented within this master thesis program, due to the lack of time. However, some initiatives in this way will be taken. One of the goals here is to validate the framework. A perfect way to do it would be a case study, and somehow its implementation for the analysis the City of Riverside can be seen as its implicit validation. Another action in this way is connected to the place where I'm developing this dissertation. In particular, being in touch with domain experts, practitioners, companies and other researchers, allowed me to collect ongoing feedbacks on its development. Another way used to prove the truthfulness of the model was demonstrating step by step its conceptual development by mentioning surveys

conducted by various organizations on that specific theme, or from corporate reports of companies involved in this field, or from both journal and conferences papers. Furthermore, actual cases (see as an example the Oulu Living Lab Initiative in chapter 2) were mentioned from studies and researches released by institutional organizations, as well as by various consulting societies. A further deeper validation will be given within the subsequent postgraduate program on this topic.

3.6 EVALUATION:

Within this step what must be done is "observe and measure how well the artefact supports a solution to the problem". So, what is actually implemented here is a comparison between the results coming out from the demonstration step (i.e. the results that comes from the artefact's usage) and the "objectives of a solution" (defined in paragraph 3.3). In this document this step will be treated in terms of analysis of the results from the framework applied to City of Riverside and their comparison with the two main research objectives previously defined.
Concerning those statements proved by citations of external surveys, field investigation, and case studies, they were taken as valid, after an assessment of the issuer. In other words they do not need to be evaluated as the issuers were considered trusted (McKinsey, Gartner, governmental authorities, etc.).

3.7 COMMUNICATION:

It is the final step in the DSRM proposed by Peffers (2007). It consists in "communicate the problem and its importance, the artefact, its utility and novelty, the rigour of its design, and its effectiveness to researchers and other relevant audiences such as practising professionals, when appropriate". It refers to the usage of the structure of the DSRM process to develop the document. As shown in the figure above, each step has its correspondent chapter in this document. So, this master thesis will be the first communication "tool". Then other initiatives will be taken, mostly during the postgraduate program. In particular we will try to attend to as many conference as possible, in order to publish some papers.

Chapter 4:

A COMPREHENSIVE FRAMEWORK FOR SMART CITIES

Within this chapter a comprehensive framework for smart cities it will be defined. In particular, we have now conducted a systematic review of the existing literature. Arising from this integrated analysis (see chapter 2) we propose this following definition of Smart City:

"*an urban area that leverages its technological and social infrastructure implementing people-private-public partnerships supported by an innovative governance in terms of policies, leadership and proper ongoing management principles, to enable smart information services, aiming at improving its critical capabilities*"

As a consequence we derive the dimensions for our comprehensive framework, in terms of mutually exclusive and collectively exhaustive areas that fully encompass all the enabler factors of Smart Cities. These dimensions are:

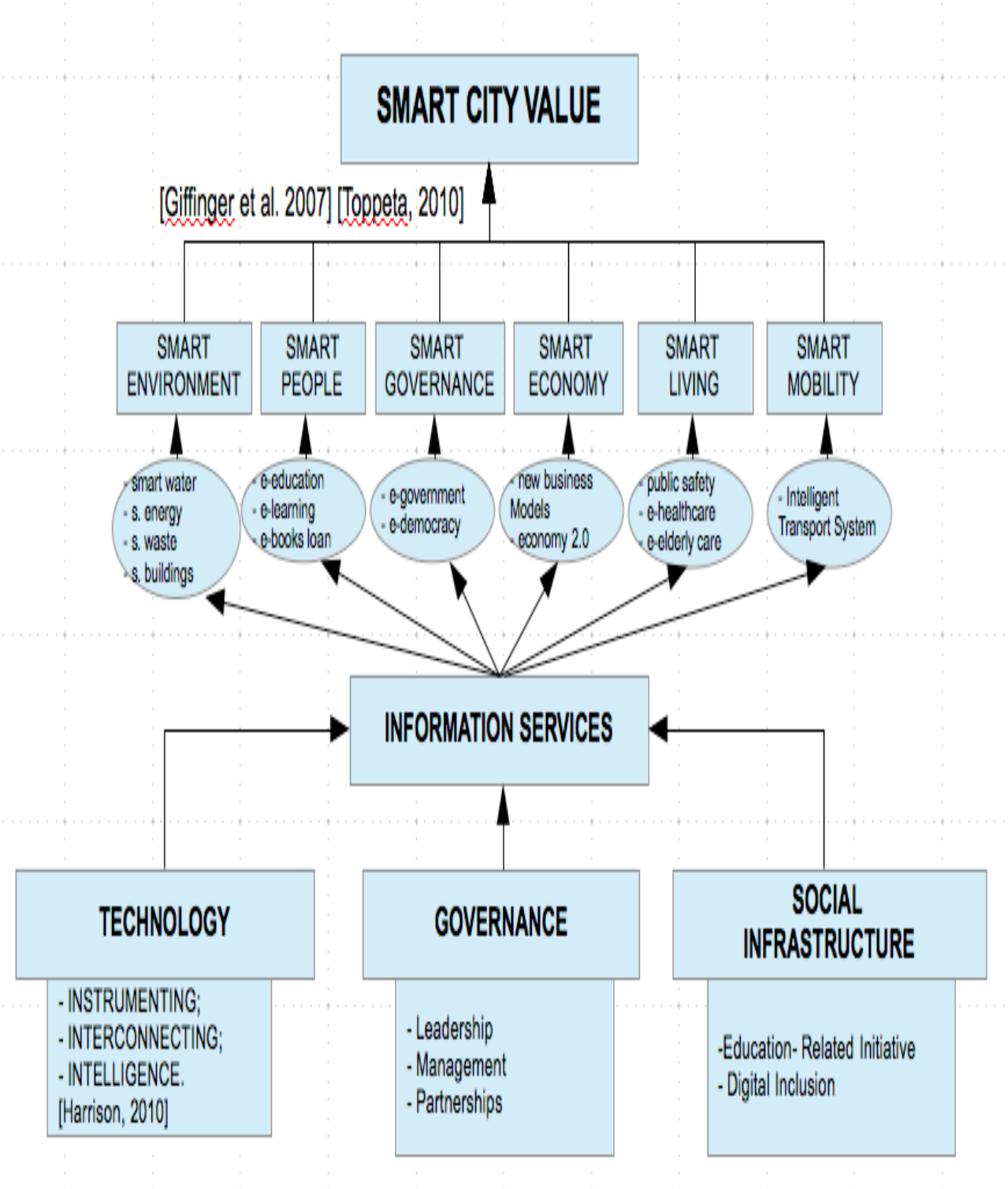
- Governance: here leadership, management e partnership principles are taken into account;
- Social Infrastructure: it covers education-related initiatives and digital inclusion principle;
- Technology: here all the technological component of the Smart City is considered;
- Information Services: this dimension encompasses all the services enabled by the proper implementation of the previous three areas. In first approximation, the delivery of services can be seen as the ultimate goal of the Smart City. As a consequence, it has to be included into our comprehensive frameworks.

One emerging way of thinking is that for a city to function well it needs an appropriate level of complexity at all levels in its operation. This complexity is needed not just in its physical networks - its roads, its buildings and its communications, but also culturally and economically [Harrison et al, 2011]. These factors, that are brought together into this Smart Cities Framework, can be used to study and determine success factors of smart city initiatives or projects. In addition to sustainability and leavability, our framework addresses several internal and external factors that affect design, implementation and use of smart cities initiatives.

It's obvious that embedding intelligence in objects creates new functionality (that's the usual motivation for doing it), but less immediately evident is that it also alters the shapes and sizes in

which people will approach them. It is critical to refer to members of the city not only as individuals, but also as communities and groups and their respective wants and needs within cities. People and communities is a component that requires smart cities initiatives to be sensitive in balancing the needs of various communities [Chourabi et al, 2012].

FIGURE 10: SMART CITY FRAMEWORK



4.1 GOVERNANCE

First of all, it is necessary here to provide a definition of the term governance itself. Even here in literature many different definitions have been provided. Here we analyse the most quoted ones.
The World Bank defines governance as the manner in which power is exercised in the management of a country's economic and social resources for development [World Bank, 1991]. An alternate definition sees governance as: the use of institutions, structures of authority and even collaboration to allocate resources and coordinate or control activity in society or the economy. (Bell et al, 2002).
According to the Governance Analytical Framework (GAF) governance can be defined in broader terms. It refers to the "processes of interactions and decision-making among the actors involved in a collective problem, that lead to the creation, reinforcement or reproduction of social norms and institutions".
What is actually common in all of these definitions is to take into account all the stakeholders that manage shared resources, their interactions, and the way in which the decision process is managed.
Here we believe, also consistently with the review of the literature, we should decompose the governance dimension into three more sub-domains, that are: leadership, management and partnerships. In first place, it is needed to underline the difference between the first two components. To do it, we quote here a very synthetic and meaningful sentence by Peter Drucker: "Management is doing things right; leadership is doing the right things".
In this project, leadership stands for all the interactions of those that in a State structure occupy the highest level, and that suggest ideas and strategies using means to influence behaviours within the community (society). Management is related to processes in which (such as, for example) strategies and ideas will be implemented and the personnel who will be involved".

According to Theo Heimann infact,management has three different meanings,
Management as a **Noun**: refers to a Group of Managers.
Management as a **Process**: refers to the Functions of Management i.e. Planning, Organising, Directing, Controlling, etc.
Management as a **Discipline**: refers to the Subject of Management.

Successful management of growing cities is no simple task, and cities vary widely in how well they are able to handle the evolving demands. To deliver the benefits of economies of scale while minimizing the hazards of rapid growth, cities need to have professional planning and coordination, capable and accountable governance, and sustainable and responsible fiscal management [Dobbs et

al. 2012]. To this purpose is useful to mention the analysis conducted in [Washburn et al. 2010] in which the innovative pivotal figure of the Smart City CIO is described. In particular, the three high-level tiers to help CIOs determine their level of involvement, are deeply defined. In detail this work distinguishes those three layers as: “of a city, of a critical city infrastructure or service, and of a consumer of critical city infrastructure or services”, highlighting the level of involvement in planning , implementing and delivering value under the smart city concept.

With regard to the partnership, will be understood as the way in which public and private interact to achieve a common goal.

Local government, research institutes, universities , citizens and businesses have to be involved in co-creating internet-based applications and services in all sectors of the economy and society. "These new ways of innovation are characterized, firstly, by a high level of citizen involvement in co-creating Internet-based applications and services in all sectors of the economy and society; secondly, by the emergence of new forms of collaboration among local governments, research institutes, universities, citizens and businesses (e.g. Public-Private-People Partnerships)"[Shaffers et al, 2011].

4.2 POLICY CONTEXT

An important topic here refers to the political policy context. Within a Smart City highly innovative environment, that is meant to change (or at least simplify) relationships between the different stakeholders that all together build the city's structure, the policy context can not be neglected at all. Transformation from an ordinary (non smart) city to a smart city also entails the interaction of technological components with political and institutional components [Mauher et al. 2006]. The policy context is critical to the understanding of the use of information systems in appropriate ways. Hence, an innovative government stresses the change in policies, because a government cannot innovate without a normative drive addressed in policy [Eger et al. 2010]. There is sometimes a a sceptical view of innovation in the public sector. In the private sector, the focus is on managers and staff as sources of innovation, both working inside the organization, and networking outside it. However, for the public sector, we also have to consider the role of policy-makers and policy advisors in the innovation process (Hartley, 2005). To this purpose we present here an interesting scheme where [Benington, Hartley, 2001] have represented the three different politic context (figure 2) in which each of them contains particular conceptions and assumptions about the nature of the world, and the roles of politicians, managers and the population. The first two may be

familiar as 'traditional' public administration and 'New Public Management' (NPM), while a third paradigm is based on evidence of emerging patterns of governance and service delivery, which they call 'citizen-centred governance', or 'networked governance', that can be considered closer to the environment in which Smart Cities can evolve.

Figure 11 : Changing ideological conceptions of governance and public management.

	'Traditional' public administration	*'New' Public Management*	*Networked governance*
Context	Stable	Competitive	Continuously changing
Population	Homogeneous	Atomized	Diverse
Needs/problems	Straightforward, defined by professionals	Wants, expressed through the market	Complex, volatile and prone to risk
Strategy	State and producer centred	Market and customer centred	Shaped by civil society
Governance through actors	Hierarchies Public servants	Markets Purchasers and providers Clients and contractors	Networks and partnerships Civic leadership
Key concepts	Public goods	Public choice	Public value

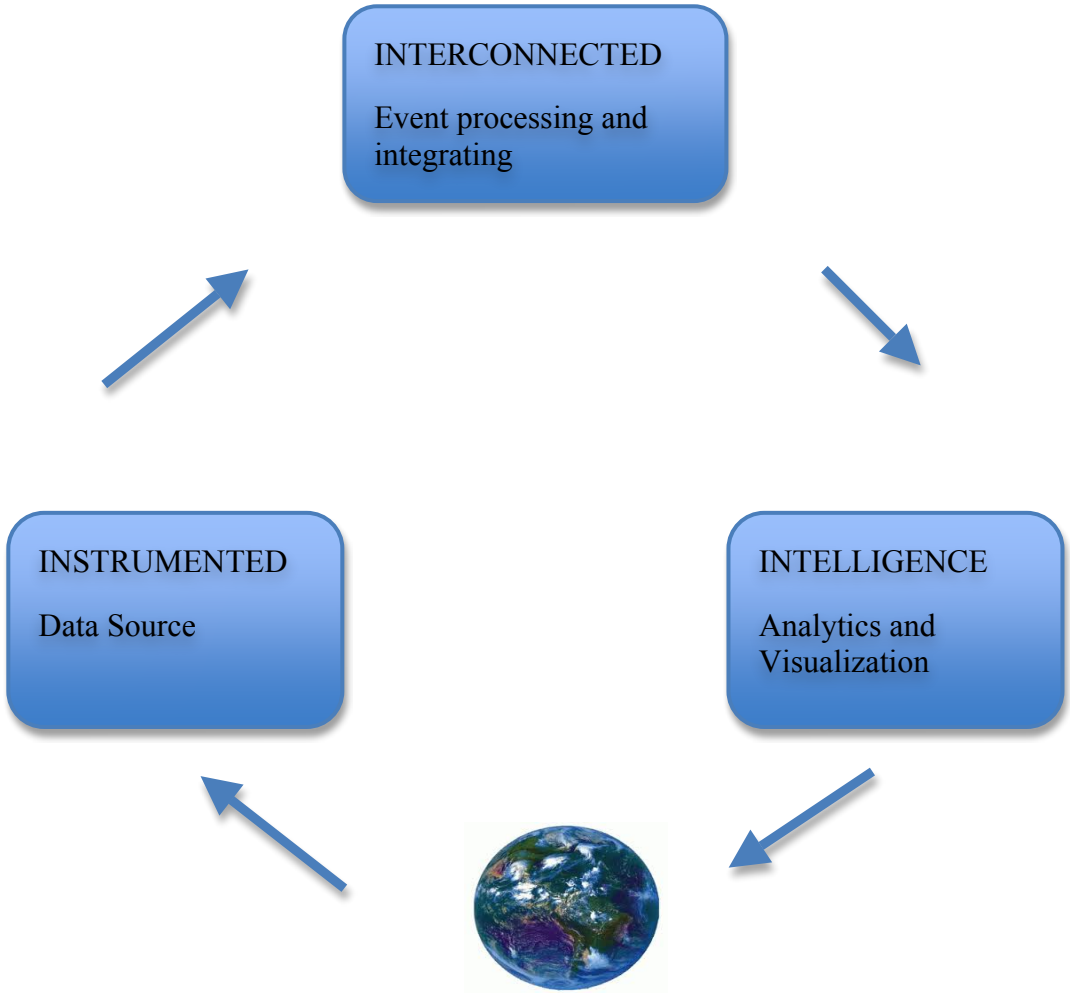
Source: Benington and Hartley, 2001.

4.3 TECHNOLOGICAL DIMENSION

In this vision, a central role is held by the growing importance of information and communication technologies (ICT) in driving the economic competitiveness, environmental sustainability, and general liveability of cities. The stimulation of ICT-based applications enhancing citizens' quality of life is now becoming a key priority (Shaffers et al, 2011). With this new technologies support, the smart city solutions will improve the ability to forecast and manage urban flows and push the collective intelligence of cities forward (Harrison et al, 2009). Taking as a reference the IBM patterns (Harrison et al, 2010), define this above concept of technological "framework " as a

closed loop of interconnected city systems. This loop can be characterized by three basic step: instrumented, interconnected and intelligence *(figure 3*)

FIGURE 12 : TECHNOLOGICAL CLOSEN LOOP



- **Instrumented**

  Sensor-based systems extend visibility into the real world of transportation, utilities, water, and buildings, providing new real-time sources of data that were either previously unavailable or prohibitively expensive to collect.

- **Interconnected**

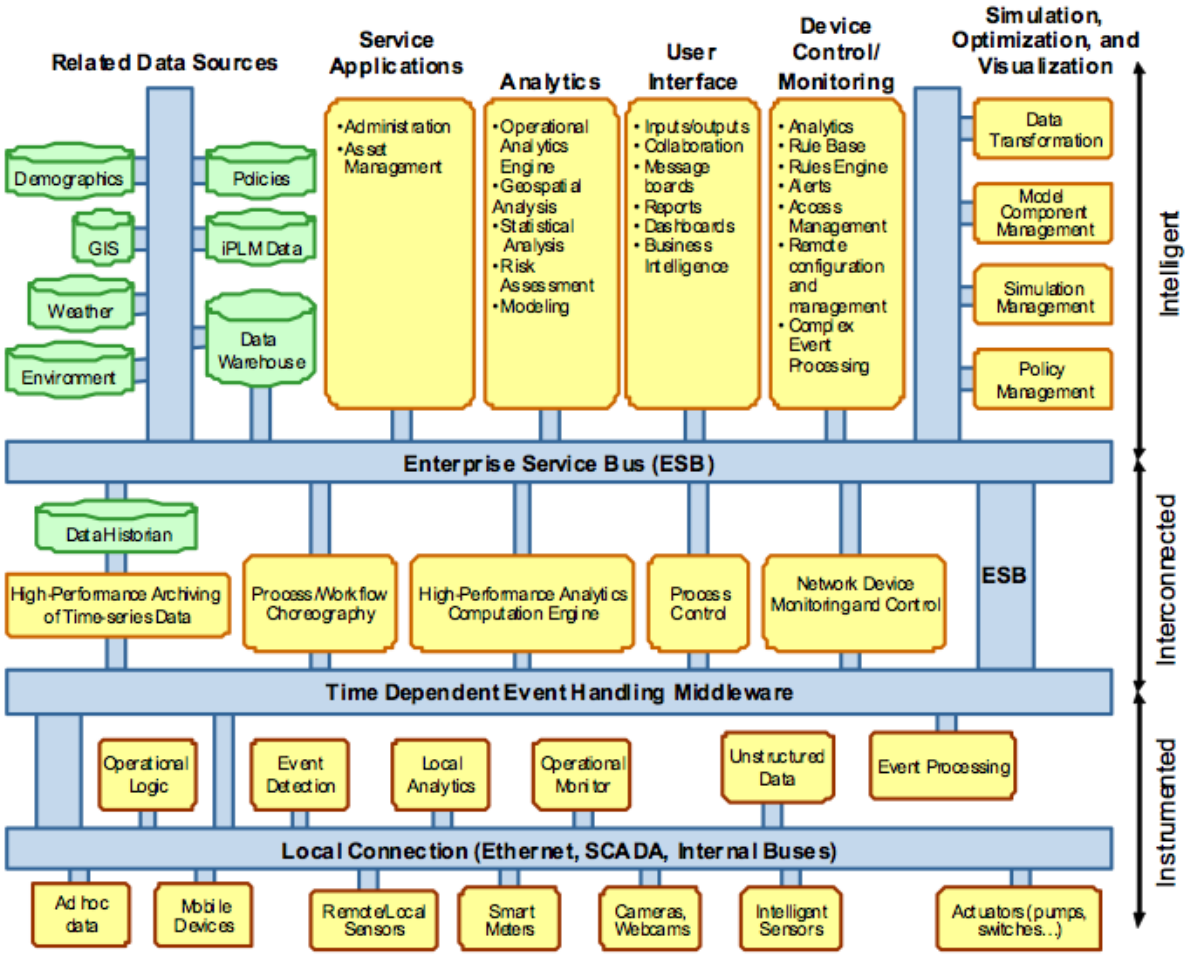
Event-processing software derives business-relevant events from the raw stream of sensor inputs, and integration middleware brings these events into the required context, enabling insight into the actual behavior of real-world operational systems.

- **Intelligence**

Using available data, aligned with further enrichment from the integration of systems, mathematical algorithms and statistical tools can be harnessed to provide deeper insight into city events. Outcome prediction, scenario modeling, and simulations can be performed to aid risk management and provide for more informed decision making.

Figure 13 shows the various components at the layers that are applicable to building smarter cities solutions. This high-level component diagram was developed to show services that can help in the operation of a city and its domains.

Figure 13 : SMARTER CITY COMPONENT DIAGRAM



Source: Harrison et al , 2011.

The instrumented layer (*lowest layer in Figure 13*) has various data sources including sensors, meters, cameras, and unstructured data. These data sources measure and feed data back to systems, such as Supervisory Control And Data Acquisition (SCADA[1]), which monitors and controls particular functions. The devices and products at this layer are provided by various companies that specialize in this area. The activities found at this level can measure water quality, collect electrical meter readings for a grid, or provide building measurements to determine its energy usage. Aspects of this data can be sensed and used to generate events and alerts, which in turn, can be published by using an enterprise service bus (ESB[2]).

The interconnected layer (*middle layer in Figure 13*) adds event services that map various inputs (as identified in the instrumented layer) into events of interest. This data can be combined with other event-related information occurring throughout the city or domains to create a rich source of data that can be used to enhance decision making.

The intelligent layer (*upper layer in Figure 13*) processes relevant city data in a broader context to identify city-relevant events that need to be analyzed or acted upon. A service-oriented architecture (SOA)-based model, along with existing applications and management systems, is used to transform data and perform analysis. Analytics along with additional related data (such as weather) can be applied to provide further insight. This layer includes user or role-oriented capabilities, where data and information are displayed by using various types of user interfaces, such as dashboards. Accessing this data and information with intelligence applied to it can ensure that the users can take action and make informed decisions.

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[1] *SCADA (supervisory control and data acquisition) is a type of industrial control system (ICS). Industrial control systems are computer controlled systems that monitor and control industrial processes that exist in the physical world. SCADA systems historically distinguish themselves from other ICS systems by being large scale processes that can include multiple sites, and large distances (Lemos,2006).*

[2] *An enterprise service bus (ESB) is a software architecture for middleware that provides fundamental services for more complex architectures. n essence, ESB does for distributed heterogeneous back end services and applications and distributed heterogenous front-end users and information consumers what middleware is really supposed to do: hide complexity, simplify access, allow developers to use generic, canonical forms of query, access and interaction, handling the complex details in the background.*

4.3.1 Understanding Technological Layer

Understanding the instrumented layer

The instrumented layer is made up of sensors, actuators, programmable logic controllers (PLCs), and distributed intelligent sensors. This technology is based around control engineering and has a large amount of physical infrastructure. Currently, communication between the controller and the sensor and actuators is achieved by using field buses and other interfaces.

The technology has evolved to allow for wireless connection to the sensors and actuators from the controller. Wireless communication means that sensors and actuators can be placed in an environment without the need of physical wiring. Data that is captured from these sensors is numeric and is used in a logical manner. Sensor data is becoming more sophisticated with video and digital signal processing.

This layer includes the following key capabilities:

Data capture and control

– Integrate a wide range of sensors and devices

– Provide the ability to collect and move data

– Execute local commands to take action

– Run distributed operational logic

Manage distributed device infrastructure

– Provides the ability to manage devices and sensors

– Offers remote configuration and management of devices

– Provides the ability to monitor and provide security of these devices and their data

Understanding the interconnected layer

Domain control systems are designed with a specific task in mind. In a city, many hundreds or even thousands of control systems can exist simultaneously performing their dedicated tasks. For

example, most traffic light intersections are stand-alone control systems based on a programmable logic controller (PLC) system.

To monitor the domain effectively, a clustering of all these individual systems is required, which is performed at the interconnected layer. The data from individual domain control systems and other data sources are linked together and transformed into event-related information. This information is then sent to the intelligence layer for further processing by using an information bus, commonly called an enterprise service bus. With the ESB, the data for various sources can be propagated to the higher-order BI[3] and BA[4] systems.

This layer includes the following key capabilities:

Event processing and services

– Event and stream processing

– Data identification, aggregation, and association

Data modeling and integration

– Domain-specific information models

– Interoperable information framework

– Integration with existing data

– Federated data management

Process integration

– Extend existing systems and enable new business processes

– Monitor business processes

– Provide information to systems and people

---

[3] *Business intelligence (BI) is a set of methodologies, processes, architectures, and technologies that transform raw data into meaningful and useful information. BI can handle large amounts of information to help identify and develop new opportunities. Making use of new opportunities and implementing an effective strategy can provide a competitive market advantage and long-term stability (Rud l, 2009).*

[4] *A Business Analyst (BA) is someone who analyzes the existing or ideal organization and design of systems, including businesses, departments, and organizations. BAs also assess business models and their integration with technology.*

Understanding the intelligent layer

The intelligent layer has undergone the most change as applications and software are developed to take better advantage of the information provided by the interconnected layer. Significant technology developments have occurred in BI, BA, optimization, event management, and rules engine applications to greatly improve the ability to analyze data and visualize information at this level. The key to designing this layer is to understand the city requirements and city policies, because this layer provides the tools and user interfaces (access to the applications and data) for the city officials.

This layer includes the following key capabilities:

Analytics

- Domain-specific analytic applications
- Application of mathematical models
- Performance dashboards and key performance indicators (KPIs)

Business optimization

- Model business processes for optimization
- Application of optimization techniques
- Optimizing asset usage and streamlining business processes
- Improve operational logic and business rules

Business process services

- Event-driven SOA processes
- Sense and respond dynamics
- Enterprise application integration
- Alignment with city policies

4.4 SOCIAL INFRASTRUCTURE

The technological dimension, however, is a mean to Smart City, not an end. An IT infrastructure and related applications are prerequisites, but without real engagement and willingness to collaborate and cooperate between public institutions, private sector, voluntary organizations, schools and citizens there is no Smart City [Lindskog, 2004].

Once that the governance and the technological dimensions have been analysed, the third fundamental pillar to successfully build the Smart City's foundations refers to the Social Infrastructure. This building block can be decomposed in two different domains: education-related initiatives and digital inclusion. Only implementing a technological infrastructure (under the conditions expressed above) is not enough to successfully build the Smart City; citizens must be also involved in the process of growth. As it will be clearer analysing our Riverside case study, the whole population have to be given of the instruments, have to be "educated", and there is a growing need to provide them the data and the information in order to get them involved in this huge innovative plan.

Social infrastructure (intellectual capital and social capital) is indispensable endowment to smart cities. That infrastructure is about people and their relationships. Smart city is a mix of education/training, culture/arts, and business/commerce, and a hybrid mix of social enterprises, cultural enterprises, and economic enterprises [Barlett, 2005]. Stronger approaches to increase awareness among inhabitants, education and leadership, offer services that are accessible to all of the citizens, to get rid of barriers related to language, culture, education, skills development and disabilities (Coe et al, 2001). Social learning soothes the digital divide concern for those who lag behind the prevalent use of new technologies. Education and training related actions should develop IT skills, nurture knowledge workers, facilitate the environments of social learning, and improve IT training in schools, organizations and industries [Cairney et al, 2000].

In agree with the intelligence forum (www.intelligentcommunity.org), when we talk about digital inclusion, we're really talking about prevent digital exclusion. As broadband deploys widely through a community, there is serious risk that it will worsen the exclusion of people who already play a peripheral role in the economy and society, whether due to poverty, lack of skills, prejudice or geography. Deeper exclusion increases income inequality and all of the ills that go with it, while raising yet another obstacle to social mobility.

Typically, communities seek to promote digital inclusion through programs addressing:

Access. When local governments conclude that market failure is preventing some segments of their population from having access to broadband, they respond by building networks or partnering with private-sector carriers to reduce business risk to acceptable levels.

Affordability. Even when broadband is available, the cost of the computer and connection can be out of reach for some parts of the population. Communities typically respond by providing free access to computers and connections at public sites like libraries and community centers, as well as by subsidizing computers and connectivity for target groups.

Skills. A computer and broadband connection are useless without the right skills, ranging from basic literacy to keyboarding, PC literacy and facility with the Web. Communities respond to a skills gap with training programs for every age group in schools, libraries, community centers and special purpose facilities.

Despite improving the quality of education itself, the digital inclusion principle should also aim at a cost reduction. "The introduction of PCs and the internet will increase access to educational resources for those in rural areas or those who cannot be full-time students. Likewise , the use of digital content and collaboration technologies can improve the quality of education , at more convenience , at a lower cost" [Washburn et al, 2010].

4.5 SMART CATEGORIES

Finally, as the last dimension of our framework we include the delivery of smart information services. Summarizing, we have already defined all the enabling components to achieve this status, that in our opinion represents the huge agglomeration of the components of the Smart City Value.
In fact, the final goal of a Smart City is to provide smart services [Giffinger et al. 2007] across the city's critical capabilities. In order to provide a useful taxonomy to describe these services I conducted a study in collaboration with the BIG Group and particularly together with Giovanni Maccani (practitioner in the Smart City field). Here we went across the literature we had previously collected to check which domains have been chosen and find a reference for our taxonomy. In total 31 contributions between journal and conference papers and corporate reports, were taken into account. The process was really time consuming and we propose here a summary table of the study (Table 4).

Table 4 Domains summary table

Domains Aggregated view / **References**	Type of source	Energy	Water & Waste	Utilities	Environment	Smart Food	Mobility	Built Environment	Healthcare	Economy & Commerce	Government / Municipality	Social Capital	Community	Tourism and Culture	Entertainment	Shopping	Communication	Smart Living & Public Safety	Education	Research / Universities	Agriculture	**% of domains covered**
[Abdulrahman, 2012]	Journal Papers	x	x	*	*	x	x	x	x													**40.00%**
[Caragliu et al. 2011]	Journal Papers							x		x	x	*	x	x	x			*	*			**45.00%**
[Dodgson et al. 2011]	Journal Papers	x	x	*	*		x			x	x	x	*				x	*	*			**60.00%**
[Lombardi et al. 2012]	Journal Papers	*	*	*	x				*	x	x	x	*					x	*			**55.00%**
[Naphade et al. 2011]	Journal Papers	x	x	*			x		x		x							x	x			**40.00%**
ARUP [2010]	Corporate	x	x	*	*	x	x															**30.00%**
IBM [2009]	Corporate	x	x	*	*	x				x		x	*				x	*	*			**55.00%**
CISCO [2012]	Corporate	x	x	*	*		x	x			x							*	*			**45.00%**
OVUM [2011]	Corporate	*	*	*	x			*	x	x	x	x	x					*				**55.00%**
IBM [2011]	Corporate	*	*	*	x		*	x		*	x	x	*					*				**55.00%**
EU [2011]	Corporate						x	x	x		*	*		x	x	x	x	x	x			**55.00%**
SIEMENS [2007]	Corporate	*	*	*	x		x		*	x	x	x	*		*			x	*			**65.00%**
FIREBALL [2012]	Corporate	*			*		*	x	*	x	x			*				*	*			**50.00%**
THINK! [2010]	Corporate	*	*	*	x		x		*	x	x	x	*		*			x	*			**65.00%**
FORRESTER [2010]	Corporate	*	*	x	x		x	x	x		x	*						x	x			**55.00%**
ALCATEL [2012]	Corporate	*	*	x	x		x	x	x		x	*						x	x			**55.00%**
PURPOSE [web]	Corporate	x	x	*	*		x	x	x		x	*						x	x			**55.00%**
SCHNEIDER [web]	Corporate	x	x	*	*		x	x			x											**35.00%**
ROBINSON [web]	Corporate	*	*	x	*		x		x	x	x	x		x				x	x			**60.00%**
PIKE [web]	Corporate	*	*	x	*		x	x			*											**35.00%**

ICOS [web]		*	*	x	*			*		x	x						x			40.00%
HITACHI [web]		x	x	*	*		x			x				x			x		x	x	50.00%
NET!WORKS [web]		*	*		x		x		*	x	x	x	*		*			x	*			60.00%
[Alawadhi et al. 2012]	Conference Papers	*	*	*	x			x		x	x	*	x								45.00%
[Angoso, 2009]		x	x	*	*		x		x		*							x				40.00%
[Chourabi et al. 2012]		*	*		x			x		x	x	*	x					*				45.00%
[Giffinger et al. 2007]		*	*	*	x		x		*	x	x	x	*	*				x	*			65.00%
[Lee, 2012]			*		*			x			x	*	x									30.00%
[Nam et al. 2011]											x	x	*									15.00%
[Steinert et al. 2011]								x			x	*	x					x				25.00%
[Schaffers et al. 2011]		x	*	*	x				x		x	x	x				x	x				50.00%
INTEL - DCC		x	x	*	x		x	x	x	x	x		x					*	x			60.00%
% considered		87.10%	87.10%	77.42%	87.10%	9.68%	67.74%	58.06%	54.84%	58.06%	90.32%	64.52%	54.84%	16.13%	16.13%	3.23%	16.13%	77.42%	48.39%	3.23%	3.23%	

Note: *: either considered within the domain, or explicitly defined as a "sub-domain".

In particular we developed a concept matrix in which all the domains chosen to taxonomies services were listed and related to the corresponding author. As an approximated measure of the exhaustivity of each classification we provide the percentage of domains covered in relation to all the domains defined (very first row in the table). In order to narrow down this study, we define three main ranges of domains in relation to the percentage of the sources that considered in its work that particular domain (see last row of the previous table). In particular the 3 categories are:
1st class domains (must be considered): Energy, Water & Waste, (Utilities), Environment, Mobility, Government / Municipality, Social Capital, Smart Living and Public Safety;
2nd class domains (should be considered): Built Environment, Economy / Commerce, Healthcare, Community, Education;
3rd class domains (might be considered): Smart Food, Tourism and Culture, Entertainment, Shopping, Communication, Research / Universities, Agriculture.

As a result of this analysis (describe the entire systematic process here would take too much space/time) we identified the best taxonomies (highlighted in green within the table). We found them to be better compared to our initial proposal (the row highlighted in red). Anyway, the three

best contributions in terms of exhaustivity are different adoptions and interpretation of the most famous one that is from [Giffinger et al. 2007] (see figure 6 in paragraph 2.2.2).

4.6 ANALYSIS OF THE DOMAINS

In this paragraph will be analyzed the six critical components of a Smart City [Giffinger et al, 2007] and for each of them will be defined the tergets, the critical success factors and the contribution that ICT can make in their development.

table 5 : MAIN TARGETS WITHIN THE DOMAINS

DOMAINS	***TARGETS***
Smart Living	• Improve city's inhabitants' quality of life [Hall, 2000], • Improve healthcare sector [Washburn et al. 2010], • Improve public safety [Witters, 2012].
Smart Environment	• Decrease city's carbon footprint [Angoso, 2009], • Implement advanced waste management practices [Maloney, 2011], • Increase water [Venkatesen, 2010] and energy supply efficiency [Stancic 2009].
Smart Mobility	• Reduce traffic congestions [Mulligan, 2010], • Enable Intelligent Transportation Systems [Chen-Ritzo et al. 2009]
Smart People	• Improve educational sector [Toppeta, 2010].
Smart Economy	• Increase employment rate [Lombardi et al. 2012], • Define new business models to attract companies for a Sustainable conomic growth [Doobs et al. 2012].
Smart Governance	• Provide efficient and transparent e-government services [Chourabi 2012].

4.6.1 Smart Living

WHY SMART LIVING?

- "By 2030 12% of worldwide population will be +65 generation (from 7% in 2010). Hence, new health-care and elderly-care solutions are needed" [IBM Smarter City Program, 2010];
- "A Smart City has to be safe; a smarter safety initiative allows to anticipate, rather just react, to problems" [Mulligan 2010].

CRITICAL SUCCESS FACTORS:

- I ncrease health-care and elderly-care services availability, increase citizens' quality of life and satisfaction, (IBM Smarter Cities Program).

IT CONTRIBUTION

- Usage of data that can predict where and when crimes will take place. "What is needed is a timely enough manner to make the difference" [IBM Smarter Cities Program;]. Firemen: info can give insights into the ways that fires occur (buildings, plants, manufacturing places). Info are collected and then integrated into some analytical tools. The results are predictions on where those things are more likely to occur (IBM Smarter Cities Program).
- ..To feed real-time information to fire and police departments. (Washburn et al, 2010).
- Cities are planning to make a public safety network that includes a first responder network, emergency dispatch and coordination, closed-circuit television (CCTV) and video analytics, the ability to create a virtual command centre, and real-time geolocalization information [Washburn et al,2010].

Smarter Healthcare System:

A Smart healthcare system is built on scalable storage systems and a communication platform. Hence, patient records are electronically stored and shared wherever they are needed. The communication platform enables quick response to emergency services. Video-conferencing technologies facilitate remote medical centre services to patients' homes, for those who can not travel to hospitals [Washburn et al, 2010].

4.6.2 Smart Environment

To better face this topic, it will be divided in three parts:

- **Smart Energy**
- **Smart Buildings**
- **Smart Water Management**

Smart Energy

WHY SMART ENERGY?

- Cities consume 75% of world energy [BOMA 2006];
- Through Smart Grids, globally could be reduced carbon emissions by 2.03 Gt CO2e (worth € 79 billions) [Steinert 2011];
- The world marketed energy consumption is projected to increase by 44% from 2006 to 2030 (and will increase by 73% from BRIC countries) [EIA: Energy Information Administration, US].
- energy accounts for the largest portion of GHG emissions (29%) [McKinsey Smart 2020 Report].
- ***CRITICAL SUCCESS FACTORS:***

  Energy efficiency, integration of renewable sources;

IT CONTRIBUTION:

"Energy generation and distribution use 1/3 of all primary energy. ICT could make electricity generation more efficient by 40% and its transportation and distribution by 10%" [Stancic, 2009].

- **Smart Grids:** is an electrical grid that uses information and communications technology to gather and act on information, such as information about the behaviors of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity (U.S. Department of Energy. "Smart Grid / Department of Energy" 2012).
- **VPP (Virtual Power Plant):** a virtual power plant is a cluster of distributed generation installations (such as microCHP, wind-turbines, small hydro, back-up gensets etc.) which are collectively run by a central control entity.

  The concerted operational mode delivers extra benefits such as the ability to deliver peak load electricity or load-aware power generation at short notice. Such a VPP can replace a conventional power plant while providing higher efficiency and more flexibility. Note that more flexibility allows the system to react better to fluctuations. However, a VPP is also a complex system requiring a complicated optimization, control, and secure communication methodology(Fang et al, 2011).
- **SCADA.** Acronym for **s***upervisory* **c***ontrol* **a***nd* **d***ata* **a***cquisition*, a computer system for gathering and analyzing real time data. SCADA systems are used to monitor and control a plant or equipment in industries such as telecommunications, water and waste control, energy, oil and gas refining and transportation. A SCADA system gathers information, such as where a leak on a pipeline has occurred, transfers the information back to a central site, alerting the home station that the leak has occurred, carrying out necessary analysis and control, such as determining if the leak is critical, and displaying the information in a logical and organized fashion. SCADA systems can be relatively simple, such as one that monitors environmental conditions of a small office building, or incredibly complex, such as a system that monitors all the activity in a nuclear power plant or the activity of a municipal water system.
- **SMART METERS:** A smart meter is usually an electrical meter that records consumption of electric energy in intervals of an hour or less and communicates that information at least daily back to the utility for monitoring and billing purposes [Federal Energy Regulatory Commission Assessment of Demand Response & Advanced Metering]. The smart meter

records your use information multiple times a day---such as once per hour---and transmits this information to your utility provider. You'll be able to see when you use the most energy.

- **WAMs (Wide-Area Measurement System):** is a smart, automatic network that applies real-time measurements in intelligent, automatic control systems to operate a reliable, efficient, and secure electric transmission infrastructure. It provides operators with high-quality data and analysis tools to detect impending grid emergencies or to mitigate grid outages. WAMS will monitor the grid parameters in real time, facilitate calculating locational margin prices in real time to support market designs, and assist in providing customer price transparency.

Smart Buildings

WHY SMART BUILDINGS?

- Globally, through Smart Buildings, emissions can be reduced by 1.68 Gt CO2e (worth € 216 billions) [Steinert, 2011].
- Buildings consume 41% of worldwide energy and contribute for 21% in CO2 emissions. In London residential and non residential buildings account for 67% of city's CO2 emissions. In Dublin, energy audits find new buildings built with up to 30% of saving potential [Mulligan, 2010].
- Increasing energy efficiency of buildings globally would reduce energy demand by 20%, more than the global use of energy by shipping and air transportation combined [Doobs, 2012].
- Heating, Cooling, and lighting of buildings account for more than 40% of European energy consumption [Stancic, 2009].

CRITICAL SUCCESS FACTORS:

- Buildings energy efficiency, **LEED** Certification;

IT CONTRIBUTION:

- **BMS** (Building Management System) is a computer-based control system installed in buildings that controls and monitors the building's mechanical and electrical equipment such as ventilation, lighting, power systems, fire systems, and security systems, **LEED** (Leadership

in Energy and Environmental Design) encourages the usage of Smart Computing technologies, such as BMS to automate heating and cooling, and sensors to power down lights when not in use.

Smart Water Management

WHY SMART WATER MANAGEMENT?

- 60% of all water is allocated to domestic human use [Toppeta, 2010].
- by 2025 the water demand in municipal areas will increase by almost 80 billions cubic metres [Doobs, 2012].
- worldwide, 44% of people are living in water stressed areas, and it is expected to grow by 39% by 2040 [Dirks, 2009].
- freshwater consumption is expected to rise 25% by 2030due largely to the increase in population [Washburn, 2010].
- Through the usage of ICTs, water savings in cities could reach 50% [We Are Water Blog, 2012].

CRITICAL SUCCESS FACTORS:

- Increase awareness among users, locate inefficiencies, optimize usage.

IT CONTRIBUTION

"Through the usage of ICTs, water savings in cities could reach 50%" [We Are Water Blog, 2012].

- Water and Flood sensors.
- Tele detection by satellite in combination with semantic web sensors: for detecting leaks and breakdowns in real-time and chemical alteration of water.
- Communication Networks integrated to Information Treatment Systems: to enable water management in real-time.
- Systems for obtaining biogas (as well as electricity, heating, refrigeration) from waste water.
- Smart Grid.

4.6.3 Smart Mobility

WHY SMART MOBILITY?

- "Worldwide carbon emission from transportation could be reduced by 1.52 Gt CO2e (worth € 280 billions)" [Steinert, 2011].
- "In US, were lost $ 78 billions, because of 4.2 billions lost hours, wasted fuel and pollution. This percentage is growing by 8% per annum" [Dirks, 2009].

CRITICAL SUCCESS FACTORS:

- Enhance travellers information services, reduce transport needs and streamline logistic, reduce congestions, wasted hours and fuel.

IT CONTRIBUTION:

In London through a Smart Mobility initiative, have been achieved: "30% average drop in congestion, 37% average increase in traffic speed, 12% drop in particulate matter and nitrogen oxides, and a 20% decrease in fossil fuel consumption and CO2 emissions" [Washburn, 2010].

- ITS (**Intelligent Transport System):** Intelligent Transportation Systems include the application of advanced information processing (computers), communications, technologies and management strategies, in an integrated manner, to improve the safety, capacity and efficiency of the transportation system. ITS applications can generally be divided into the following eight major functional categories:
  1) Traveller Information Services (e.g. traveller advisory systems, etc.).
  2) Traffic Management Services (e.g. advanced traffic signal systems, freeway incident detection and management systems, etc.).
  3) Public Transport Services (e.g. electronic transit schedule information, GPS tracking of bus movements and locations, etc.).
  4) Commercial Vehicle Operations (e.g. weigh-in-motion, electronic truck clearance at vehicle inspection stations and border crossings, etc.).
  5) Electronic Payment Services (e.g. electronic toll payment, transit fare payment, etc.)
  6) Emergency Management Services (e.g. improving emergency vehicle response time by fleet tracking, route guidance and signal preemption, etc.).

7) Vehicle Safety and Control Systems (e.g. in-vehicle technologies such as on-board computers, collision avoidance sensor technologies, etc.).
8) Information Warehousing Services (e.g. traffic safety data collection, archived data management, etc.).

- computer-assisted simulation integrated with mathematical models to predict by comparing scenarios.

4.6.4 Smart People

WHY SMART PEOPLE?

- *"Creativity is recognized as a key driver to Smart City, and thus people, education, learning and knowledge have central importance"* [Boulton, 2012].
- "*A Smart City is also a Learning City, that is actively involved in building a skilled information economy workforce"* [Edvinsson, 2006].

CRITICAL SUCCESS FACTORS:

- Develop human resources and social capital, life-long learning systems.

IT CONTRIBUTION

" the use of ICT in education will increase access, improve the quality and experience, and reduce costs" [Washburn, 2010].

- The introduction of PCs and internet in delivering education, will increase access from rural areas as well as from those who can not be full time students. Other benefits would come from costs reduction and from the quality of the education itself.
- E-education solutions for a mpre consistent education and to eliminate urban/rural disparities.

4.6.5 Smart Governance

WHY SMART GOVERNANCE?

- "Governments are migrating away from the nation-state model of their politics, because cities are becoming important actors. More and more cities now have directly elected mayors, instead of political appointees" [Dirks, 2009];
- "City Leaders should create an environment favourable for smarter community services (e.g. e-health, e-government, e-business, intelligent transportation), and create a favourable environment for citizens and for their engagement/inclusion, extending their access to info and knowledge (e-education, e-learning)" [Steinert, 2011].

CRITICAL SUCCESS FACTORS:

- E-government 2.0, transparency, participatory government.

IT CONTRIBUTION:

- E-government, E-government describes the use of technologies to facilitate the operation of government and the dispersement of government information and services. E-government, short for electronic government, deals heavily with Internet and non-internet applications to aid in governments. E-government includes the use of electronics in government as large-scale as the use of telephones and fax machines, as well as surveillance systems, tracking systems such as RFID (Radio-frequency identification), radio tags, and even the use of television and radios to provide government-related information and services to the citizens.
- Optimize operational efficiency providing: an executive dashboard to show the overall status of a city's operation, and advanced analytics asset management and collaboration tools (insights via centralized information).
- Social media and crowd sourcing for more frequent involvement of all stakeholders in tactical planning and feedback on strategy. Internet saloons (training open spaces to combat digital divide of elder people) (Toppeta, 2010).
- Social gaming (like criticalcity.org), portals and collective involvement on good practice (e.g. StoptheFever.org, ClimateChange, GenerazioneClima), adventure-based learning, urban gardens (Toppeta 2010).
- Collaborative discussion groups (such as Ning, RCM:PartecipaMI, straight lines, E21-OpenDCN: citymap, barcamp, citycamp, Online Jam, etc.). Tools fore-democracy and

direct communication with public institutions, cultural sector and the third sector, online surveys & widely communicated results (Toppeta 2010).

4.6.6 Smart Economy

WHY A SMART ECONOMY?

- "By 2025 urban consumers are likely to inject around $ 20 trillion a year in additional spending into the world economy. Moreover, cities dominate the global economic activity because of powerful economic scale" [Doobs, 2012].
- "$ 10 billions investments in broadband communication, health care and energy grids, allowed the creation of 1 million new jobs in US alone" [Atkison, 2009].

CRITICAL SUCCESS FACTORS:

City competitiveness, sustainable growth, innovative business models, employment.

IT CONTRIBUTION

- Internet based temporary aggregation of services;partners and customers for creative solutions are achievable by Web 2.0 in SaaS[1] mode (Toppeta, 2010).
- Incubators linked to universities , chambers of commerce, analysis and consulting companis, professional services, etc..(Toppeta, 2010).
- Logistics systems of neighborhood for withdrawal orderonline (often associated with preference for biological and local goods) and lowered packaging impact (Toppeta, 2010).
- Complementary marketplace for jobs in not for profitorganizations (volunteermatch.org, socialidarity.it, etc), km0 and Fair-trade products, farmers' markets, bank of time, cooperative buying groups (or investment or production), micro-credit and social lending (e.g. ZOPA,Prestiamoci.it, Jak bank, Terzovalore.com, etc.), crowdbased fund raising, cash converters / swap shops, neighborhood e-auctions & bartering sites. (Toppeta, 2010)

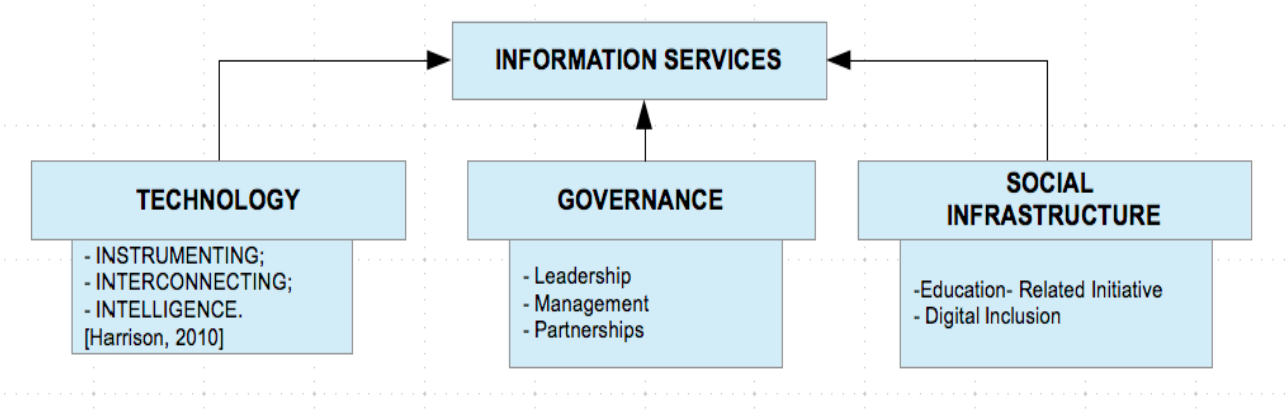
[1] Software as a service (SaaS, pronounced sæs or sɑs), referred to as "on-demand software", is a software delivery model in which software and associated data are centrally hosted on the cloud. SaaS is typically accessed by users using a thin client via a web browser.

Chapter 5:

RIVERSIDE PROGRESSIVE MODEL

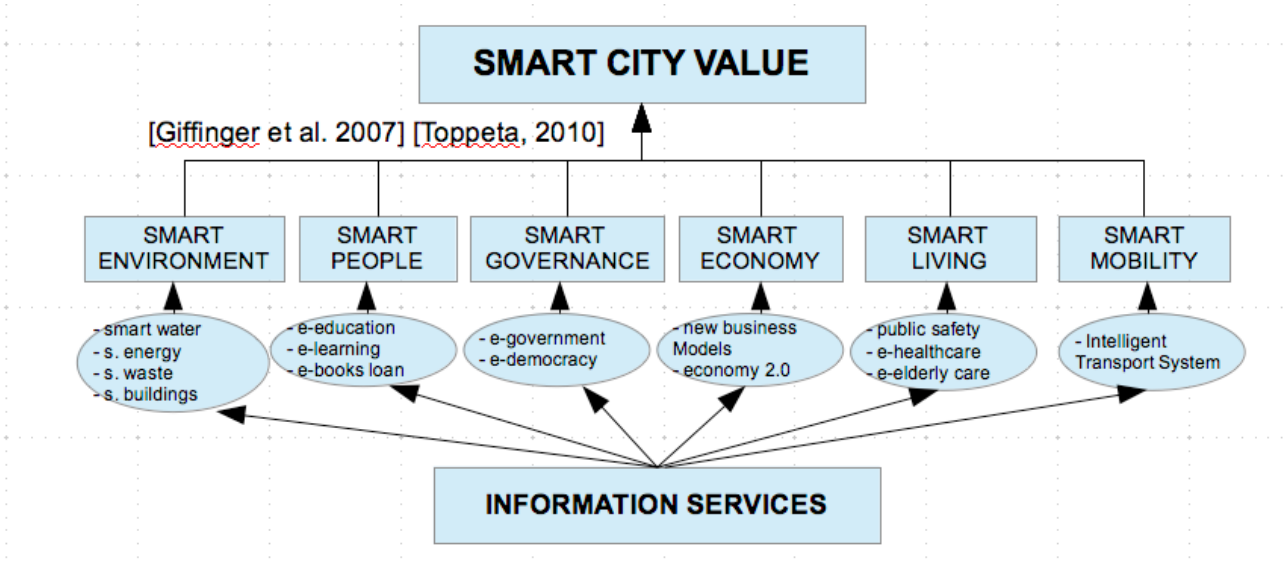
After the creation of a comprehensive framework, in this chapter will be analysed a real case of a city that in the recent years started a journey to become smart. The framework will be taken as reference to analyze this path and to subdivide all the initiatives and the services provided in their areas of competence. As mentioned in the previous chapter, the framework can be divided in two parts, the first one describes the supporting structure on which a city should leverage to start a smart journey (governance, technology and social infrastructure, see fig. 14), the second one describes the critical areas in which a Smart City is divided and represent an "output" that highlights the ICT services provided to improve efficiency and citizens' quality of life (see fig.15).

Figure 14: Smart City's Supporting Structure



I chose to analyze the real case of Riverside, a Californian city of about 300 000 inhabitants, that in 2012 was elected as "Intelligent community of the year" by Intelligent Community forum. In the first part of this chapter will be analyzed all the main initiatives and the strategic plans adopted in the City in a range of 8 years so as to shape a progressive model that underline in a schematic way how every supporting part of the city was involved. In the second part will be analyzed the ITC services provided to improve efficiency of the city, and will be linked with official statistics that support this change.

Figure 15: Smart City's service-oriented approach



5.1 WHY RIVERSIDE?

Riverside is located in the heart of Southern California's inland region, 60 miles west of Palm Springs and 50 miles north-east of Newport Beach. It is a hilly community of 303,871 people making it the 61st most populous city in the United States and 12th in California. With 55,000 enrolled in one of four higher education institutions, Riverside is truly a college town. In the 1980's and 90's the Riverside region was marketed for low real estate prices and inexpensive electricity. This made Riverside a prime candidate for the booming logistics/warehousing industry, housing, large retail centers and other land-intensive low-technology businesses. However, this low-tech sector also brought with it low-wage services, low median per capita income and a relatively low number of residents with college degrees. By 2000, the City's commercial environment had become warehouse centric supporting the nearby Ontario Airport expansion and two major railroads that carry 120 trains per day of payload from coastal ports through Riverside to locations across the country. The warehouses brought jobs to this region, but not the quantity or higher paying positions the City of Riverside was seeking. A study commissioned by Riverside's Mayor and City Management in 2004 concluded that high technology businesses with their high paying jobs were not locating in Riverside because of the shortage of skilled labour, a state government that was making doing business in California difficult, the presence of few existing high technology companies, and no comprehensive plan to attract or to grow them. By 2004, customer satisfaction at the departmental level was at an all time low and trust between the outsourcer and City departments was non-existent. The datacenter was a mess, city departments were doing their own thing, customer service requests and complaints were poorly handled and status updates took hours or were not available at all. No awards

were won as the City lacked technical sophistication.. Police, Fire, Community Development, Utility and other departments were not using IT and Communications Technology as competitively as their peer cities. The IT Department was struggling and not involved with Riverside's high technology community et all. Even though each had outstanding innovative talent, City, university and business communities were not focused on how they could work together in leveraging technology to create a more vibrant, attractive community. By 2005, the City had grown by 100,000 residents in 15 years and surpassed the ability of management to deal with City's size and growth rate. Elected officials expressed frustration that the City was not keeping up with growth. Facilities were not well maintained and services were not meeting customer needs. Streets were not repaved or repaired in a timely manner and medians were mostly dirt with no landscaping. Graffiti had also become a problem. The City did not have a good reputation as a place to live or work, smog and traffic were perceived as huge problems, the Federal Government had to intervene in police operations, the high school dropout rate was way too high, and graduates and residents were seeking careers elsewhere.. It was clear that Riverside needed to change. To compete and thrive in the 21st century it needed a new sense of direction, a new image, new infrastructure, new technology, and new services. It needed to energize its economy, attract business, and increase the number of college degree residents. To do this would take a leadership team that could energize the entire community to work together toward a common purpose of re-establishing Riverside as an economic powerhouse and great place to live, work and enjoy. From 2004 in fact, the city, supported by his governance, started a journey to become Smart, with big investments in digital inclusions, becoming one of the most virtuous Smart City of the U.S. (first Smart City of the 2012 from the Intelligent Community Forum). Riverside is a interisting case study because of this metamorphosis, and the analysis and schematizacion of the main steps within a progression model could be a reference for future studies.

5.2 RIVERSIDE'S MAIN INITIATIVES

In the next paragraph the main Riverside's initiatives will be listed and subdivided in the respective areas of competence. This subdivision is not immediate and some initiatives will be reported in more than one category because they affect more framework's blocks. For instance, the "Seizing ur destiny campaign", which will be discussed later, is a online platform where every part of the city is involved (city leaders, university, businesses) to improve quality of life in a technological vision. Therefore in the framework blocks, "Seizing our destinity campaign" affect both the "technological" and " governance" part.

Dates and Statistics Sources

www.smartriverside.org

www.riversideca.gov

www. seizingourdestiny.com

www.intelligentcommunity.org

www.greenriverside.com

www.usa.com

www.city-data.com

wwwwww.riversideceos.org

wwwwww.rusdlink.org

wwwwww.riversidevirtualschool.net

5.2.1 Governance Initiatives

RTCF (Riverside Technology CEO Forum,)

In 2004 was created the Riverside Technology CEO Forum as an arena for Technology CEOs to network, discuss relevant topics and issues, and develop and deploy programs and action items of importance to the growth and prosperity of riverside's technology industry. In Collaboration with University of California, Riverside facilitated by Dean Tripathi, RTCF had their first meeting at Bourns College of Engineering (BCOE), UCR. Today, RTCF continues to have its monthly meetings at BCOE. BCOE was the first and most significant collaborator to the success of RTCF (more info on www.riversideceos.org).

HTTF (High Technology Taskforce)

In 2004, Riverside Mayor (Ron Loveridge) and Riverside Community College District Dean of Economic Development (John Tillquist) created the High Technology Taskforce (HTTF) to identify steps, programs and projects required to successfully transform Riverside into a High Tech knowledge based community.

HTTF included: government and university leaders, and CEOs from Riverside's research oriented high technology companies.

CIO (Chef Information Office)

In September 2005, Steve Reneker become the City's first Chief Information Officer (CIO). Steve came to the City with extensive leadership experience in city and county government, the private sector, industry associations and community organizations. Steve was charged with rebuilding and managing the Information Technology Department which included the outsourcing contract that provided Citywide IT resources.

SODC (Seizing Our Destiny Campaign)

The Seizing Our Destiny Campaign (www.seizingourdestiny.com) was born in 2009 when civic leaders and City officials came together to imagine a 20-year strategic vision that mobilizes the skills and resources of a broad cross-section of Riversiders toward one common goal – a better community for us all. From the beginning it was understood that Seizing Our Destiny must continually measure progress toward our vision of enhanced quality of life. Seizing Our Destiny is a community-driven campaign that builds on Riverside's existing strengths to create an even better place to live, work and play for future generations. Their goal is to improve quality of life, attract diverse and dynamic people, encourage innovation and work together for the common good. In 2009 the city council branded Riverside as the "City of arts & Innovation" and in 2010 approved "Seizing our Destiny", the Agenda for Riverside's Innovative Future as the City's strategic plan roadmap to the future. Every City Department, university, business and community organization embraced the strategy to revitalize Riverside, ignite its economy, and set the pace to establish the City as one of California's premier communities.

HTBD (High Tech Board of Directors)

To help ensure "Digital Inclusion" success, in 2007 CIO Steve Reneker recruited a high-tech community oriented SmartRiverside Board of Directors. They included leaders from the City, other local government agencies, high technology businesses, the chamber of commerce, universities and school districts, venture capital firms, and high tech hardware, software and services companies that includes the Assistant City Manager, three City Department Directors, President of the Chamber of Commerce, two School Superintendents, Dean of UCR's Bourns College of Engineering, Tech Coast Angel Chairman, five High Tech CEOs and regional leaders from Google, Apple, ACS/Xerox, AT&T, Cisco, Dell, EMC, ESRI, USI, Oracle, and Microsoft.

HTTF (High tech task force revision)

In 2008, the Riverside Technology CEO Forum (RTCF) revisited the HTTF initiatives, re-examined Riverside's competitive advantages, and recommended new focus on global competition, embracing technology businesses to also bring growth to traditional industry sector. Strategic recommendations adopted by City Council included:

1. Prioritize Sectors for Economic Development (IT, communications, renewable energy,biotech & medical technologies, and water & transportation infrastructure)
2. Nurture Local Technology Businesses
3. Create New Technology Businesses
4. Capitalize on the Local Talent Pool
5. Technology Businesses and City Hall:
    - Explore City Hall Technology Enhancements
    - Create a " Tech City Think Tank"
    - Engage Local Educational Institutions
6. Build Teh City Infrastructure

IE (Innovation Economy Initiative)

In 2010, the City of Riverside in partnership with UCR (University of California, Riverside) and Innovation Economy Corporation, a Riverside-headquartered innovation commercialization company, established the Innovation Economy (IE) Initiative. By working together, the IE Initiative brings together ideas, resources, people, money and processes to attract new high technology businesses, incubate new start up technology companies and create high paying local career opportunities in technology, bio-medicine, and environmental science. Since the signing of the initiative, Innovation Economy Corporation (IEC) has begun commercializing innovation. An agreement with the University of California, Riverside allows IEC to obtain the rights to Intellectual Property (IP) and research conducted by the university. IEC looks for IP that has the potential to transform those assets into high-value, world-wide game changing businesses by leveraging its experienced management team, best-of-breed commercialization processes and resources, access to worldwide markets, and ability to attract capital that supports the development of portfolio businesses and funding of new opportunities.

CiHi (California iHub Initiative)

In 2010, was launched the California's iHub Initiative, that provides a platform for regional innovation clusters to flourish. The iHub initiative allows business, academia, government, and venture capitalists to leverage such assets as research parks, technology incubators, universities, and federal laboratories in an effort to foster innovation as a state-wide job creation and community building tool. All this in collaboration with San Diego, in a joint force that will add a unique focus on the field of bio-mimicry. (http://www.business.ca.gov/Portals/0/AdditionalResources/Reports/Round%20II%20iHub%20Guidelines.pdf)

TIS (Technology Imperative Strategy)

In 2010, The CEO Forum developed a strategy paper called The Technology Imperative that became the City's roadmap to an innovative economy and led to the CIty changing its brand to the "CIty of Arts and Innovation". Riverside has consolidated data centres, reduced the number of its physical servers by more than 50% through virtualization and implemented PC Power Management Software saving more than 250000 kilowatt hours and 150 tons of CO2 per year. Its modern Emergency Operations Centre is the disaster recovery site and can withstand an 8.0 magnitude earthquake. Essential computing services such as Riverside Public Utility's revenue generating commodity trading system can be mirrored for fail safe operation (http://www.riversideca.gov/it/Innovation.asp).

C&G Task Force (Clean and Green Task Force)

To uphold Riverside's long-term commitment to going green, Mayor Ron Loveridge assembled the city's Clean & Green Task Force in 2005. Led by community members Bill Warkentin and Jane Block, the task force gathered regularly to help guide Riverside on its path toward greater sustainability.

The Clean & Green Vision

Sustainable Riverside maximizes energy efficiency and makes the most efficient use of resources, and minimizes negative environmental consequences. Above all, it means meeting the needs of its citizens while not degrading or destroying the natural and constructed systems that will sustain future generations.

SPS (Sustainability Policy Statement)

In 2007, the task force created a green visioning statement, one that would inform residents of Riverside's existing sustainability resources, build on the policies of the city's General Plan, ensure that the new green guidelines would be followed, provide a framework for sustainability pilot projects, and initiate partnerships among regional agencies and nearby cities.

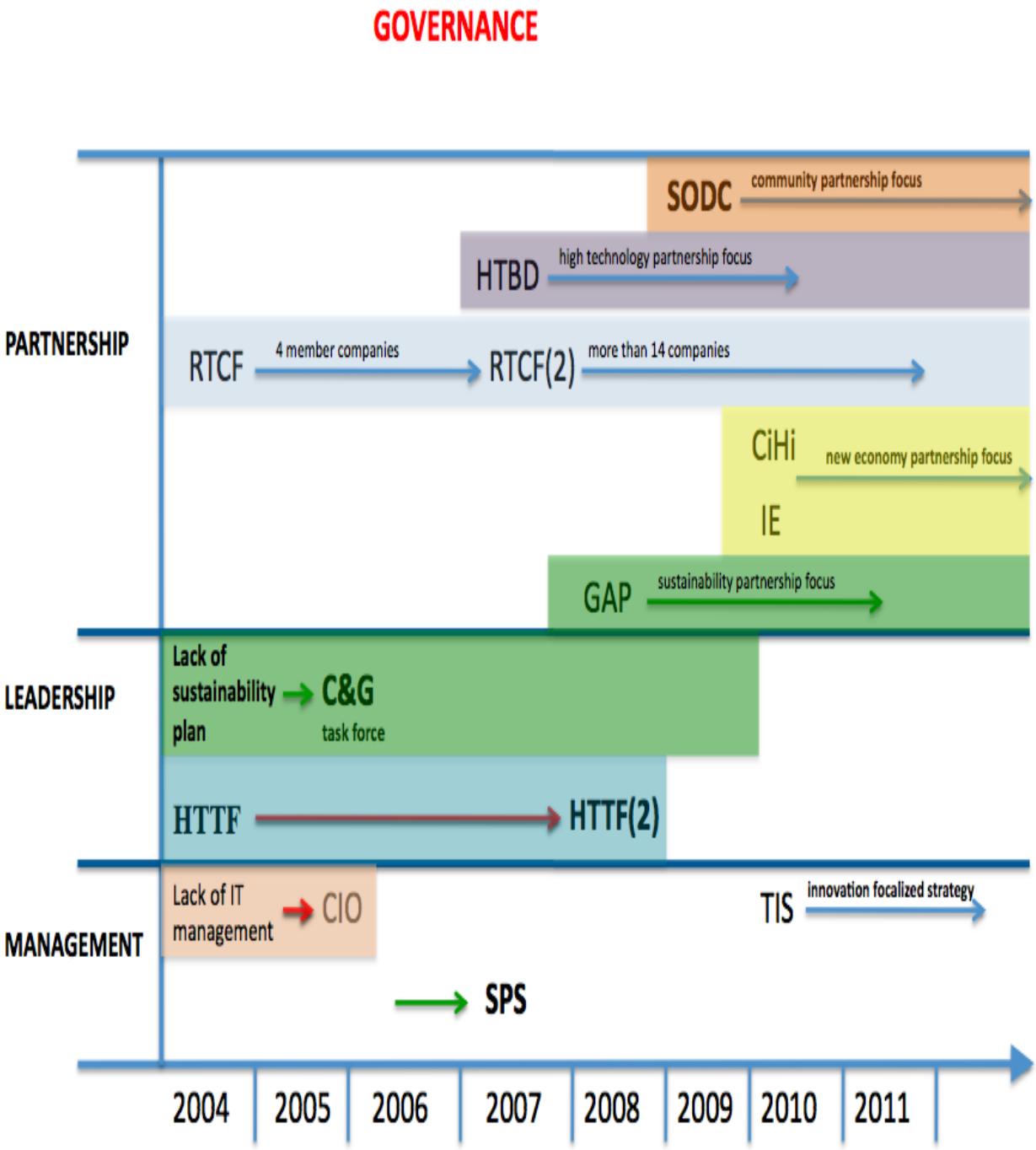
Calling it the Sustainability Policy Statement (SPS), the task force's new document featured eight main categories: Save Water, Keep it Clean, Make it Solar, Make it Shady, Clean the Air, Save Fuel, Make it Smart and Build Green. Not long after the policy statement had been approved and adopted by the Riverside City Council, the task force embarked on the creation of a guidebook, one that would tie specific tasks to the policies of the SPS. Calling it the Green Action Plan, the guidebook focused on seven key areas of city life: energy, greenhouse gas emissions, waste, urban design, urban nature, transportation and water.

GAP (Green Accountability Performance Committee)

To ensure that the tasks of the Green Action Plan would be carried out successfully, the city in 2008 formed a Green Accountability Performance (GAP) Committee, and within just two years nearly each of the plan's 38 tasks had been accomplished. As for the waste diversion goals of the plan, the GAP Committee began working with California's Department of Conservation (CDC) on its highly effective

recycling program. Thanks to this partnership, Riverside now diverts more than half of the city's waste away from landfills (www.greenriverside.com).

Figure 16 : Governance main initiatives



5.2.2 Social Infrastructure

DIP (Digital Inclusion Program)

In 2006, SmartRiverside initiated one of the most aggressive Digital Inclusion programs in the United States. The strategy is to use its citywide WiFi service to provide free technology training, free personal computers, free software, free wireless customer premise equipment (CPE) and free broadband Internet service to all of the City's more than 30,000 families. Wifi broadband speed of 500kbps (later upgrades to 1Mbps) is used to avoid potential carrier lawsuits while providing improved internet performance to underprivileged families. SmartRiverside's strategy is to partner with school districts, the Salvation Army, libraries and community centers to reach the entire 82 square mile city and provide services in both English and Spanish.

RUSD (Riverside Unified School District's)

in 2005 there is the creation of Riverside Unified School District's (RUSD), a virtual platform for the 43 schools in the Riverside Area, RUSD has provided 10,000 electronic mobile devices and digital textbooks for their students. All 2,100 Ramona High School students have digital textbooks with wireless connectivity to teacher websites. RUSD has established a STEM Academy (high school focused on science, technology, engineering and math), an all- digital high school, a nationally acclaimed virtual high school, the State‘s first School to Home program linking teachers, students and parents of 6th ,7th and 8th graders using laptop computers. RUSD provides 10,000 electronic mobile devices and digital text books for their students. RUSD's Ramona High School was the first in the state to have all 2100 students using digital (Coby Android) textbooks with wireless connectivity to teacher websites.. Carrying a tablet computer with a 7-inch screen is a lot easier than lugging around a backpack full of heavy textbooks — and more helpful too, Ramona High School students say. The tablets are used as dictionaries, keeping teacher notes, looking up words, learning foreign languages, learning graphs, equations, concepts and algebra, checking homework assignments, tracking GPAs and much more.

The most significant school2home result relates to the proportion of parents who knew how to access their child‘s information online and who had in fact done so. Before the training, only 27% of the parents knew how to access this information and only 5% had actually done so. After the training, 84% knew how to do it and more than half of the parents had actually looked up their child‘s records online.

(http://www.rusdlink.org/site/default.aspx?PageID=1)

CWS (Community workforce strategy)

In 2006 a Riverside 's coalition of city, school district, higher education, business and community stakeholders first order of business has been to re-assess every educational process and every segment of the population. Progress is regularly reported to City's "Seizing Our Destiny" website. Coalition members include Riverside 's Education Roundtable, Higher Education Business Council, Bill and Melinda Gates Foundation funded Completion Counts Project leaders and the Chamber of Commerce Business Education Partnership Committee. Community strategy to transform to a knowledge workforce is centred around five desirable industries (high-tech, biomedical science, nanotechnology, software, energy) that were chosen because of their potential to bring clean, green businesses, create high-paying jobs, attract knowledge workers, meet market demand and take advantage of Riverside's infrastructure. The coalition strategy has been to provide new innovative learning processes; lifelong learning for all; learning that supports career development and enhances personal growth; showcasing students and faculties work, discoveries, research and productions; linking residents with training ,job placement and retention services; and integrating the many resources in Riverside.

City strategy includes providing affordable, attractive, well located housing opportunities for technology professionals with nearby entertainment, cultural attractions, and opportunities for sports and recreation; sponsorships and support for high technology job fairs, conventions and events where employers can find local talent, and where technology professionals can discover Riverside; advanced Internet portals for local employment promotion, marketing and around-the-clock access to an array of educational, social and community services.

FWP (Free Wireless Program)

One of SmartRiverside‘s first major initiatives was a Citywide WiFi project to deliver free WiFi to all residents in Riverside. The City partnered with AT&T who expanded the network to cover 78% of the City‘s developed area (50 square miles) before transferring the network in 2010 to the City who contracted with US Internet (USI) to provide maintenance, enhanced performance, and improved customer service.

The WiFi program includes:

- **Video Security Projects** : a variety of applications have been implemented for parks, railroads crossings, city facilities. This is achieved through the use of permanent and mobile cameras placed where/when needed. The cameras can be set to trigger recording by series of events. Video is transmitted to the data center where it is stored and available for authorized viewing
- **In Car Video**: Public safety video is transmitted over the 4.9 GHz network to police headquarters where events are stored and available for review by authorized police records management staff.

- **Traffic Signal Control**: The City's traffic management system is designed to view signals for the progression of light timing to ensure a smoother traffic flow during peak traffic times and to signal real-time controls when traffic congestions exists.

DIP (Digital Inclusion Program)

In 2006, SmartRiverside initiated one of the most aggressive Digital Inclusion programs in the United States. The strategy is to use its citywide WiFi service to provide free technology training, free personal computers, free software, free wireless customer premise equipment (CPE) and free broadband Internet service to all of the CIty's more than 30,00 families earning less than $45,00 total income.

The Mayor and City Management quickly approved hiring a full time technician to start a Digital Inclusion program. Using 2000 Census data (avail then), about 10% of Riverside‘s population was at $45,000/year or under (low income). Policy was established to make the program available (including one free PC) to any household in this low income category (exception for foster children). The program initially focused on providing training at the City‘s Community Centers and paid college students to teach the classes using Microsoft literacy program materials. Microsoft provided the initial grant of $50,000 to pay these students but SmartRiverside needed to figure out how to self-sustain training after year one.

Riverside Unified School District contacted SmartRiverside within the first year and proposed a program to ensure that every student in their school system had a PC with broadband access at home. If SmartRiverside would provide PCs to their students first, they would provide all of the training at their school locations at no cost. SmartRiverside outfitted their labs so that students could use computers during the day and digital inclusion training could be done in the evenings, after school or on weekends. Within 2 years, every student in the system had internet access. As a result of these benefits the school was able to obtain grants that provided half their students with electronic books (tablet or netbook).

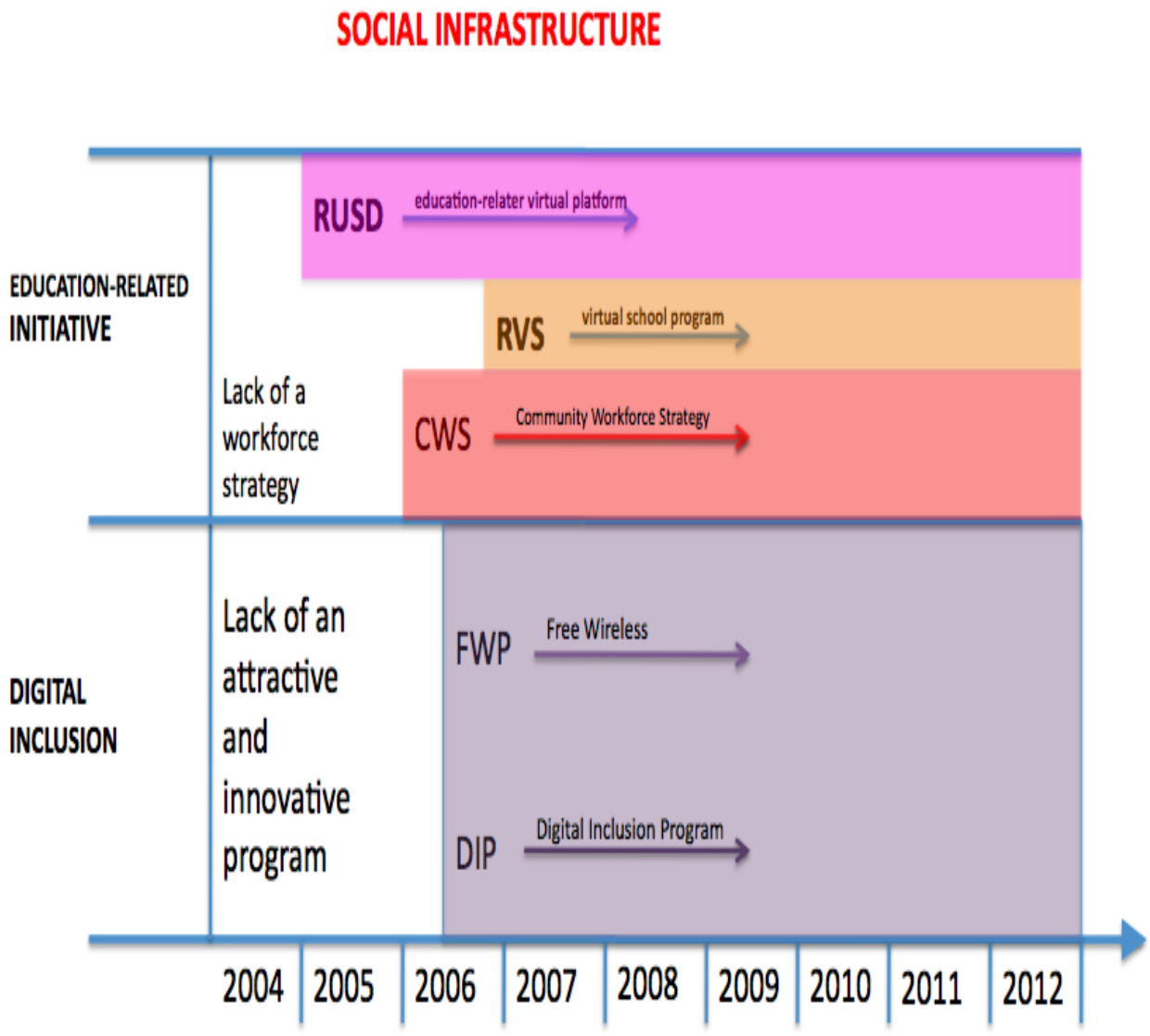
RVS (Riverside Virtual school)

Riverside Virtual School (RVS) was born in 2007 and is an accredited, tuition-free, public school offering high-quality, technology-rich interactive online classes for students within the Riverside Unified School District. RVS students benefit from the flexibility that online learning provides, including opportunities for course acceleration, unique enrichment programs, online mentors, virtual clubs and organizations, and access to learning 24 hours per day, seven days per week. RVS students can also participate in athletic team sports and fine arts programs (band, orchestra, theatre). Riverside Virtual School links include the North American Council for Online Learning (NOCOL) who facilitate collaboration, advocacy, and research to enhance quality K-12 online teaching and learning; and the

University of California Riverside‘s (UCR) digital resource program with websites, social networking and learning management all in one place. Technology courses include Cisco Academy, AP Computer Science, Web Design, Programming C++, and Programming Visual Basic.

(http://riversidevirtualschool.net/)

Figure 17 : Social Infrastructure Main Initiatives



5.2.3 Technology Initiatives

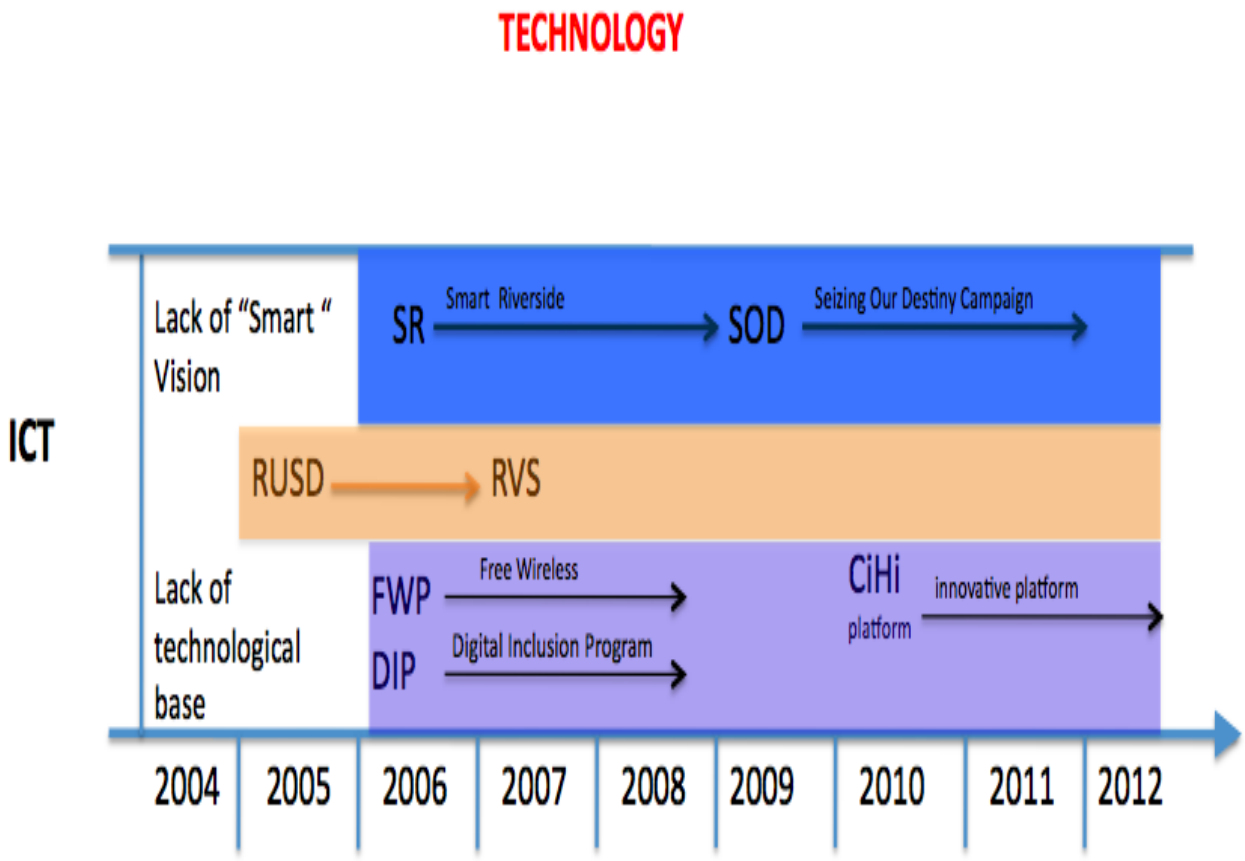
SR (SmartRiverside)

2006 is the year of the creation of SmartRiverside community (www.smartriverside.com), the CIO Steve Reneker was appointed Executive director, to create a platform that would provide broadband connectivity for all Riversiders as well as a host of innovative programs they could use to accomplish the goals recommended by the HTTF and adopted by City Council.

SOD, CiHi (see 5.2.1)

RUSD, RVS , FWD, DIP(see 5.2.2)

Figure 18 : Technology Main Initiatives



5.3 SERVICES

5.3.1 Smart Environment Services

Grease to Gas Project

The grease to gas initiative eliminates waste in the most cost-efficient and environmentally friendly way by turning it into energy. Through this project, the city of riverside intends to reduce dependence on purchased energy. Grease discharge from restaurants used to be a major cause of sewer overflows. With limited options, the city of riverside successfully crafted an award-winning alternative to dispose of this waste. The grease to gas project uses grease collected from restaurants and adds it to the anaerobic digestion process. This process allows microorganisms to feed on the solids of sewer and grease waste in order to create methane gas that can be treated and used for power. On April 27, 2005, the city began the Grease to Gas project.

Green Riverside

ON 2005, a task force was created to highlight Riverside's need for sustainable practices. The task force responded with the 2007 Sustainability Policy Statement (SPS), (see paragraph 5.2.1) a seminal document with eight categories: Save Water, Keep it Clean, Make it Solar, Make it Shady, Clean the Air, Save Fuel, Make it Smart and Build Green. Later that year, the SPS was officially adopted by Riverside's city council. As a result of this task force was created Green Riverside Come (www.greenriverside.com), a online platform that covers all the topics about Riverside sustainability plan.

E-Waste Program

SmartRiverside is a State Certified E-Waste (Electronic Waste) Collection Facility. Systems that do not meet the minimum requirements for the Digital Inclusion Program are disposed of by a State Approved e-Waste recycling center that pays SmartRiverside for the e-Waste material. The recycling and refurbishment of this material contributes to the operational costs of SmartRiverside, supplies low-income families with free computer systems and most certainly assists in protecting our environment in accordance with our nation's Green Initiatives. The center recycles 200tons of computer and electronic equipment each year and uses the revenue from this program to help pay for the 150 free refurbished PCs given away every month to low income families to help " bridge the City's digital divide". The E-waste is also tax deductible (http://www.smartriverside.org/ewaste/).

HET (High-Efficiency Toilets)

The High-Efficiency Toilet (HET) Incentive Program is a water conservation rebate program that offers Riverside Public Utilities' customers a chance to replace high water- use toilets, or upgrade Ultra Low Flush Toilet models with water-saving HET models. HETs are the new standard in water-efficient toilets and use only 1.28 gallons of water per flush (gpf) or less. There are also Dual Flush HETs that offer a separate, low water use flush for liquids that only use between 0.8 to 1.1 gpf.

WBIC (Weather-Based Irrigation Controller)

A Weather-Based Irrigation Controller (WBIC) is a sprinkler control device that automatically adjusts irrigation schedules in response to changing weather or environmental conditions. The WBIC rebate program provides rebates for residential customers who install these systems. Sensors on WBIC systems can tell the device if it's hot or raining and adjust watering times accordingly. Studies have shown that by using a WBIC a household can reduce their outdoor water use by about 20%. That translates into savings of about 40 gallons per day, or 14,600 gallons per year. Additionally, the health and appearance of landscape will likely improve, and runoff will be significantly reduced.

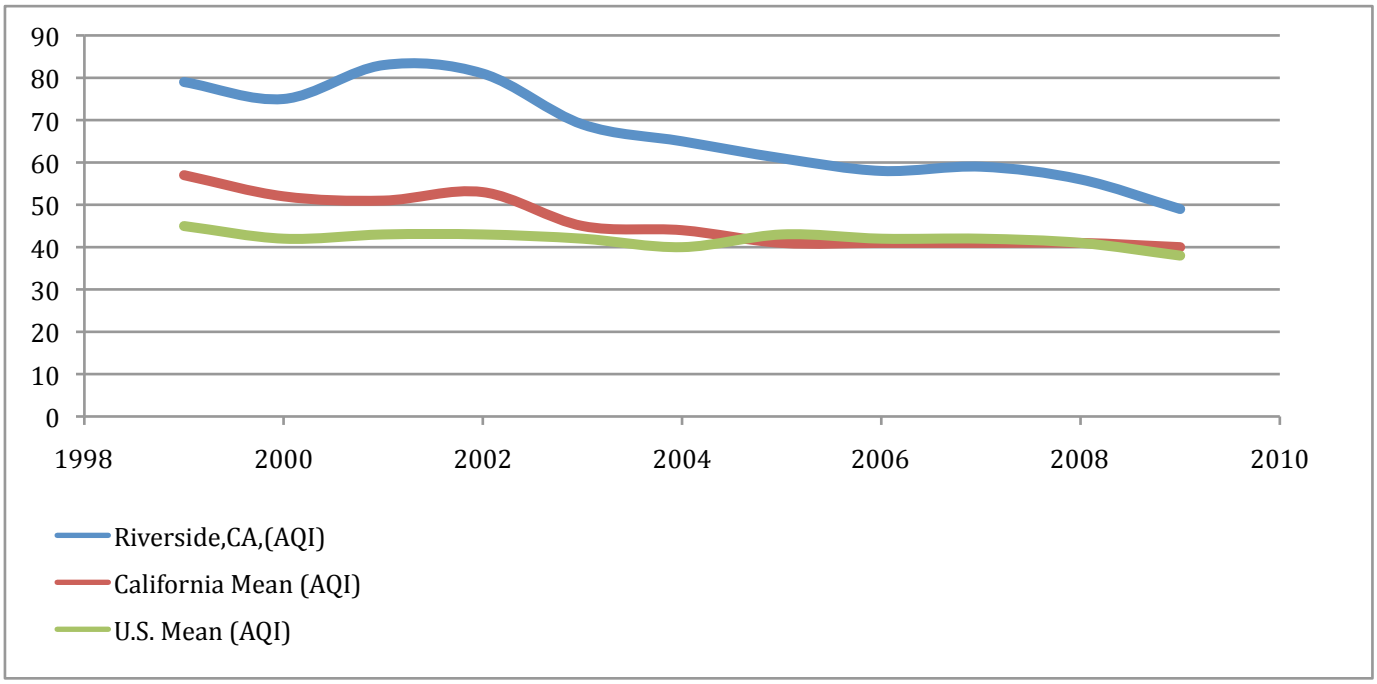
Pool Pump Billing Credit Rebate Program

Using your pool pump when energy demand is low can help keep electric rates down and reduce your impact on Riverside's electrical grid. This is especially true during the warm summer months when electricity use is high. In our effort to support energy conservation, Riverside Public Utilities is giving our residential electricity customers a $5 credit toward their monthly electricity bill for every month they use their pool pumps during off-peak hours.

Linked Statistics

Environmental Dates

Figure 19 : AVERAGE AIR QUALITY INDEX (AQI) BY YEARS

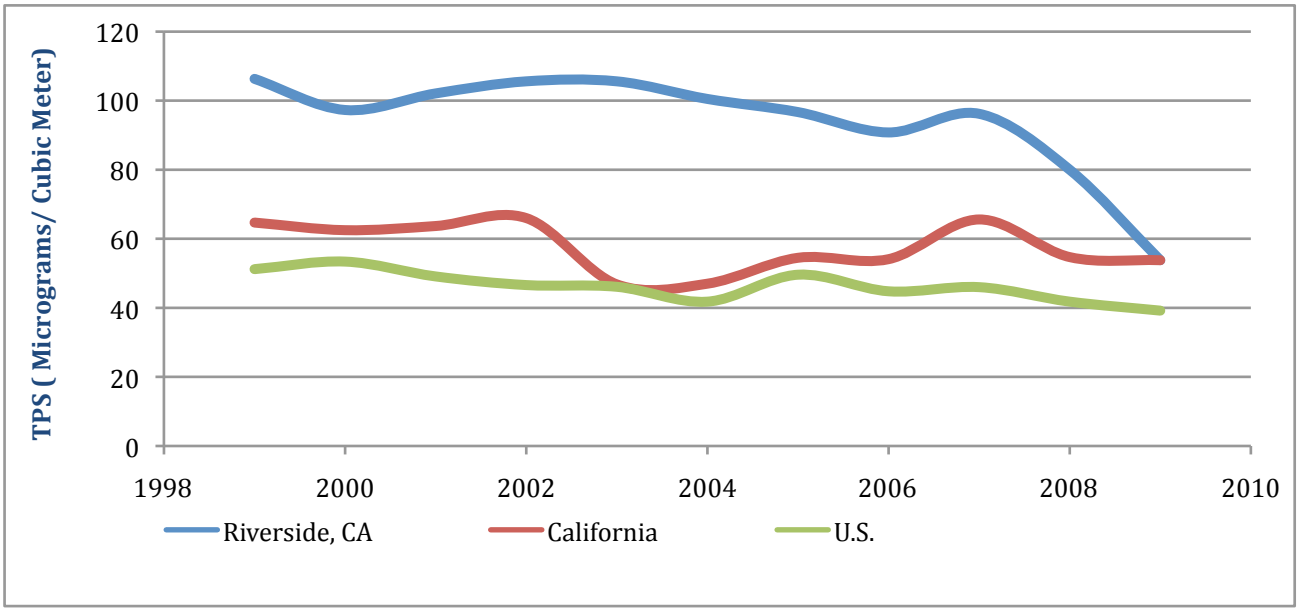


Source : www.usa.com/riverside

The United States Environmental Protection Agency (EPA) has developed an index which they use to report daily air quality. This Air Quality Index (AQI) is divided into six categories indicating increasing levels of health concern. An AQI value over 300 represents hazardous air quality whereas if it is below 50 the air quality is good.

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

Figure 20 : Average Total Suspended Particulate (TPS) by years



Source : http://www.usa.com/riverside-ca.htm

Tiny airborne particles or aerosols that are less than 100 micrometers are collectively referred to as total suspended particulate matter (TSP). These particles constantly enter the atmosphere from many sources.

Human sources include:

Motor vehicle use.

Combustion products from space heating.

Industrial processes.

Power generation.

Natural sources include:

Soil.

Bacteria and viruses.

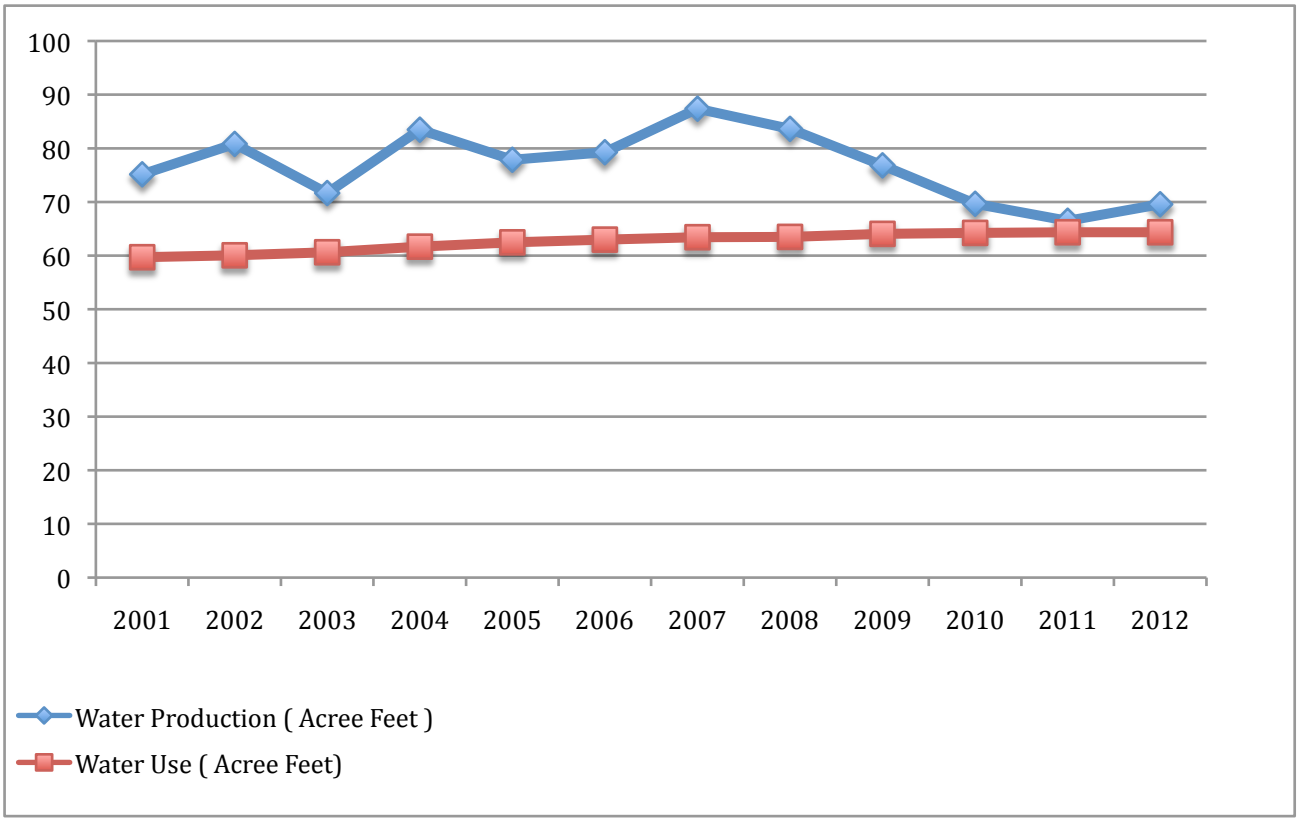
Fungi, molds and yeast.

Pollen.

Salt particles from evaporating sea water.

RIVERSIDE WATER PRODUCTION/USE

Figura 21 : Riverside's Water Production/ Use



An acre-foot is a unit of volume commonly used in the United States in reference to large-scale water resources.

1 international acre foot ≡ 43,560 international cubic feet (by definition)

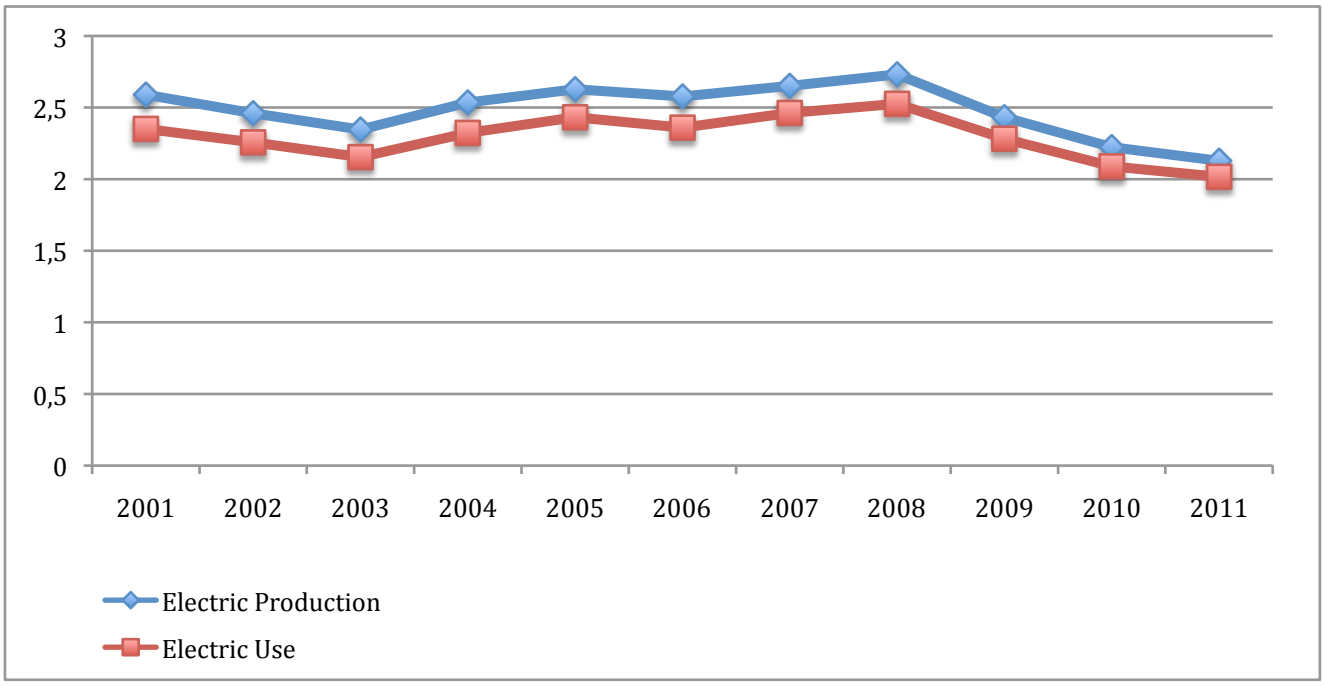
= 1233.48183754752 m3 (exactly)

As seen in the table above, water waste has been greatly reduced in the last 5 years.

Linked services

- **HET (High-Efficiency Toilets)**
- **WBIC (Weather-Based Irrigation Controller)**

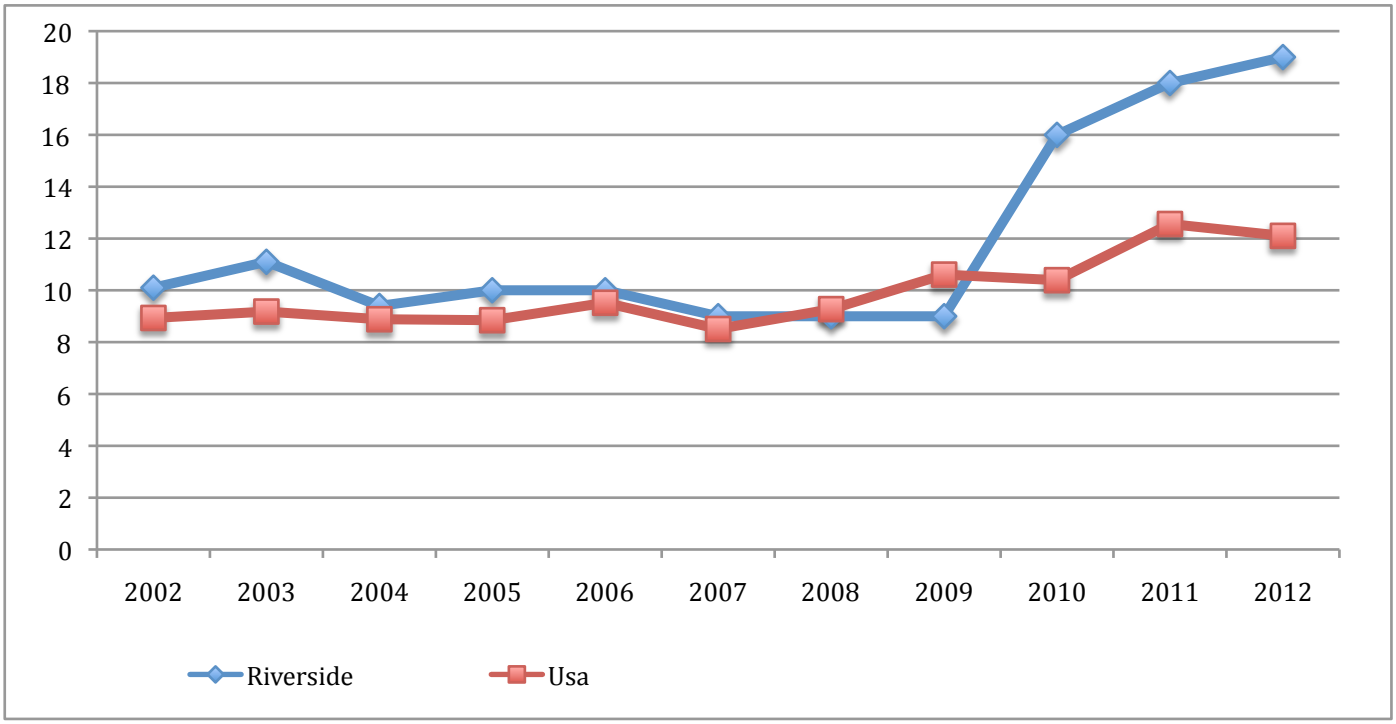
Figure 22 : Riverside Electric Production/Use



Source : www.riverside.org/utilities

Electric Generation by Renewable Source

Figure 23: Renewable growth resource USA /RIVERSIDE



Source : http://www.riversideca.gov/utilities/elec-provrate.asp;
http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_1_1

5.3.2 Smart Governance Services

Government TV

The city of riverside's government Tv channel (gTv) is a multi-faceted resident engagement tool that has been expanded significantly to create vibrant promotional and educational programming. Initially designed to allow viewers the opportunity to view city council meetings directly from their home, it now features not only council meetings but 24-7 programming, public service announcements and videos covering subjects from historic places to fitness and nutrition initiatives in the city. GTv is also available online for those who wish to tune in on a computer. G-TV was launched in 2008.

Online City's Services

I will now explain an example of a list of online services that it's possible to access directly by home.

Services to citizens

- Pedestrian Food Vendor Applications

- Special Event Application and Form
- Contractor verification form
- Parking Citation Payments

5.3.3 Smart People Services

City of Riverside website

The City of Riverside's website has been awarded a top 10 designation in the nation in the Best of the Web Awards for cities larger than 250,000 - http://www.centerdigitalgov.com/survey/88/2011. The City ensures that their content is kept current, easily assessable and publishes current content not only to the home page at http: //www.riversideca.gov/ but to several social media sites such as Facebook, Twitter and YouTube simultaneously. The site is completely ADA accessible which is critical since community houses the Blindness Support Center and School for the Deaf. The site is designed so that it loads fast over the City wide WiFi for all of Digital Inclusion families to access. The City also proudly displays our Intelligent Community Logo award directly on home page which gets over 1.5M hits annually.

Riverside Outlook

The Riverside Outlook is a quarterly newsletter that is mailed to all residents, business owners, and also is distributed electronically via an opt-in e-mail delivery service (GovDelivery) and all are archived on the Cities website at http://www.riversideca.gov/outlook/. These include updates on innovation, green initiatives and other important information going on in the community. In addition, there is a weekly Outlook distributed via e-mail to over 100,000 opted in residents on all current events such as celebrating 5,000th Digital Inclusion graduate http: //www.riversideca.gov/outlook/2011/2011-1019.html, GIS Day at the Museum http: //www.riversideca.gov/outlook/2011/2011-1109.html, and successes such as reaching Top 7 most intelligent community in the world http://www.riversideca.gov/outlook/2011/2011-0330.html.

Automated Permits Inspection Scheduling

In this program , you can now schedule, cancel and reschedule inspections for all Public Works Construction, Street Opening or Grade Permits **online**. Based upon availability, an inspection can be

scheduled a minimum of two (2) working days in advance. When scheduling your inspection request, you will need to have your:

Contractor's License Number

Public Works Permit Number

Type of Inspection

Site Location

Site Foreman's Name & Contact Number

5.3.4 Smart Living Services

311/ Riverside Resident Connect

Riverside residents have enjoyed the simplicity of calling 3-1-1 to reach the "one-call-does-it-all" 311 Contact Center for any city-related question or service for several years. The 311 Center was created in 2007 as a centralized point of contact for Riverside residents. With 311, callers don't have to know what department or person they need; the center will find out for them and has capability to communicate with them in any language. An informative YouTube video explains it all at http://www.youtube.com/watch?v=9s Q4uEHqALM. Recent enhancements, however, have taken that interaction to a whole new level. The 311 WEB page allows residents or visitors to enter service requests 7x24. If residents ―register‖ on the WEB page (eService) they get enhanced access that provides assistance with identifying city addresses or street names, asks additional questions needed by departments and feeds the request directly in to the 311 CRM (customer relationship management) system to get the request handled more quickly, as well as the ability to track status of requests previously submitted. Free 311 smart phone applications developed for iPhone, Android, or Blackberry users, make reporting even easier – just take a photo of the problem being reported and click Send. The GPS location where the photo was taken is added automatically.

GAT (Graffiti Abatement Tool)

The City of Riverside departments of 2008 Information Technology, Public Works, Police, and City Attorney have worked closely together to develop and implement one of the most successful graffiti abatement solutions in the U.S. City staff remove graffiti within 24 hours, document removal costs via special digital GPS cameras and then share the information with the Police Department and City Attorney for crime analysis, prosecution and offender fee collection. Vandals sign their work with a moniker, allowing the Graffiti Abatement tool (GAT) to be used to track every piece of graffiti in the city. The digital cameras are used to record incidents, images, locations and monikers. This data is then sent electronically to a police database used to create a GIS map of the graffiti locations with links to the pictures and stored data about the incident. GAT tracks information such as the style of graffiti, tools used to create it; removal method, materials used, and the hours of labour that went into getting rid of it. (Since 2007, when the GAT was developed, the city has collected more than $282,000 in restitution relating to 1,500 tags at an average removal cost of $175 each).

Explore Riverside Mobile App.

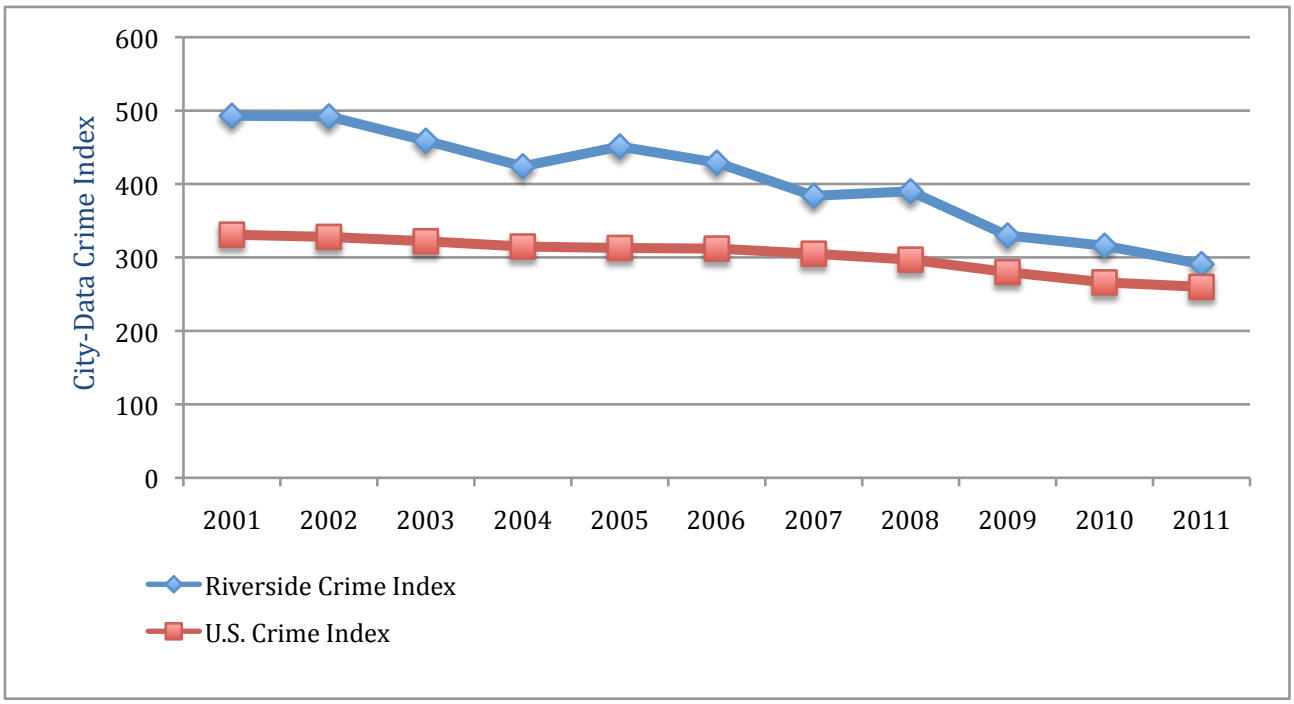
The Explore Riverside mobile app is available for free download on the iPhone and Android smartphones. The mobile app provides information on restaurants, shopping and entertainment as well as provide current location directions to get you where you want to go.

Linked Statistics

RIVERSIDE/ U.S. CRIME INDEX

City-data.com crime index counts serious crimes more heavily. It adjusts for the number of visitors and daily workers commuting into cities.

Figure 24 : Riverside/U.S. Crime Index



Source : City Data (http://www.city-data.com/city/Riverside-California.html)

Crime in Riverside detailed stats: murders, rapes, robberies, assaults, burglaries, thefts, arson

5.3.5 Smart Mobility Services

TMC (Traffic Management Center)

The City of Riverside‘s advanced 2006 Traffic Management Center features six large video screens that can be used separately or as one enormous screen to monitor and instantly change signal lights to ease heavy traffic at 290 intersections and 12 railroad crossings. Traffic signal coordination patterns are set for average conditions during the day but when extreme or 19. Please provide up to three examples of

innovation in the delivery of products and services by local businesses and institutions, including new business formation. unusual conditions arise, adjustments can be made instantly. Operators can move cameras to look in any direction and zoom up to a half a mile. WiFi data transmission technology is used to communicate with controllers at the intersections to change signals in real time.

Riverside Go-Transit program

The Riverside Go Transit Program is an incentive for City residents to use public transportation. Public transportation provides residents a link to all parts of the community and offers stress-free commuting, while reducing vehicle trips and the resulting emissions throughout the City. Once registered in the program, residents can purchase passes online or in person at Riverside City Hall. Passes are good for unlimited travel during the life of the pass, as designated by type.

5.3.6 Smart Economy Services

TriTech Small Business Development Business Center (SBDC)

TriTech SBDC helps Riverside high technology and high growth businesses and entrepreneurs commercialize new technologies, market products and services and identify capital and knowledge to take their enterprise to the next level. They provide consulting at no charge.
In 2006, Riverside Community College (RCC) hosted the TriTech Small Business Development Center and brought the organization to Riverside. TriTech holds workshops and training programs to assist start-up companies secure SBIR/STTR grants, develop access to capital strategies and funding presentations, plus development of go-to-market strategies. Currently the TriTech SBDC has helped create and retain 30 jobs, has provided $9,150,000 in access to capital, and $1,850,000 in Change in Sales.

High Technology Ombudsman Services

In 2007, Greg Lee was hired to be the high technology business attraction and retention ―Concierge‖ as recommended by the CEO Forum‘s High Technology Task Force (HTTF). As the single point of contact for all high technology business, Mr. Lee serves as the ombudsman for technology business promotion and development in the City of Riverside. Greg attends CEO Forum meetings and activities and is their point of contact for the City. Ombudsman Services are designed to meet the specific and often unique needs of today‘s growing technology-sector companies. Whether the need is access to capital, site selection assistance, networking with local leaders, or other, the goal of the Tech Ombudsman is to

support the growth of local technology companies. Assistance begins with a phone call or site visit to discuss company plans and challenges. The response is then customized, bringing in the key partners and program facilitators best suited to provide the guidance and services needed.

Business Online Application

I will now explain an example of a list of online services that it's possible to access directly by home.

Business Licenses :

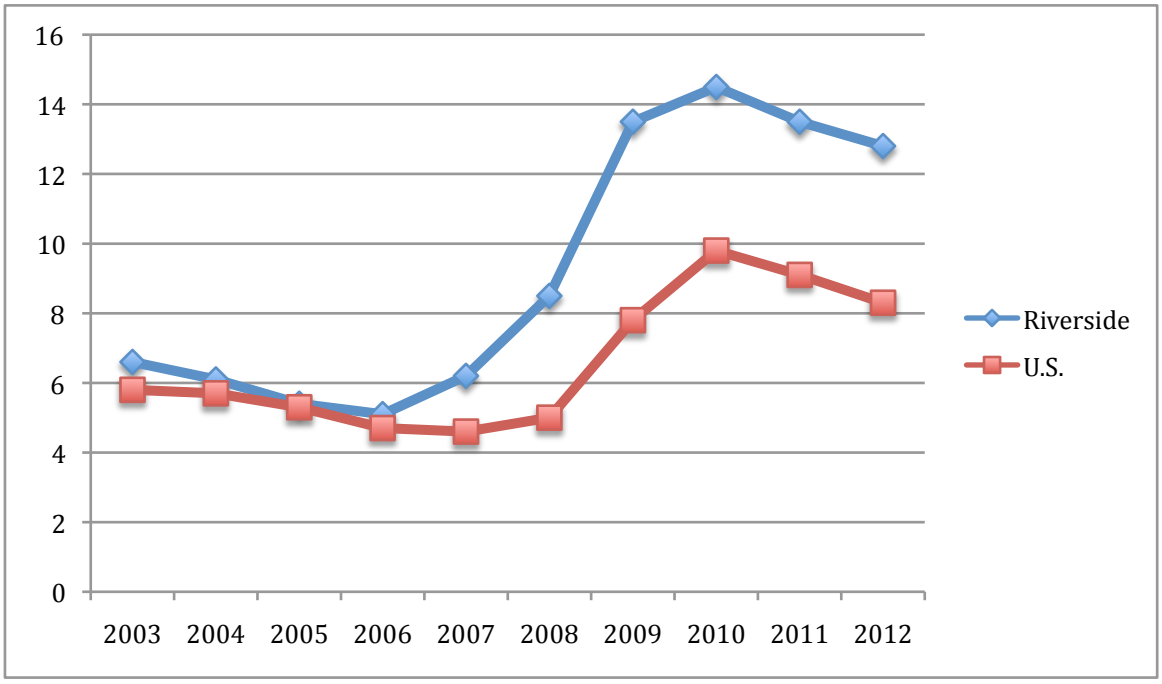
- Business Licences Application
- Business License Renewal
- Business Emergency Plan
- E-Filing

E-filing is a system for submitting tax documents to the Internal Revenue Service through the internet or direct connection, without the need to submit any paper documents. Tax preparation software with e-filing capabilities are available as stand alone programs or through websites or tax professionals from major software vendors for commercial use).

Linked Statistics

To better analyse the following dates, (figure 13, figure 14), it should be noted that before 2004 Riverside's economy based mainly on the housing market, one of the most bisogna sempre tenere presente che malgrado la voglia di cambiamento, fino al 2004 l'economia di Riversid si basava principalmente sul mercato edilizio, one of the most affected by the crisis. This current economic recession has resulted in unemployment rates exceeding 14% (see figure 13), 1 in 17 homes in foreclosure, and property values dropping back to 1999 levels. Property tax revenues declined 40% in 2009 alone. Community strategy in the last years is centered around five desireable industries (high-tech, biomedical science, nanotechnology, software, energy) that were chosen because of their potential to bring clean, green businesses, create high-paying jobs, attract knowledge workers, meet market demand and take advantage of Riverside's infrastructure. Is in this optisc that the following data should be read.

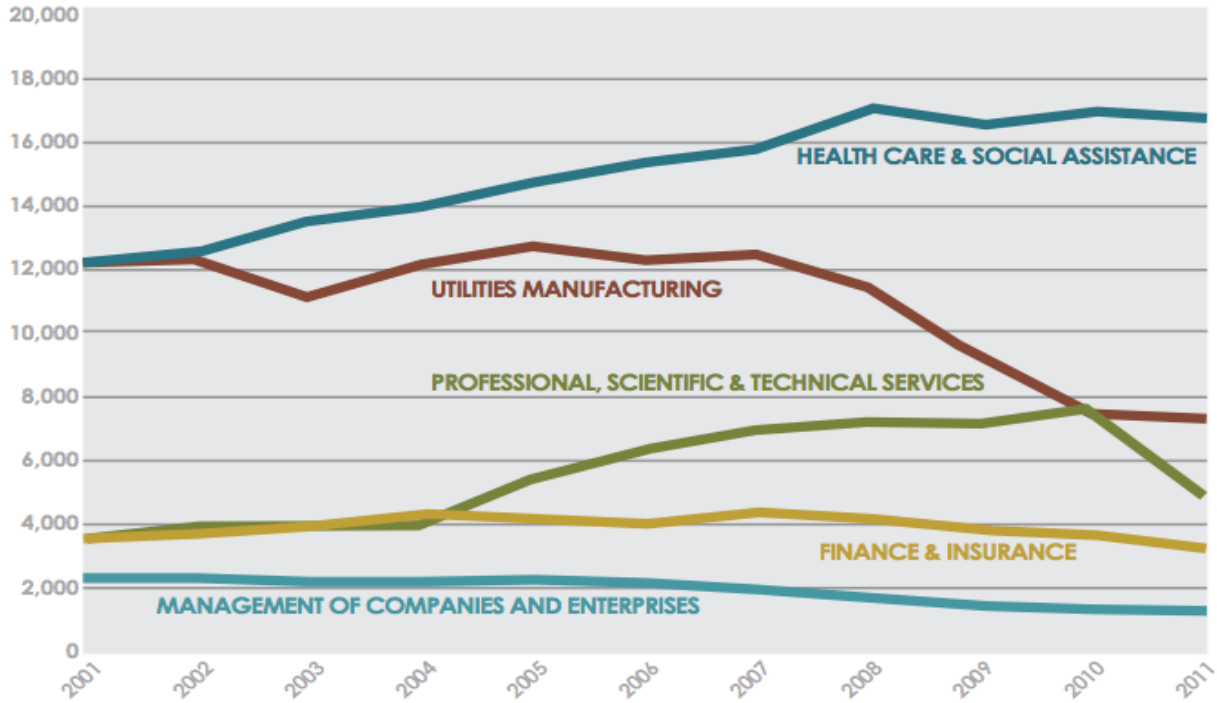
Figure 25 : Unemployment Rate By year(%)



Source : www.city-data.com ; www.bls.gov

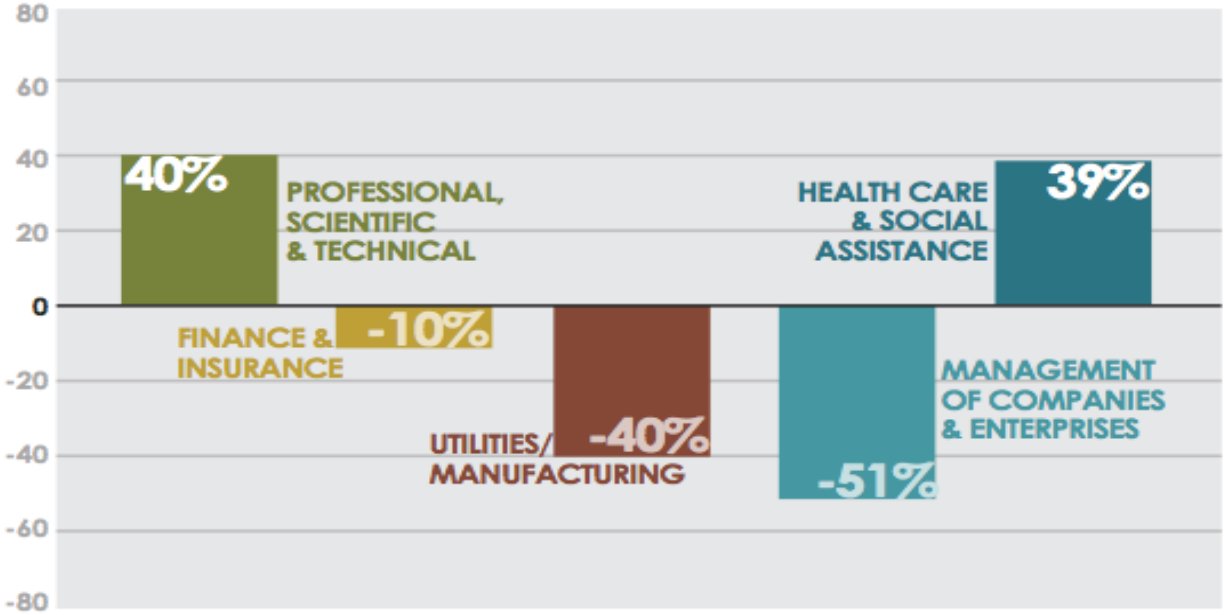
10 YEAR JOB GROWTH IN PROFESSIONAL, SCIENTIFIC, AND TECHNICAL SERVICES

Figure 26: Riverside 10 years employment in 5 desirable industries



Source : Riverside's quality of life index, (www.Seizingourdestiny.com)

Figure 27 : RIVERSIDE'S JOB GROWTH OVER 10 YEARS

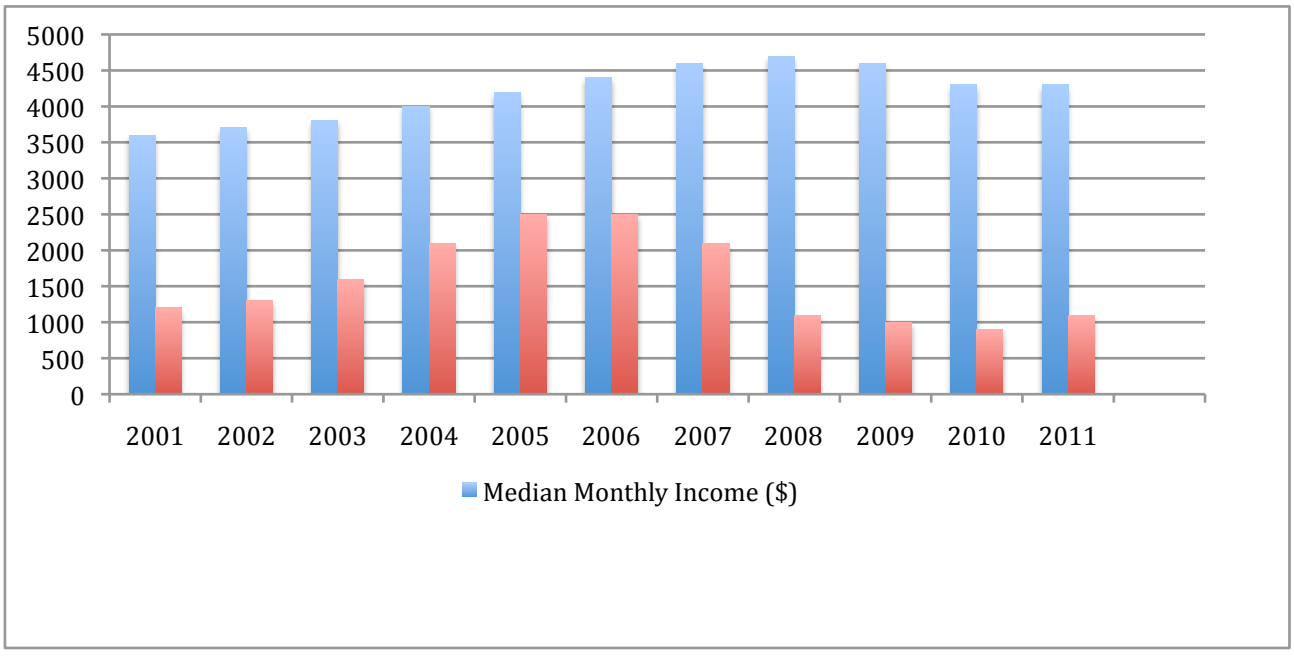


SOURCE : Riverside's quality of life index, www.Seizingourdestiny.com

HOUSING AFFORDABILITY INDEX

Riverside now has a housing market that can better accommodate first-time home buyers. This is highly attractive to young professionals and companies looking to locate here.

Figure 28 : Housing affordability index



Source : Riverside's quality of life index, www.Seizingourdestiny.com

Figure 29 : Main Services graphics

5.4 SUMMARY AND CONCLUSIONS

In this chapter was analyzed Riverside's real case, mapping those that were considered the main initiatives and the consequent services provided (see paragraph 5.3). The analysis of a real case highlights how the journey to become "Smart " is involved in a completely holistic vision and despite it's impossible analyze every aspect that affects the change, the practical study underline how it's necessary the implication of all of three main blocks (that were considered in the framework as the backbone of a city: governance, technology and social infrastructure, see figure 1 chap.5) to achieve long-term results. Furthermore, Riverside's case underscore how the governance has a huge responsibility, being the first to trigger the spark, to manage resources in a strategic view, and to allow the other blocks towards a definitive direction. How mentioned above in paragraph 4.2, the political and legislative environment in which a city is involved has a significant effect on the future development, can in fact be a key tool in the achievement of a strategic plan, or can be a bureaucratic carcass in which a city collide day by day.

Chapter 6:

CONCLUSIONS

This final chapter will conclude this master thesis. Here a short summary on what have been done and stated within this dissertation will be provided.
The main focus of this research project was around the emerging concept of Smart Cities. Due to the novelty of the topic, a well acknowledged and embedded definition of this domain of analysis was not available from the existing literature. As a consequence, the first step that was undertaken in this project, was the analysis of the trends that are crashing cities' balances, and so are pushing them towards considering innovative smarter approaches (see chapter one).
Then, through a careful review of the literature, I tried to understand which are the most quoted studies in this field and on which issues they focus. The immediate result of this second step of the research, has led to an unequivocal conclusion: there are three main currents in defining Smart Cities: a technology-oriented vision (strongly promoted by IBM [Dirks et al. 2009]), an approach-oriented one [Schaffers et al. 2011], that is sponsored by many initiatives within the European Commission, and a purely service-oriented one [Giffinger et al. 2007][Toppeta, 2010].
By having a clear overview on what is meant for Smart Cities in the different literature streams, I was able to provide an integrated definition. This was provided at two different levels of granularity: a text definition, and a comprehensive framework. The main aim of the framework was to explore the Smart City concept at a greater level of detail, through the identification of the mutually exclusive and collectively exhaustive dimensions that fully encompass its enabler factors. In other words, through the definition of the framework, I was able to unify the key components in a single model to highlight the supporting structure of a city, its connections and its critical areas where provide new ICT-based services. The dimensions of the framework (i.e. governance, Technology, Social Infrastructure and Services), have been the backbone for this project.
The next step refers to the application of the above mentioned Smart City Framework in a real case, choosing as reference Riverside, a Californian city of 300.000 inhabitants, which in recent years has initiated its journey towards the achievement of the "Smart City Status". Retracing this path (8 years long), I was able to study how Riverside moved from a situation of crisis (brain drain and a lack on interest from enterprises) till being considered the Smart City of the year in 2012, by the Intelligence Community Forum. The core part of this master thesis is the analysis of Riverside's

changing, mapping, within a progressive model, year by year all the main initiatives, the strategic plans and the ICT-based services provided, taking as reference the framework structure. It is evident that the strategic path of a city include countless factors, and it 's difficult to highlight all them in a master thesis. In fact, this project aims to be a tool for helping city leaders as a benchmarking in a developing plan, and a starting point for future work. However, through this Riverside Progression Model, it becomes easier to define and implement an extremely needed long-term strategic plan, having broad impacts across the so called triple bottom line, that includes social, environmental and economic perspectives.

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