Smart and Digital City: A Systematic Literature Review

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Abstract The concept of Smart City embraces several definitions depending on the meanings of the word "smart": intelligent city, knowledge city, ubiquitous city, sustainable city, digital city, etc. Many definitions of Smart City exist, but no one has been universally acknowledged yet. From literature analysis it emerges that Smart City and Digital City are the most used terminologies in literature to indicate the smartness of a city. This Chapter explores the literature about Smart City and Digital City from 1993 to the end of 2012 in order to investigate how these two concepts were born, how they have developed, which are the shared features and differences between them. To accomplish with these goals, three steps were followed: (1) to set up a search strategy for systematic literature review to collect a representative subset of papers about Smart City and Digital City using Google Scholar; (2) to store the selected subset in an ad-doc database to synthesize the literature review; (3) to organize the literature review subset to extract quantitative and qualitative data and information about Smart City and Digital City evolution. The author proposes a literature review taxonomy through five specific analysis: (1) time analysis, to explore the causes of the trend of Smart City and Digital City literature in the latest twenty years; (2) terminology analysis, to examine how and where these two ideas were born and what have been the main events influenced their development; (3) definitions analysis, to select and compare the most cited and validated definitions of Smart City and Digital City trying to identify similarities, differences or overlaps between these two concepts; (4) typology analysis, to investigate if Smart City and Digital City are included into a specific urban strategy pursued by government or if they face specific urban problems without a comprehensive framework; (5) geographic analysis, to understand where are the largest concentrations of Smart Cities and Digital Cities in the world and which are their main characteristics and best practices.

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1 Introduction

During the latest years of XX century, two important phenomena have been emerging: urbanization and information and communication technologies (e.g. ICT). Eighties' and nineties' technological advancement and economic growth contributed to increase well-being, mainly in the greater urban centers. This fostered the urbanization leading to a progressive abandonment of rural areas towards greater cities and metropolis, which can offer many opportunities in terms of work, education, social life and so on. People strong inclination to concentrate in cities generated both positive and negative effects at global level [1]. On one hand it causes the increasing of cultural level, the creation of new job opportunities and an improvement of economic conditions. On the other hand, concentration in cities increased traffic jam, carbon dioxide, greenhouse gases emissions and waste disposal with consequences on health conditions. City dimension drives energy and natural resources demand, the need of territory redevelopment and adequate infrastructures availability. In this scenario, to save the earth and people health, the idea of smart cities emerges, that is, cities able to solve urban issues paying attention to the environment. For this reason, in the nineties, the concept of smart growth has begun to spread: it implies a community-driven reaction to solve traffic congestion, school overcrowding, air pollution, loss of open space and skyrocketing public facilities cost [2].

In the international context, in order to achieve the objectives established in the Kyoto Protocol, the Smart City concept was born and has been adopted by many institutions (e.g. European Commission, Setis-EU, OECD, etc.) which labeled as "smart" initiatives and projects relevant to cities sustainability. Indeed, if we "google" the term "smart city", we can find more and more results about: city sustainable initiatives, institution road-maps to enhance green growth and quality of life, the usefulness of ICT infrastructures, the involvement of citizens in public life, the need to reduce digital divide, and so on. But giving a comprehensive definition of Smart City is far to be done. A major hurdle in identifying such definition is the ambiguity of meanings attributed to the word "smart" and to the label "Smart City". Some examples of these several meanings are: Digital City, Wired City, Knowledge City and Green City, "which often link together technological informational transformations with economic, political and socio-cultural change" [3]. All those meanings are somehow part of the fuzzy concept Smart City and they cannot be regarded as mere correlated themes of it. Especially Smart City and Digital City are often used without specifying their similarities and differences. A brief analysis of scientific literature and paper title shows that smart city and digital city are most recurrent terms, but their meaning is rarely clarified.

This paper aims to light the shared features and dissimilarities between Smart City and Digital City concepts looking at a sound definition of both. To lead this

study, the author inquires about the beginnings of Smart City and Digital City phenomena, considering the time frame 1993–2012. In this context, the author organized the research in the following steps:

- paragraph 2 defines the research method, aiming to identify and organize a subset of papers relevant for the literature review analysis;
- paragraph 3 examines the collected data trying to answer to the specific questions through five analysis:

    1. *time analysis* answers to the Research Question 1: "How and when Smart City and Digital City concepts were born?". This analysis aims to show the trend of papers about Smart City and Digital City in the time frame 1993–2012 and to investigate about the drivers of this trend;
    2. *terminology analysis* answers to the Research Question 2: "Which events mainly influenced the development of Smart City and Digital City ideas?". This analysis aims to show the time distribution of papers regarding Smart City and Digital City during the latest twenty years, highlighting the most important causes which influenced the widespread of these two concepts; definitions analysis answers to the research Question 3: "Which are the main shared features, differences and overlaps between Smart City and Digital City contents?". This analysis aims to compare each other the most recurrent and acknowledged definitions about Smart City and Digital City, identifying their similarities and differences;
    3. *typology analysis* answers to the Research Question 4: "Are Smart City and Digital City included into a comprehensive urban strategy? Or are they the sum of standalone projects? In this context do they follow a top-down or a bottom-up approach?". This analysis uses papers labeled as "empirical study" or "theoretical study" regarding smart/digital cities/initiatives during the time frame 1993–2012 to understand if their origin is more theoretical and top-down, or more empirical and bottom-up;
    4. *geographic analysis* answers to the Research Question 5: "How these two types of city strategies are widespread in the world?". This analysis aims to show the location of empirical studies regarding Smart City or Digital City implementation, highlighting the concentration of these concepts per continents;

- paragraph 4 addresses concluding remarks.

2 Methods: Search Strategy for Systematic Literature Review

The literature review about Smart City and Digital City has been carried out using the methodological model proposed by Vom Brocke et al. [4] in their study about the importance of rigor in documenting the literature search process. This methodological model is based on a five phases framework for the literature search

process. These phases are: (1) definition of the review scope, (2) conceptualization of topic, (3) literature search, (4) literature analysis and synthesis, (5) research agenda.

In the following paragraphs these phases are introduced referring to the literature review about Smart City and Digital City.

2.1 Definition of Review Scope

In order to clearly define the scope of this literature review, the author refers to an established taxonomy presented by Cooper [5] that includes six characteristics for literature review: (a) focus; (b) goal; (c) organization; (d) perspective; (e) audience; (f) coverage.

a. *Focus* is the central area of interest to the reviewer. This area could concern: research outcomes, research methods, theories, practices or applications; this literature search focus regards all types of papers, from theoretical to application-centered ones;
b. *Goal* regards what the author hopes the review will fulfill. The aim of literature review could regard: integration (such as, to clarify contradictory ideas or to bridge the gap between theories and practices), criticism (such as, to critically examine the literature to demonstrate the unwarranted previous theories), central issue (such as, what has been studied in the past, what researchers will study in the future, what has hindered the development of some topics, and so on); the aim of this study is to synthesize past literature and to identify the central issue of the literature review about Smart City and Digital City, that is to investigate how these two concepts were born, how they have developed, what are their similarities, differences and overlaps;
c. *Organization* concerns how the reviewer organizes his search study. The literature review could be organized by: chronological order, conceptual order (that is, to group the same ideas), methodological order (that is, to group the same methods of work); this literature is sorted by chronological order first and by conceptual order after;
d. *Perspective* is the point of view of reviewer in discussing the literature. The reviewer could lead the study with: a neutral position (he plays the impartial role as an honest "judge") or an espousal of position (he plays the role of an "advocate"); the author considers worthwhile to adopt an essentially neutral literature search perspective, because there is no interest to foster a specific position or policy about the topic;
e. *Audience* concerns groups of people (such as specialized researchers, general researchers, practitioners, policy makers, general public and so on) whom the review is addressed; the audience of the literature review are specialized scholars and industry makers.

Table 1 The Cooper's taxonomy applied to the smart city and digital city literature review

	Characteristic	Cooper's options	Author choice
a	Focus	Type of papers involved (methodological, theoretical, practices, applications, outcomes)	All types of paper
b	Goal	Integration, criticism, central issue	Central issue
c	Organization	Chronological, conceptual, methodological	Chronological first, conceptual after
d	Perspective	Neutral, espousal of a position	Neutral
e	Audience	Groups of people whom the review is addressed	Specialized scholars and industry makers
f	Coverage	Exhaustive, with selective citation, representative, central, pivotal	Representative

f. *Coverage*, it regards how the reviewer searches the literature and how he makes decisions about the suitability and quality of documents. The coverage could be: exhaustive, exhaustive with selective citation, representative, central or pivotal; the author decided to choose a reasonably representative coverage.

Table 1 summarizes the choices made by the author, regarding the Cooper's taxonomy about the review scope.

2.2 Conceptualization of Topic

Vom Brocke et al. [4] suggest that "a review must begin with a broad conception of what is known about the topic and potential areas where knowledge may be needed". Therefore, in order to choose the key concepts on which to base the literature review, the author began the study on Smart City by looking:

- several papers about the meaning of the word "smart" (in particular the paper of Hollands [3] and the IBM report [6]), because Smart City is a broad concept including many aspects of urban life, such as urban planning, sustainable development, environment, energy grid, economic development, technologies, social participation, and so on; therefore, also the word smart assumes a large range of meanings, linked with its different field of application;
- several papers about the different terminologies which identify a "smart" city, because it is not clear if these different terms want to say the same thing or if they define different cities, strategies and technologies (especially the paper of Pardo and Nam [2], Dameri [7], Su et al. [8]);
- several papers about the Smart City definitions (especially the paper of Pardo and Nam [2, 9], Chourabi et al. [10]).

However, exploring these papers, we cannot find a comprehensive definition accepted by academics, businesses and institutions about what Smart City is and

which are its key elements and boundaries are. The difficulty to define Smart City regards mainly two aspects:

1. the adjective "smart", because it depends on the meaning we attribute to this word. In literature, several typologies of city refer to Smart City concept, such as Intelligent City, Knowledge City, Wired City, Digital City, and so on [4];
2. the label "smart city", because it is a fuzzy concept and it is used in ways that are not always in accordance each other. There are many cities that define themselves as Smart City when they identify some own characteristics as "smart", but without referring to a standard meaning.

For these reasons, nowadays, a unique definition of Smart City does not exist yet [2]. Moreover, from this first literature review it emerges that there are many terminologies of Smart City, but to understand if each of them could be considered as synonymous of Smart City, it is necessary to clearly define if they have some shared features, overlaps or differences. To achieve this goal, the author analyzed and compared different definitions of city linked to the label "smart city". Table 2 shows this comparison, listing the definition and the reference. For each definition, there are in evidence some words to highlight the meaning of these concepts: the bold character is used to outline the human component of different city concepts; while the italic character is used to outline the applied technologies.

From the literature analysis, it emerges that all these concepts are not in contradiction with each others and they disclose some shared features and are partially overlapped [7].

Pardo and Nam [2] organizes these definitions in dimensions depending on some recurrent shared characteristics, in order to define the most used terms. These dimensions are:

1. *Technology dimension*; it is based on the use of infrastructures (especially ICT) to improve and transform life and work within a city in relevant way. This dimension includes the concepts about Digital City; Virtual City, Information City, Wired City, Ubiquitous City and Intelligent City;
2. *Human dimension*; it is based on people, education, learning and knowledge because they are key drivers for the smart city. This dimension includes the concepts about Learning City and Knowledge City;
3. *Institutional dimension*; it is based on governance and policy, because the cooperation between stakeholders and institutional governments is very important to design and implement smart city initiatives. This dimension may include the concepts about Smart Community, Sustainable City and Green City.

Finally, we can see that Digital City also embraces several meanings of "smart", such as virtual city, cyber city, wired city, ubiquitous city and so on [11, 12–14]. Moreover, Digital City is sometimes considered as a Smart City based on ICT infrastructures, because one of the most important technologies used to support Smart City strategies is ICT [7]. Therefore, from this analysis, it appears that Digital City is the most recurrent terminology linked to the meaning of Smart City.

Table 2 The different meanings of smart city

Concept	Definition	Reference
Wired city	"Wired cities refer literally to the laying down of *cable and connectivity* not itself necessary smart"	Hollands [3]
Virtual city	"Virtual City concentrates on *digital representations* and manifestations of cities"	Schuler [11]
Ubiquitous city	"Ubiquitous city (U-City) is a further extension of digital city concept. This definition evolved to the ubiquitous city: a city or region with *ubiquitous information technology*"	Anthopoulos et al. [39]
Intelligent city	"Intelligent cities are territories with high capability for learning and innovation, which is built-in the creativity of their population, their institutions of knowledge creation, and their *digital infrastructure* for communication and knowledge management"	Komninos [40]
Information city	"Digital environments collecting official and unofficial information from local communities and delivering it to the public via *web portals* are called information cities"	Anthopoulos et al. [39]
Digital city	"The digital city is as a comprehensive, *web-based representation*, or reproduction, of several aspects or functions of a specific real city, open to non-experts. The digital city has several dimensions: social, cultural, political, ideological, and also theoretical"	Couclelis [41]
Smart community	"A geographical area ranging in size from neighborhood to a multi-county region whose residents, organizations, and governing institutions are using *information technology* to transform their region in significant ways. Co-operation among government, industry, educators, and the citizenry, instead of individual groups acting in isolation, is preferred"	California Institute [42]
Knowledge city	"A Knowledge City is a city that aims at a knowledge-based development, by encouraging the continuous creation, sharing, evaluation, renewal and update of knowledge. This can be achieved through the continuous interaction between its citizens themselves and at the same time between them and other cities' citizens. The citizens' knowledge-sharing culture as well as the city's appropriate design, *IT networks and infrastructures* support these interactions"	Ergazakis [43]
Learning city	"The term 'learning' in 'learning cities' covers both individual and institutional learning. Individual learning refers to the acquisition of knowledge, skills and understanding by individual people, whether formally or informally. It often refers to lifelong learning, not just initial schooling and training. By learning, individuals gain through improved wages and employment opportunities, while society benefits by having a more flexible and technological up-to-date workforce"	OECD [44]

Table 2 (continued)

Concept	Definition	Reference
Sustainable city	"Sustainable city uses *technology* to reduce CO_2 emissions, to produce efficient energy, to improve the buildings efficiency. Its main aim is to become a green city"	Batagan [45]
Green city	"Green City follows the Green Growth which is a new paradigm that promotes economic development while reducing greenhouse gas emissions and pollution, minimizing waste and inefficient use of natural resources and maintaining biodiversity"	OECD [46]

For these reasons, the author decided to focus on Smart City and Digital City; these two topics will be analyzed together because they are the most used and representative terminologies in the literature to indicate the smartness of the city; but they are quite different to require a distinct analysis and further comparison.

2.3 Literature Search

This phase "involves database, keyword, backward and forward search, as well as an ongoing evaluation of sources" [4]. To conduct this literature search process, the author evaluated the following search strategy steps: (a) to choose the database source; (b) to choose keywords and search criteria; (c) to choose if to apply backward and forward search; (d) to evaluate the literature subset suitability.

a. First, it is needed to choose the *database source* among the available ones. The selected on-line database has been Google Scholar, because it includes a broad field of publications (especially such as papers and journal articles) which focus on the chosen topic.
b. Second, it is needed to choose the most suitable *keywords* and *search criteria* in order to extract a representative subset from the selected database. In the present case, the search was conducted between February and May 2013. The system was request to search the words "*Smart City*" *OR* "*Digital City*" *OR* "*Smart Cities*" *OR* "*Digital Cities*" only in the title of paper and excluding all citations and patents. In this way, the search results included 987 papers. Then, the Google Scholar database was request to sort all the results by year of publication within 1993–2012 range. The author chooses this twenty years range in order to have a reasonable representative subset which does not include the work in progress (such as it could happen including 2013). After the filtering, the search results reduced to 843 papers which have been stored in an ad-hoc database. This database has been called "Literature Review Storage DataBase"

(LRS-DB) where each record corresponds to a paper. It is characterized by the following attributes:

– publication year;
– authors' name;
– title of work;
– source which identifies the typology of scientific publication;
– affiliation of authors, country included;
– abstract;
– keywords used by authors to index their work;
– citations only when superior to twenty;
– tag "smart" or "digital" in order to classify papers into Smart/Digital City label on the base of adjective used in the title;
– type of study identifies if the contribution is a theoretical study, a case study or a report;
– if case study, the object of it (that is, a smart or digital project or a smart or digital city);
– the name of the city in case of empirical study;
– the continent of city in case of empirical study;
– abstract available to delete the papers which are not abstract available.

c. Third, it is needed to choose to apply *backward and forward search*. In the present case, the amount of papers was considered an appropriate pool to investigate how and when Smart City and Digital City concepts were born, how they have been developing and if there are some shared features between these terminologies. Thus, the author decided not to apply any backward search nor forward search.

d. Fourth, *evaluation* in "all phases means limiting the amount of literature identified by keyword search to only those articles relevant to the topic at hand" [4]. In this phase, the LRS-DB was used as a source input platform and some criteria were applied to it to restrict the search. Indeed, the author removed: duplicates, thesis, power point presentations, white papers, book's introductions, competition announcements, all works which are not in English language and/or have not the full abstract available. The application of these criteria resulted in the exclusion of 115 papers, leading to a total 705 ones relevant to the present study.

Figure 1 shows in a sketch the steps of these described systematic review process.

The LRS-DB is an important tool for data-mining aiming to fulfill the following objectives around the Smart City and Digital City concepts:

• to filter the literature;
• to identify how Smart City and Digital City have been evolving during time;
• to identify research trends during the last two decades;
• to pinpoint the most studied research themes;
• to pinpoint the less studied research themes which can perhaps be expanded in future.
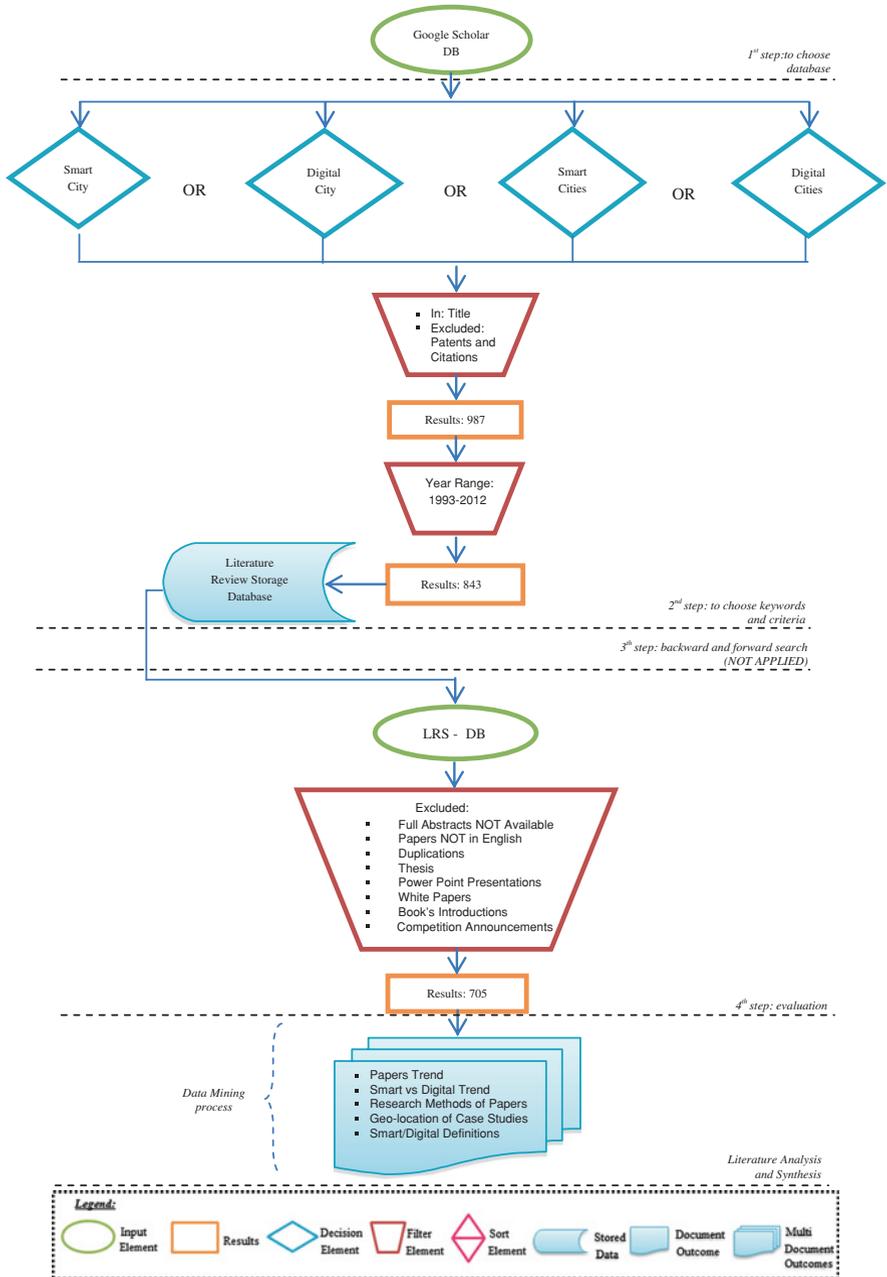
Google Scholar
DB

1st step: to choose database

Smart City   OR   Digital City   OR   Smart Cities   OR   Digital Cities

- In: Title
- Excluded: Patents and Citations

Results: 987

Year Range: 1993-2012

Literature Review Storage Database   ← Results: 843

2nd step: to choose keywords and criteria

3rd step: backward and forward search (NOT APPLIED)

LRS - DB

Excluded:
- Full Abstracts NOT Available
- Papers NOT in English
- Duplications
- Thesis
- Power Point Presentations
- White Papers
- Book's Introductions
- Competition Announcements

Results: 705

4th step: evaluation

Data Mining process

- Papers Trend
- Smart vs Digital Trend
- Research Methods of Papers
- Geo-location of Case Studies
- Smart/Digital Definitions

Literature Analysis and Synthesis

Legend:
Input Element | Results | Decision Element | Filter Element | Sort Element | Stored Data | Document Outcome | Multi Document Outcomes

Fig. 1 Search strategy for systematic review

A part of these goals will be reached in this work,[1] while others are going to be accomplished in the future research studies.

2.4 Literature Analysis and Synthesis

"After collecting sufficient literature on a topic it has to be analyzed and synthesized" [4]. Therefore, the aim of this phase is to organize the papers stored in the LRS-DB to analyze systematically the collected literature. To accomplish with this goal, the 705 papers were organized to investigate about:

a. *time analysis*, it explores the evolution of researches about Smart City and Digital City during the latest twenty years. To achieve this purpose, the stored papers were organized by years of publication to count them per each year. The output of this analysis is to show in a graphic the trend of papers about Smart City and Digital City idea in the time frame 1993–2012;

b. *terminology analysis*, it explores how and when Smart City and Digital City concepts have being conceived and the relationships between the two topics. To achieve this goal, the stored papers were organized by years of publication and by "smart" or "digital" label, according to the adjective used in the title of paper. The output of this analysis shows in a graphic the time distribution of papers regarding Smart City or Digital City during the latest twenty years;

c. *definitions analysis*, it explores the most cited definitions of Smart City and Digital City, to compare their meanings and contents. To accomplish with this goal, the stored papers were organized by the most recurrent and validated definitions, according to the citation number and to the paper focus;

d. *typology analysis*, it explores if Smart City and Digital City are two initiatives which follow a specific urban strategy defined by governments (they have in this case a top-down approach) or if they solve specific and stand-alone urban issues without a comprehensive strategic vision (therefore they have a bottom-up approach). To achieve this aim, the stored papers were organized by years of publication and by "empirical study" or "theoretical study" label, according to the research method highlighted in the abstract of paper. The output of this analysis is to show in a graphic the distribution of papers labeled as "empirical study" or "theoretical study" regarding smart/digital cities/initiatives during

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[1] Thanks to the use of LRS-DB, in this chapter will be investigated about the evolution of Smart City and Digital City concepts during the latest twenty years, in order to understand: how and where these two concepts were born, what causes mainly influenced their evolution, if Smart City and Digital City follow a bottom-up approach, where are the most large concentrations of Smart cities and Digital cities in the world, which are the empirical cases more frequently studied by researchers, how much these two topic are overlapping strategies and how much they are different. Therefore, this study is the first step to deep explore other research dimensions aiming to clearly design the contents and the boundaries of Smart City and Digital City idea.

the time frame 1993–2012; it helps to understand if the empirical studies come first, or after, the theoretical study of these topics, that is, if the bottom-up approach prevails on the top-down one, or vice versa;

e. *geographic analysis*, it explores where Smart cities and Digital cities are more concentrated in the world. To achieve this purpose, the stored papers were organized by "empirical study" label and by the "city of empirical study", according to the paper abstract. The output of this analysis shows in a graphic the distribution of empirical studies regarding Smart City or Digital City implementation all over the world.

2.5 Research Agenda

"The literature search process never comes to a definitive end" [15]. The final purpose of this literature review is not only to clarify the similarities and differences between Smart City and Digital City, or to find a good definition to identify both of them; but also to result in a new research agenda, which should be more insightful than the research question posed at the beginning. This new research agenda will aim to deep the characteristics of Smart City and Digital City, investigating about the contents of the papers included into the LRS-DB and also collecting several empirical case studies, to verify if the theoretical definitions designed in the present works are suitable to embrace the real implementation of Smart City or Digital City experiences all over the world.

3 Results

This section describes and explains the results obtained by the analysis of the LRS-DB, answering to the Research Questions #1, 2, 3, 4, 5 exposed in the previous paragraph.

3.1 Time Analysis

The purpose of time analysis is twofold; it aims both to analyze the time trend and distribution of researches regarding Smart City and Digital City and to understand which are the main determinants of this time trend.

To accomplish these objectives, the 705 papers stored in the LRS-DB were organized by chronological order, classified depending on publishing year to count them.

Figure 2 shows the number of papers about Smart City and Digital City during the latest twenty years. As trend line highlights, the first study concerning this topic is dated 1994. Between this start point and 1997, no more publications were found. After that, the total number has been gradually increasing until 2005. From
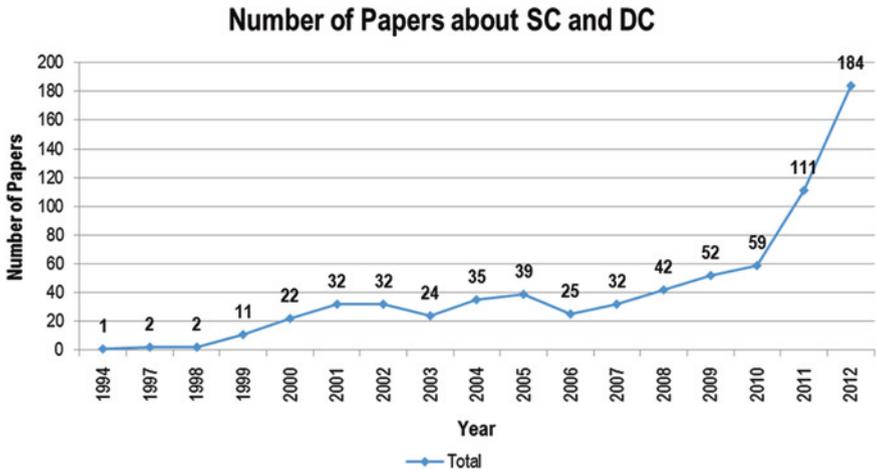
Number of Papers about SC and DC

Fig. 2 Time analysis: number of papers about smart city and digital city

2006 to 2009, the trend line shows a steady increase (plus 10 units per year), while from 2010 its growth was doubled year by year up to 184 units at the end of 2012. Therefore, the interest about Smart City and Digital City is quite stable from 1993 to 2010 and it increases exponentially from 2010 to now.

Examining time analysis results, five dates have been identified as possible causes which could have influenced the development of Smart City and Digital City concept. These dates are: 1997, 2000, 2005, 2008, 2010.

1. *1997*. This year was characterized by *Kyoto Protocol*. Its main purpose is to limit CO_2 emissions and consequently to safeguard the environment all over the world. The Kyoto Protocol was signed by 192 Parties, including European Union and 191 States (such as, all United Nations members with the exception of the United States, Andorra, Canada, South Sudan). Nevertheless, it was entered in force in 2005 after Russia ratified it in October 2004. All parties were required to prepare policies and measures to decrease CO_2 emissions in their respective countries. There are two commitments periods in which developed countries have to achieve binding limitations or reductions emissions of greenhouse gases: the time frame between 2008 and 2012 and the time frame between 2013 and 2020 [16]. The Kyoto Protocol has certainly influenced the way to think the city, especially modern and industrialized cities characterized by a strong urbanization. In this context, during the latest twenty years, all State Parties have begun to foster several initiatives about CO_2 emissions reduction to apply them within their own boundaries with consequent studies increase about these scenarios. This role of Kyoto Protocol in driving countries and cities to design and apply environmental policies is also one of the main drivers of interest about the Smart City topic; less relationships are between Kyoto Protocol and Digital City.
2. *2000*. Two thousands were characterized by widespread of *Internet* all over the world, not only in business or academic context but especially in everyday life

[17]. In these years the *ICT* infrastructure, such as broadband infrastructures, wireless sensor networks, Internet-based networked applications, open platforms, were spread more and more, in order "to work together to form the backbone of a large intelligent infrastructure" [18]. Thanks to the use of Internet-based infrastructures, the e-services supply regarding healthcare, energy, education, environmental management, transportation, mobility and public safety, has begun to spread among citizens. At the same time, mobile phones have become more accessible for everybody (not only for businessmen but also for each citizen) evolving in technologically sophisticated products able to use the Internet access-point and to supply intelligent services to the users. The accessibility to the Internet in urban life has become easier and more popular [17, 19]. The newness it is that the city increases its cooperation with the surrounding territory in physic and virtual terms, in order "to build an arena where people in communities can share knowledge, experience and mutual interests" [20]. The author observes that this scenario supports more and more the concept of Digital City as a wired-city based on Internet, in which it is possible to provide public and private services to create socio-economic value for customers, citizens and the civil society [21]. Therefore, the Internet diffusion is one of the main driver of interest regarding the Digital City concept; less relationships are between the Internet and Smart City;

3. *2005*. During this year the *Kyoto Protocol entered in force* on the 16th February. After this moment, the international initiatives about the safeguard of environment have spread to achieve the Kyoto Protocol aims. Therefore, this scenario has fostered the development of smart strategies all over the world, focused on the environment safeguard.

4. *2008.* In 2008 two important events could have been influenced smart/digital researches: *the IBM Smart Planet concept* and *the Covenant of Mayors*.

   – IBM is the first company paying attention to the concept of "*Smart Planet*". For IBM, Smart Planet is as an instrumented, interconnected and intelligent planet in which leaders in business, government and civil society around the world could use Big Data to "transform enterprises and institutions through analytics, mobile technology, social business and the cloud" [6]. For IBM, this is the way to compete in the "smart" era, to have a good quality of life and to improve the city. Therefore, IBM has started a new business in this sector supplying to governments smart solutions focused on communications, energy and utilities, healthcare, insurance, retail, transportation, and so on. After that, many companies worldwide (such as Cisco, ABB, HP, Siemens, Ericsson, etc.) followed the IBM idea studying new smart projects for urban city issues. Therefore, putting together the event of the entered in force of Kyoto Protocol and the diffusion of Smart Planet concept, the author observes that the adjective "smart" gather with the word "city" has begun to widespread in every research field. However, the Smart City referred by IBM is not only smart, but also digital, because the role of ICT in pursuing the Smart City goals is crucial This is one of the most important example of confusion between smart and digital.

   – *Covenant of Mayors* is a self-started initiatives of European Cities. This initiative is finalized to spread the Smart City concept and to reduce CO_2

emissions by more than 20 % by 2020 through increased energy efficiency and fostering renewable energies. The agreement is fostered by European Commission in the frame of fulfilling the objectives of Strategy 2020 [22]. Its actions mainly focuses on: clean mobility, private and public buildings redevelopment, citizen awareness on the energy consumption theme. The signatory cities agreed to issue their own Action Plan for Sustainable Energy (PAES), which consists in a roadmap for fulfilling the agreement objectives. The Covenant of Mayors initiative is not isolated, it interacts with a number of projects, policies and initiatives. The main synergy in place is with the Strategic Plan for Energy Technologies (SET Plan). Indeed, SET Plan outlines the logic frame where the actions to fulfill Agenda 2020 objectives have to be developed [23]. In this context, the Smart City concept develops more than Digital City and it mainly regards the sustainability in terms of pollution reduction and environmental quality improvement.

5. *2010.* In 2010 the EU launched the *Europe 2020 Strategy* about delivering [22]: smart growth investing in education, research and innovation areas; sustainable growth investing in technologies and resources low-carbon economy; inclusive growth giving a strong emphasis on job creation and poverty reduction. The Europe 2020 strategy is focused on five goals in different areas, which should be achieved by European Union within the end of 2020 year. These goals concern: employment, research and developments, climate change and energy sustainability, education, poverty and social inclusion. Aiming to achieve these objectives, each European country commits to carry out smart or digital initiatives in its own major cities. In this way, the Europe 2020 Strategy has increased the widespread of both Smart City and Digital City concepts and, of consequence, the research studies about them.

Linking the papers trend with the most important events, the author identifies the links between technological and political situations and smart/digital researches. It emerges from the literature analysis that the time increasing of papers has been influenced by the Internet development, that justifies investments in Digital City initiatives, and environmental global policies, such as Kyoto protocol and EU 2020 Strategy, explicitly focused on sustainable growth and CO_2 emissions reduction, more influencing the Smart City investments. Therefore, both Smart City and Digital City strategies, and consequently also researches about these topics, are the effect of technology advancements and environmental sensibility. These two causes explain the most of papers published about Smart and Digital City and the exponential increase of papers after 2009.

3.2 Terminology Analysis: Smart Versus Digital

The terminology analysis aims to separate papers regarding Smart City from papers regarding Digital City and to order them chronologically, to distinguish the different time trends characterizing these two research topics. To accomplish with
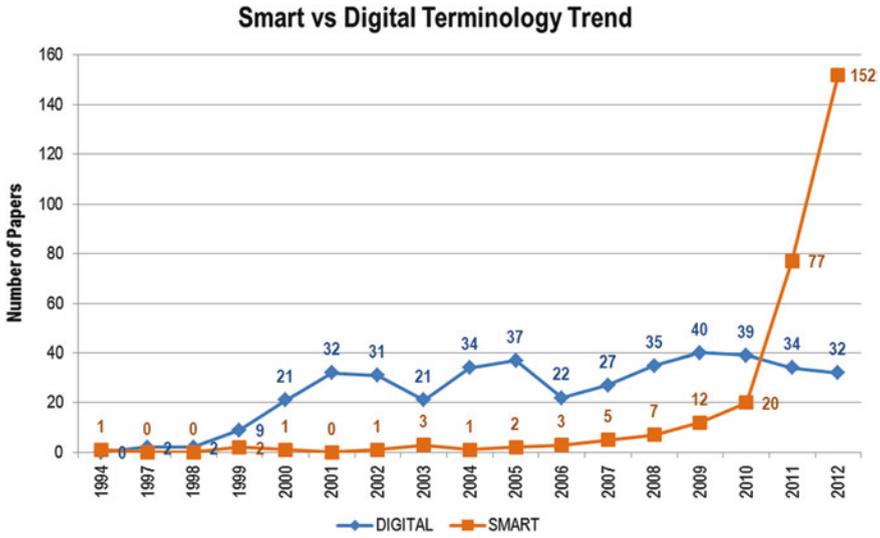
Fig. 3 Terminology analysis: smart versus digital terminology trend

these objectives, the 705 papers stored in the LRS-DB were organized and counted by chronological order of publication and by the label "smart" or "digital" according to the title of paper. The papers terminology trend is represented in Fig. 3.

Figure 3 shows the time distribution of Smart City papers and Digital City papers year by year. The graph underlines that these two topics have a very different time trend and it clearly appears from the figure that the Digital City concept was born before the Smart City one. Indeed, Digital City was conceived and developed in the nineties, in the context of Internet adoption in everyday urban life [20]. Smart City was born in 1994, but papers regarding this topic are few or zero until 2010, when the European Union started to use "smart" to qualify sustainability projects and actions in the urban space [24].

About papers labeled "Digital City", they have been rapidly increasing from 1997 until 2009. In this time frame, "Digital City" is always more used respect to "Smart City". Instead, after 2009, papers labeled Smart City have begun to exceed respect to Digital City papers. In this context, the author identifies two main events influencing the high interest in Digital City topic, in year 1994 and 2000.

1. *1994*, in this year Digital City Amsterdam was born. Amsterdam is the first Digital City in the Netherlands and in Europe. Nowadays, "it is usually taken as example of a successful project in that field" [25]. A major part of its success depends on the use of a virtual *metaphor of city*, because "the use of appropriate navigation metaphors can help to make the structure of modern information systems easier to understand and therefore easier to use" [26]. From this success, other cities tried to repeat the Amsterdam experiment contributing to spread the metaphor of "Digital City".

2. *2000*, this year was characterized by a large widespread of the *Internet* in everyday life and by *ICT* diffusion among citizens [17, 18]. In this context, the author believes that the newness of topic, the accessibility and affordability of the Internet and digital devices fostered the increase of papers labeled "Digital City". In these years, there were several studies about Digital City definition: some researchers affirmed that a Digital City is a wired-city [3]; while others affirmed that it is a virtual reconstruction of city [13]; but the most famous Digital City definition is by Ishida in his study about Kyoto Digital City, in which he defines Digital City as "an arena in which people can interact and share knowledge, experiences, and mutual interests" [20]. Ishida's studies have been very important for the development of Digital City topic, because they have paid attention to how a city could summarize different aspects (such as data and information, e-services, etc.) of urban everyday life on the Internet in order to facilitate people in their decisions-making process. Moreover, the Digital City idea is strictly linked with the use of ICT in public administrations and with the e-Government practices, regarding both central governments and also local governments such as municipalities and city councils and administrations. Adopting an e-Government policy a city starts a transformation path towards a digital city.

About papers labeled "Smart City", they had a flat growth until 2010. The author identifies three dates which characterized the most important increase of Smart City papers: 2005, 2007, 2010.

1. *2005*, after 2005 Smart City papers increased little by little year by year. The author identifies the reason of this growth starting point in the *entered in force of Kyoto Protocol*, which is already explained in the previous paragraph.
2. *2007*, Apple Ltd. launched the i-phone, the first *smart phone* and, from this moment, the use of smart devices has been spreading more and more in everyday life. The adjective "smart" identifies devices that combine telephony and computing: smart phone have high-speed data access by Wi-Fi and mobile broadband in order to supply in real-time digital services to their users and, at the same time, to improve their quality of life [27]. So, the success of word "smart" in mobile context could have influenced the adjective "smart" in urban city context; in this case, the smart label identifies a digital device and more generally the building of a digital urban arena, rather than the definition of smart strategies, and it contributes to overlap smart and digital meanings of innovative urban policies;
3. *2010*, papers labeled "Smart City" shows a huge hike till 2012. This strong excess of Smart City papers respect to Digital City ones could be caused by the *Europe 2020 Strategy* approved by European Commission (this issue was analyzed in the previous paragraph). Indeed, Europe 2020 Strategy have widespread the Smart City label in terms of urban space sustainability to the detriment of Digital City label, because the Europe 2020 Strategy focuses its attention on environment safeguard, sustainability and social issues [22].

Therefore, this terminology analysis regarding Smart City papers and Digital City ones highlights the evolution of these two topics:

- both Smart City and Digital City research fields start to develop in the Nineties, however Digital City has been gaining a steady interest for twenty years, while Smart City has a very low number of papers till 2009 and an exponential increasing from 2010 till now;
- the time trends of researches about both these topics are strongly influenced by external drivers, such as technological drivers like the Internet diffusion or the smart devices use, or political drivers such as the Kyoto protocol and the EU 2020 strategy;
- the different time trends regarding these two topics and the different drivers they are influenced by, shows to us that even if Smart City and Digital City are often used like synonymous, they are quite different. Their main differences regards:

  - their contents: the Digital City regards the use of ICT in urban areas, the Smart City regards the attention to be paid to the environmental quality in cities;
  - their nature and relationship with the government: Digital City is a free trend emerging from the daily use of smart and digital devices by citizens, and it incites the local governments to supply e-services, that is, to gradually transform the city into a Digital City; Smart City is a political trend, driven by international institutions, to implement adequate initiatives to improve the environmental quality in cities.

3.3 Definition Analysis

The purpose of the definition analysis is to compare the most cited definitions of Smart City and Digital City, to understand which are the main similarities and the differences between these two concepts, often overlapped or confused.

To accomplish with this goal, the 705 papers stored in the LRS-DB have been organized by the citation number and by the paper focus. Afterwards, the author analyzes and compares the most recurrent and validated definitions of Smart City and Digital City respectively in Tables 3 and 4. Each table discloses the definition and the reference, putting in evidence some words to extract the meaning of these concepts: the bold character is used to outline the human component of Smart/Digital City; while the italic character is used to outline the applied technologies.

The comparison of these definitions helps us to create a sound relationship between these two topics and to understand if and which are the links between these two different urban strategies.

If we consider the human aspect, both the topics refer to people or citizens. 7 out of 9 Smart City definitions regards citizens or people; several definitions explicitly refer to their quality of life in city. Some definitions recall the role of public

Table 3 Most cited definitions of smart city

Definition	Reference
"A Smart City is a city well performing built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens"	Giffinger [37]
"A smart community is a community that has made a conscious effort to use *information technology* to transform life and work within its region in significant and fundamental rather than incremental ways"	California Institute [42]
"A city to be 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 governance"	Caragliu et al. [1]
"Smart city is defined by IBM as the use of *information and communication technology* to sense, analyze and integrate the key information of core systems in running cities"	IBM [6]
"Smart City is the product of *Digital City* combined with the *Internet of Things*"	Su et al. [8]
"Concept of a Smart City where citizens, objects, utilities, etc., connect in a seamless manner using *ubiquitous technologies*, so as to significantly enhance the living experience in 21st century urban environments"	Northstream [47]
"A city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, *communications*, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens"	Hall [36]
"Smart City is a city in which it can combine *technologies* as diverse as water recycling, advanced energy grids and mobile communications in order to reduce environmental impact and to offer its citizens better lives"	Setis-Eu [48]
"A smart city is a well-defined geographical area, in which high technologies such as *ICT*, logistic, energy production, and so on, cooperate to create benefits for citizens in terms of well-being, inclusion and participation, environmental quality, intelligent development; it is governed by a well-defined pool of subjects, able to state the rules and policy for the city government and development"	Dameri [7]

and private services in improving the quality of life; only 4 out of 9 definitions explicitly recall the importance of the environmental impact of urban activities, the concept of better natural resources management or sustainable economic growth. Therefore, in the academic milieu, the idea of Smart City is not so focused on environmental goals, like it happens applying the EU definition; however, in empirical implementations, cities are ever more applying the EU definition, driven by the aim to obtain public funding to realize their own projects for better cities. Instead, in the academic definitions the quality of life is linked with the quality of people and community, depending on the cultural level, the data information and knowledge sharing, but also some other aspects of community life, for example awareness or consciousness, human capital, communication between people and so on.

Table 4 Most cited definitions of digital city

Definition	Reference
"A digital city is substantively an open, complex and adaptive system based on computer network and urban information resources, which forms a *virtual digital space* for a city. It creates an information service marketplace and information resource deployment center"	Qi et al. [49]
"A Digital City has at least two plausible meanings: (1) a city that is being transformed or re-oriented through *digital technology* and (2) a *digital representation* or reflection of some aspects of an actual or imagined city"	Schuler [11]
"The concept of Digital City is to build an arena in which people in regional communities can interact and share knowledge, experiences, and mutual interests. Digital City integrates urban information (both achievable and real time) and create public spaces in the *Internet* for people living/visiting the city"	Ishida [20]
"Digital city denotes an area that combines broadband communication infrastructure with flexible, service-oriented computing systems. These new *digital infrastructures* seek to ensure better services for citizens, consumers and business in a specific area"	Komninos [50]
"The term Digital City (a.k.a., digital community, information city and e-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. The goal of a Digital City is to create an environment for information sharing, collaboration, interoperability & seamless experience for all its inhabitants anywhere in the city"	Yovanof et al. [51]
"Digital City does not refer to a specific urban entity or formal communications mechanism, but it refers to a functional approach which describes four interdependent action types: Digital City supports data and information related to a city in digital format; Digital City supports a *communication infrastructure* (physical or virtual means for enabling information flows); Digital City delivers value added information and innovative services (these are likely to synthesize data from a range of sources, be location based and may include analytical interfaces); Digital City uses *virtual environments* in planning, decision-making and analysis (when data collected by citizens are used in the process of modeling or digitally recorded citizen behavior is influenced by formal planning an analysis a feedback loop is completed)"	Schiewe et al. [13], Dykes [52]

In Digital City definitions, people or citizens are cited, but their role is less proactive. Also the idea of improving the citizens' quality of life is not explicitly enounced in Digital City definitions. Instead, it appears crucial the virtualization process, that is, the transformation of a material city into a virtual city, able to create a new intangible urban dimension where people, relationships and services are virtually joined and shared to build a smarter community.

   This different approach probably derives from the different role of the ICT in these two city ideas. The Digital City is obviously based on ICT: the ICT is the core component of a Digital City and all the other aspects—citizens, services, communities, relationships, communications, information and knowledge, human and social capital—are joined through the technology. Also the Smart City has the ICT like an important element: 7 out of 9 definitions explicitly or not recall the ICT, or the Internet, or similar concepts. Reading the Smart City definitions, it emerges that the ICT is ever an important element characterizing the Smart City, but not the only one, instead together with other aspects.

   Examining the time distribution of the Smart City and Digital City definitions, it emerges also that the Smart City definitions are more recent respect to the Digital City ones: 6 out of 9 are after 2010, whereas only 3 out of 6 Digital City definitions are after 2010. We can argue that the Smart City concept somewhat includes the Digital City idea, that is, the present concept of Smart City actually is a merge of both the environmental requirements of a smart city with the digital requirements and attitudes.

   This latest evidence contradicts the idea of two different contents in Smart City and Digital City; indeed, the Smart City has born from three different sources: the EU source, focusing on the environmental requirements; the digital source, based on the previous experiences of Digital Cities; and the cultural source, that is, the human and social capital able to build the smart community.

   For these reasons, the Smart City definition analysis discloses a wide range of meanings associated with a smart city, including environmental, social and digital components.

3.4 Typology Analysis: Theoretical Versus Empirical

The purpose of the typology analysis is to separate theoretical papers respect to empirical papers and to count them during the time frame regarding the latest twenty years (1993–2012). The reason of this type of examination is to understand if Smart City and Digital City are mainly academic ideas, built on theoretical basis, or if they emerges from concrete implementations in cities, and which is the relationship between theoretical studies and empirical implementations. This analysis, moreover, aims also to investigate if Smart City and Digital City are top-down phenomena or bottom-up ones. For example, analyzing the Amsterdam Digital City case, one of the most successful in Europe and recognized like a pilot case, it emerges that it has been a bottom-up phenomenon, grown from the free use of the Internet by citizens to share their opinion before the local elections. On the contrary, the further experience of Amsterdam Smart City appears like a top-down project, where the Municipality of Amsterdam assumes the leading role to implement several smart initiatives in the urban area. To investigate about the distribution in time of both theoretical and empirical papers helps us to better understand the Smart/Digital City phenomenon and its origin.
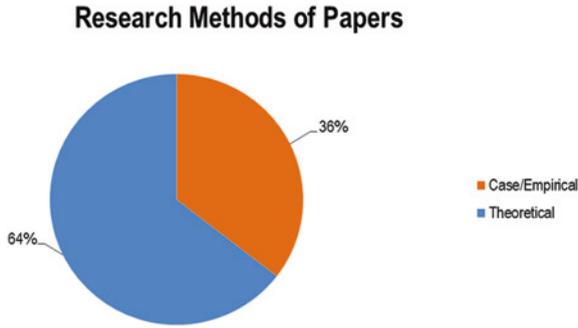
Research Methods of Papers

Fig. 4 Typology analysis: research methods of papers
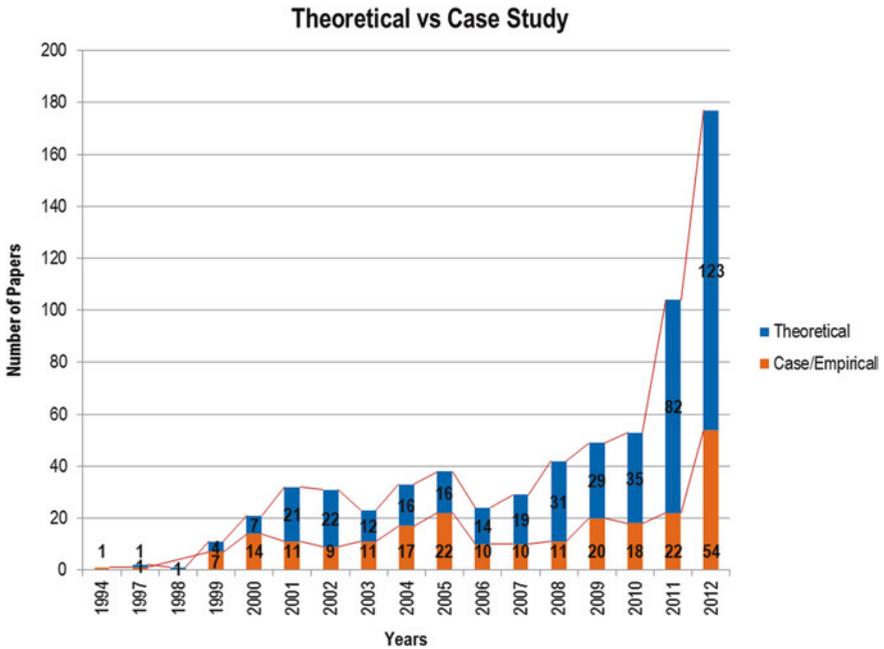
Theoretical vs Case Study

Fig. 5 Typology analysis: theoretical versus case study papers

To accomplish with these objectives, the 705 papers stored in the LRS-DB have been organized and counted by chronological order of publication and by the label "theoretical study" or "empirical study" according to the research method highlighted in the abstract. The share of each research method used in stored papers is shown in Fig. 4; while the theoretical/empirical study time trend is represented in Fig. 5.

As the pie chart shows:

1. *theoretical studies* are 64 % of the reviewed papers. As defined by Wacker [28] in his study about theory research, this category includes papers regarding the following research methods: "conceptual definitions, domain limitations, relationship-building, and predictions". This kind of study is therefore the most adopted among researchers to conduct the study about Smart City and Digital City;
2. *case studies* (also known as empirical studies) are 36 % of the reviewed papers. This type of papers includes researches where "the methodology must use data from external organizations or businesses to test if relationships hold in the external world" [28]. This kind of study includes all papers which investigate on the Smart/Digital City phenomena within its real-life context, in order to verify the empirical applications of theoretical concepts [29]. In this literature review, the object of empirical studies are especially case studies regarding cities implementations and projects defined as smart or digital.

Figure 5 shows the use of different research methods during the time frame 1993–2012: in the first decade, empirical studies are almost always more than theoretical studies. Depending on this evidence, it is possible to argue that the first steps regarding Smart City and Digital City are empirical and therefore the diffusion process probably has been mainly bottom-up; cities or other agents started to implement smart or digital initiatives, without a comprehensive strategy or a leader driving the implementation of a common and shared strategy [30].

Analyzing only the empirical papers, we can note that the smart or digital label is chosen depending on some smart or digital characteristics of one or a group of empirical implementations or projects, without referring to a smart or digital strategic vision regarding the whole city. If we consider a comprehensive smart or a digital vision of the city applied to the empirical papers, we can observe three different contexts:

1. Smart City, when the city follows sustainable strategies through the innovative and sustainable use of its own natural resources;
2. Digital City, when the city follows digital policies aiming to supply e-services to the citizens through the use of technologies such as Web 2.0, Cloud Computing, Internet of Things, and so on [31];
3. Smart City based on Digital City, when the city follows sustainable strategies using technologies applied in Digital City. In this case, the Digital City represents the ICT component on which the Smart City strategy is based.

From the empirical case studies survey it emerges also the central role of technological, innovative solutions for the Smart/Digital City implementations. We can say that the Smart or Digital City development is largely based on the application of innovative technologies to urban projects. It can also explain why at the beginning a shared definition of Smart City has not been conceived: the smart or digital projects have been influenced from the technological innovation and its application to urban areas and themes. It means that the idea of a Smart or a Digital

City has been mainly technology driven, instead of policy driven. However, after several different technological applications have been implemented in cities, and each of them has been qualified as smart, to express a unique, universal Smart City definition has become very difficult. The origin of smart implementations explains therefore why a shared definition of Smart City still lacks.

3.5 Geographic Analysis

The aims of geographic analysis is to discover where all over the world Smart City and Digital City strategies and projects have been more implemented, evidencing geographical areas more interested in smart themes and cities that are considered pilot cases worldwide.

To accomplish with these objectives, each of the 705 papers stored in the LRS-DB has been labeled by the city it refers to, according to the abstract of paper, and each city has been assigned to a continent. In this way, the subset of 705 papers has been analyzed only considering the empirical studies of Smart/Digital City, for a total of 162 case studies. Table 5 shows the relationship between cities and continents. Then the papers have been organized and counted by "empirical study" label and by the "continent". The geographical distribution of Smart/Digital Cities all over the world is shown in Figs. 6 and 7: the first graphic shows a pie chart counting the number of Smart/Digital Cities for each continent; the second one shows a bubble chart about the Smart/Digital Cities geo-location in the world.

Moreover, to better understand Fig. 7, we can see Table 5 depicting the list of Smart/Digital Cities per Continent and per Country.

The geographic analysis of Fig. 6 highlights that:

1. *Asia* is the continent where there is the highest number of Smart/Digital Cities with 49 % of reviewed papers;
2. *Europe,* after Asia, is the continent where there is a relevant number of Smart/ Digital Cities with 36 % of reviewed papers;
3. *North America*, is the third continent in terms of Smart/Digital Cities with 9 % of reviewed papers;
4. *Oceania*, *Africa* and *Middle/South America,* are the continents in which there are the lowest number of Smart/Digital Cities, with respectively 3, 2 and 1 % of reviewed papers.

Figure 7 shows the Smart/Digital Cities position in the world, in order to detect if and where they form some clusters. From the exam of the above bubble chart, different aspects emerge:

- there are macro-clusters of Smart/Digital Cities both in *Asia* and in *Europe*. If we compare this two clusters depending on their extension, we can say that Asia presents a greater cities dispersion than Europe; while Europe highlights a greater cities concentration. In Asia we observe the greatest Smart or Digital

Table 5 List of smart/digital cities geo-location in the world on the basis of 162 case studies analyzed

Continent	Cities
Asia	Amman (Giordania), Bangladesh Region (Bangladesh), Beijing (China), Caofeidian island area (China), Changzhu (China), Chengdu (China), Cheongna (Korea), Dongying (China), Dubai (Emirates), Guangdong (China), Guangzhou (China), Guiyang (China), Hangzhou (China), Harbin (China), Heilongjiang (China), Hong Kong (China), Huizhou China), Jiangan (China), Kochi (India), Kuwait Region (Kuwait), Kyoto (Japan), Lianyuangang (China), Lijiang City (China), Linyi (China), Macao (China), Masdar City (Emirates), Panzhihua (China), Pudong (China), Qianjiang City (China), Seoul (Korea), Shanghai (China), Shenzhen (China), Singapore (China), Subang Jaya (Malaysia), Taipei (Taiwan), Tang Chang'An City (China), Tokyio (Japan), Wuhan (China), Xiamen City (China), Zhengzhou (China)
Europa	Amsterdam (Netherlands), Anpwerp (Belgium), Aveiro (Portugal), Barcelona (Spain), Beaufort (France), Berlin (Germany), Bilbao (Spain), Bologna (Italy), Bolzano (Italy), Bragança (Portugal), Bristol (UK), Como (Italy), Copenhagen (Denmark), Dubiln (Ireland), Fredrikstad (Norway), Genova (Italy), Ghent (Belgium), Helsinki (Finland), London (UK), Luxembourg (Luxembourg), Malta (UK), Manchester (UK), Marseilles (France), Milano (Italy), Nottingham (UK), Oulu (Finland), Parthenay (France), Trikala (Greece), Turin (Italy), Venice (Italy), Vienna (Austria), Vilnius (Lithuania)
North America	Charlotte (USA), Cleveland (USA), Edmonton (Canada), Iowa (USA), Montreal (Canada), New York (USA), Portland (USA), Quebec City (Canada), Saskatoon (Canada), Seattle (USA), Sudbury (Canada)
Oceania	Adelaide (Australia), Brisbane (Australia), Melbourne (Australia), Parramatta (Australia)
Middle/South America	Curitiba, Paranà (Brazil), Juarez (Mexico), Mexico City (Mexico), Nassau (Bahamas), Rio de Jainero (Brazil)

Cities concentration only in correspondence to the Chinese east coast; while European Smart/Digital Cities appear to be more concentrated in the North Sea Region (that is the Netherlands, Belgium, United Kingdom, Scandinavia) and in the Mediterranean Region (that is Spain, France, Italy);

- there is a little Smart/Digital Cities cluster also near the Great Lakes Region between United States and Canada (*North America*);
- in *Oceania* and in *Africa*, there are the smallest clusters observed and in both cases they are located along the most populated and developed areas: Australian east coast and South African coast.

The same results have been reached by the Ericsson Report about Networked Society City Index. This report shows that "cities located in Northern Europe, North America and parts of East Asia have a longer tradition of producing and using ICT equipment, and have therefore been able to benefit from their
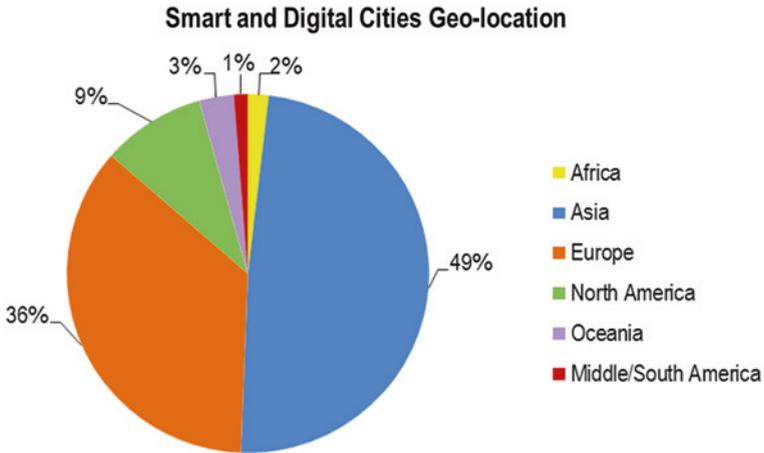
Smart and Digital Cities Geo-location

Fig. 6 Geography analysis: smart/digital cities geo-location (per continent) on the basis of 162 case studies analyzed
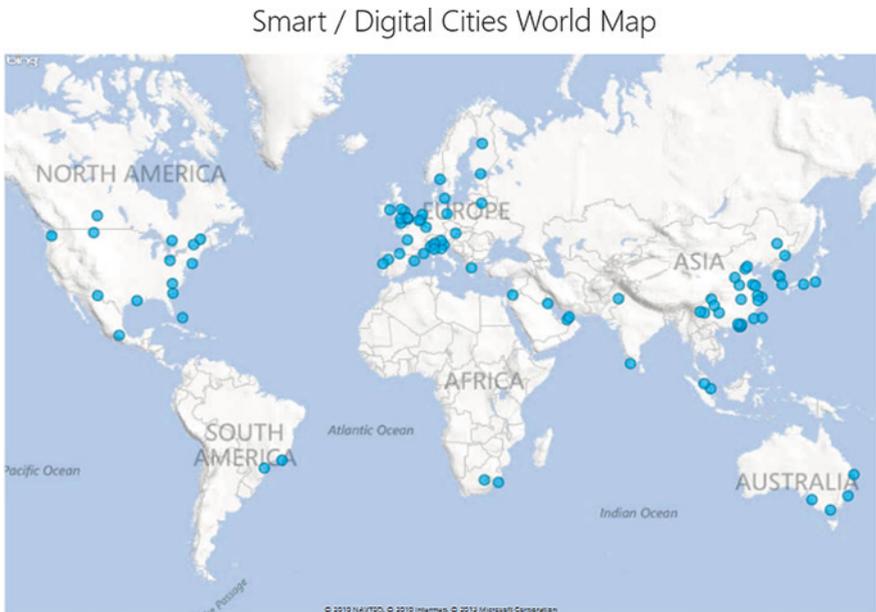
Smart / Digital Cities World Map

Fig. 7 Geography analysis: smart/digital cities geo-location in the world on the basis of 162 case studies analyzed

investments over longer periods of time" [32]. Indeed, from the literature review about city case studies, we can observe that the spread of Smart/Digital Cities in Asia, Europe and North America have some shared features:

1. the widespread and development of ICT infrastructures, considered like:

   – Internet diffusion among citizens in everyday life [17];
   – Internet more accessible and affordable for many people to reduce digital divide [33];
   – data sharing and open data;
   – increase the adoption of Community Network to supply e-government services (this aspect is more relevant especially among Smart/Digital Cities in Europe);
   – focuses on the use of ICTs for public administration;
   – to provide better public services and e-services also using Web 2.0 technology;
   – increase urban wealth [1];
   – increase innovation and entrepreneurship [32];
   – increase social cohesion;

2. the adoption of green policies for a smart growth, in order to:

   – reduce issues about urban crowding in terms of pollution reduction, improvement of urban planning, safety and sanitary conditions, power demand sustainable, and so on (these aspects is more relevant especially among Chinese Smart/Digital Cities);
   – reduce CO_2 emissions and greenhouse gases;
   – improve mobility services to reduce traffic congestion and then pollution;
   – achieve sustainable urban development and a better urban landscape [1].

Instead, Smart/Digital Cities in Middle/South America and Africa have in common the widespread and development of ICT infrastructures, but for other reasons in respect to Asia, Europe and North America. For example:

• to attract foreign investment promoting local advantage and to improve cultural, economic and social development [34];
• to enable service delivery and economic development;
• to enable the transition to a knowledge economy;
• to focus on ICT access in rural and periphery urban areas [35].

4 Conclusions

The large literature survey described in this work aims to clarify several aspects regarding the new, still immature strategies of Smart City and Digital City. Several goals have been reached thanks to this deep survey. We can summarize them respect to three large themes:

• Smart/Digital City definition;
• birth of Smart/Digital City ideas;
• diffusion of Smart/Digital City implementations.

Regarding the definition of both Smart City and Digital City, we can observe that a shared and acknowledged definition of both Smart City and Digital City still lacks. However, there are several most cited definitions and they are establishing themselves like standards (see for example Hall [36], Caragliu [1], Giffinger [37]). Digital City definitions show a higher uniformity, because all of them are focused on the key role of ICT in improving the quality of services and information supplied to citizens. Smart City definitions are more different each others, mainly because the purpose of a Smart City is often too large, that is, to improve the quality of urban life; depending on this goal, everything could be considered smart! However, deepening our analysis, we discover some shared features characterizing Smart Cities, that is, the role of innovation and technology, the environmental requirements, the economic and social development. Sometimes, especially during the latest years, also the use of ICT has been included into the Smart City perimeter; it means that the Digital City is becoming a subset of the Smart City.

Regarding the birth of Smart City and Digital City, both of them date back to twenty years ago environ. However, the Digital City has a development synchronized with the Internet diffusion, especially in everyday life and in e-government. This development has been quite stable during the latest twenty years, with some peaks around 2000. Smart City, on the contrary, had a very slow development till 2010, when the UE assumed the Smart City like one of its key development paths. From this year, papers and researches about this topic have a strong outburst.

It is interesting to note that the birth of both Smart City and Digital City has been mainly empirical, and only after sometime a theoretical research activity about these topics started to increase. Moreover, this empirical birth is also bottom-up, that is, it derives from the independent, free application of ICT or other innovative technologies to smart and digital aims, to improve the quality of life in cities. For this reason, Smart City and Digital City are often the result of a sum or collection of single initiatives, instead of the outcome of a well conceived strategy. Only the latest Smart City implementations show a new trend, towards a top-down path, where municipalities are assuming a leading role in defining and driving a comprehensive vision about the Smart or Digital City programs. Both Smart City and Digital City empirical implementations are strongly driven by the technology. ICT or engineering technologies are the real engine of the Smart/Digital projects, even if different are their application fields: information sharing, communication and citizens involvement for Digital City projects, environmental safeguard, pollution reduction and infrastructure quality for Smart City projects.

Also the diffusion of SmartCity and Digital City is largely driver from the technological progress. Indeed, the presence of Smart Cities or Digital Cities among the continents is higher where higher is the economic and scientific development of a country. Obviously, a strong driver for a Smart/Digital City implementation is the city dimension: indeed, the larger is the city, the worse is its environmental impact, to be reduced thanks to Smart City programs; the larger is the city, the better are the benefits deriving from data and knowledge sharing and e-services supply, to be taken thanks to Digital City programs [38].

Finally, we can say that the Smart City and Digital City phenomena are strongly spreading both in theoretical researches and in empirical implementations. Sometimes it is the result of a support from national or international governments, institutions or political bodies, such as the EU, that also finances Smart City projects in Europe; but more frequently it is the result of a new, innovative idea about city and urban life: more pleasant, more inclusive, greener and cleaner. The Smart City is nowadays seen like a key strategy to improve the quality of life of billions of people living in cities all over the world.

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