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A QUANTITATIVE COMPARISON OF SMART CITIES BETWEEN CHINA AND ITALY*

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Abstract. This study aims to evaluate the similarities and differences between several Smart Cities in Italy and China. For these reasons, the paper is based on two key points; the first is a broad literature review about Smart Cities to explore their evolution and identify strategic elements; the second is based on a quantitative survey of Italian and Chinese Smart Cities to show and compare common and different characteristics. The Smart City concept is a new method of seeing the city of the future. Technological and socioeconomic solutions are required for implementation concerns. Smart Cities solve local and global problems through modern technology and efficient resource management. Nonetheless, each area implements smart projects, activities, and tools as needed based on its unique concerns. There are exciting and substantial differences in Smart City implementation. The research findings present a taxonomy of parallels and differences between Italian and Chinese Smart Cities based on identified essential features.

Keywords: Smart city; Italy; Chine; Technological challenge

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JEL Classifications: I18, P46, O33, O32, M12, C54, C30

1. Introduction

The Smart City is a new way of thinking and managing economic and social relations. Technological innovation changes the role and performance of cities. The realization of this innovative configuration of the city has led to the decentralization of people and infrastructures in the metropolis, generating solutions relating to energy needs, social inclusion, employment, and quality of life. The Smart City, as an implementation of innovative technologies, represents a new management of city government. This new management must recognize local and national government contexts in which a particular city is located. Therefore, within the definition of a Smart city, for which there is no shared definition, there are different operational realizations. These differences are due to the implementation of actions and tools that best meet their specific needs and, on the other hand, the difficulty of overcoming cultural and technological delays, for example, linked to the digital divide. Following what was stated

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above, this study aims to evaluate the similarities and differences between several Smart Cities in Italy and China. In this context, three research questions (RQ) emerge: (RQ1) Which cities could be most attracted to the creation of Smart cities? (RQ2) What government decisions do the initiatives to create Smart City? (RQ3) What is the quality of life level in evolving Smart cities? Starting from the three RQs, the authors decided to investigate Italy and China, two profoundly different countries at a territorial, cultural and regulatory level, but both very active in creating Smart Cities.

In Italy, Smart Cities are widespread in metropolitan cities and small urban centres. However, the Italian government is characterized by a decentralized administrative power that delegates the construction of Smart Cities to Local Authorities. In fact, in Italy, the creation of Smart Cities is managed by the Municipalities. This legal setting determines that the objectives are predominantly local, using investments from the European Union (EU). The Italian Smart Cities aim to implement sectorial innovations, for example, in local transport (smart mobility), according to the main specific criticalities of the territory. The method followed is of the bottom-up type rather than a strategic program.

On the contrary, in China, administrative power is centralized in the central government, which dictates a precise national urban planning strategy. Therefore, the development of intelligent Chinese cities follows a strategic planning set by the central government with a top-down method. Following this research stream, the authors considered it interesting to investigate the dynamics related to the creation of Smart Cities in Italy and China. They investigated whether similarities and differences can emerge in implementing Smart Cities in these two countries. The research develops the following topics: paragraph 2 explores the international scientific literature on which to base the comparison of Italian and Chinese smart cities subsequently; paragraph 3 defines the objectives of the research and the working methodology downstream of the exploration of the literature on the topic of the Smart City which enhances the three RQs highlighted above; paragraph 4 examines the distinctive elements of the Italian and Chinese Smart Cities by comparing both the scientific literature and the empirical cases summarizing the results of the research by grouping the characteristics that emerged from the comparison between Italian and Chinese Smart Cities, paragraph 5 discuss to highlight common and non-common aspects also develop new research topic; paragraph 6 underline the necessity of research agenda; paragraph 7 deals with the conclusions of the work. The research is aimed at both local and national governments, investors, citizens, academic researchers and sector operators.

2. Literature review

Rapid advances in information technology (IT) have empowered cities to acquire and redistribute massive amounts of data to enhance the delivery of public services. Smart cities enable the public sector to boost the value of services supplied to the community by leveraging IT infrastructure and smart devices. This observation results from a course of study that can be presented using research that has received the greatest attention, both as citations and applications, by scholars and governments implementing smart cities. Table 1 highlights both approaches concerning time. Veiga et al. (2001) highlight the importance of creating a dynamic system linked to IT. A clear identification between the creation of a dynamic system and the birth and development of a smart city is not yet present in the research of the time. In 2002, Hislop's study highlighted the need to evaluate the relationship between technological innovation and service innovation. The relationship between technological innovation (IT) and service innovation (IS) represents for the authors the central and underlying theme that must be developed with both theoretical and applicative studies and research in the various economic and social disciplines that see technological innovations as the protagonist of a profound change in society. Pang et al. evaluated This research work as extremely interesting in 2014, considering it to be highly topical after 14 years after its first release. Giffinger (2007) devotes attention to the issue, clearly defining a smart city. The author identifies three main elements that must combine as a prerequisite for developing a Smart City: performance, intelligence, and autonomous aware citizens. Caragliu et al. (2009) highlight the need to deepen the studies and

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research regarding the role and potential of information and communication technologies (ICT). In this approach, particular attention is linked to the idea that Smart cities invest in human and social capital and ICT (Pariso et al., 2019) infrastructure developing economic growth and high quality of life through IT governance (Medaglia et al., 2021). Li et al. (2009) developed a specific study concerning public transport, highlighting results applicable to the development and management of smart cities with particular reference to a territory's economic and service organization dimension. Following this research stream, Lacity et al. (2010) developed a study in which physical infrastructure related to services, businesses, and close connections are strategic enabling factors to boost smart cities. Other researchers, Correia et al. (2011), starting from these studies, highlight that, in addition to technological infrastructures, physical and social capital and the political vision of governments represent enabling factors to accelerate the transition towards the development of smart cities. At the same time, Pardo and Nam (2011) highlight the importance of strategies that necessitate innovative behaviours of cooperating with stakeholders, managing resources and providing services. This is one of the first approaches highlighting the need for cooperation between the different actors who can create a smart city, assigning a specific domain to politics in developing smart cities. Technological innovation, particularly digital innovations, is at the centre of the study proposed by Komninos et al. (2012). Smart Cities are joined collective, physical, organized spaces in which digital technologies represent the enabling factor for the development of the Smart city. The central role of the environment concerning the quality of life of the inhabitants and workers in the city or reaching it as a tourist destination is highlighted by Sue et al. (2012). The role of digital innovations is also evaluated as a central element for developing the Smart City by Batty et al. (2012). Following this research stream, Meijer et al. (2014), point out the strategic importance of investments in human and social capital, in communication (Capone et al., 2020) infrastructure, as enabling factors that represent together with a wise management of participatory governance, the possibility of developing the Smart city. From an international point of view, Luftman et al. (2013) underline the importance of specific technological tools as apparatuses that create opportunities and new challenges in the organization of both public and private services. Pang et al. (2014), starting from the relationship between IT and IS, developed focus research based on technological innovation and technological bottlenecks related to government action, i.e. digital divide. Henfridsson et al. (2014) highlight the strategic importance of the relationship between IT and IS with particular attention to the digital age. Furthermore, this approach concerns many geographical areas of the world. It has been identified nationally and globally as one of the main elements to be removed to speed up the transition to the digital society (Pariso et al., 2019a) in which smart cities represent a visible achievement. Albino et al. (2015) highlight the importance of clarifying related expressions frequently used interchangeably. Like the previous ones, this contribution is interesting for the clarifications it provides to the reader in applying the main concepts associated with the study of Smart cities. In line with previous studies, Montahy et al. (2016) developed technological change as the strategic domain in terms of information, digital, and telecommunication technologies that can improve the city's services for the benefit of its inhabitants. It is interesting to report this study because the domain of development sustainability is integrated with technological change. Sustainability assessment is the strategic topic of Ahvenniemi et al. (2017). In this study, the authors develop the idea that in the 21st century, there has been a move from sustainability assessment to smart city goals. A strong critical approach linked to research based on systematic understanding can be traced back to Ruhlandt (2018). The synthesis of his criticism can be summarized as shown in Table 1. In this context, De Reuver et al. (2018) introduce digital platforms as research agenda. The authors developed the relationship between IT and IS with particular attention to future applications of digital technologies. An interesting upgrade related to digital technologies and their application was published by Nicolescu et al. (2018). Tumbas et al. (2018) highlight the strategic importance of digital innovation and specific professionality related to the future development of digital technologies. The relationships between the urban developments of cities concerning the use of technological innovations are the focus of the research developed by Lau et al. (2019). Øvrelid et al. (2019) highlight the importance of digital infrastructure as strategic support to develop digital transformation. Lyytinen (2019) argue that the development of this topic should be approached with the information system. Starting from this assumption, evaluating Smart cities using quantitative measurement variables is the theme developed by Lai et al. (2020). This approach can contribute to developing standards, "Standards are used to help regulate how smart

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cities function and contribute to defining a smart city (Lai et al., 293). Starting from real experience, Pelizza (2020) argues that IT create an accumulation of knowledge in the public sector through large amounts of data, and proper management can improve public service delivery. The author argues that this process is an opportunity and a challenge for the city. Following this research stream IT, public services Tsohou et al. (2020) published research highlighting the necessity to realize smartness in public sector innovation with sufficient management capabilities and robust technology strategies. In 2020, Wiener et al. published a contribution that pointed out results related to digital transformation in the public sector; the article is placed in the research field developed concerning the relationship between IT and IS.

The role and concept of a smart city, based on advanced information and communications technology (ICT), developed by Wu et al. (2021) is strictly linked to the impact of rapid urbanization

Table 1. The evolutionary concept of Smart city - timeline of references

Evolutionary Concept of Smart City	Reference
National Culture on IT Implementation and Acceptance as a dynamic model	Veiga et al., 2001
The difficulties in measuring benefits and costs need to be clarified about the expected impact of IT/IS and, thus, are major problems facing decision-makers.	Hislop, 2002
A Smart City is well performing built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens.	Giffinger, 2007
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 high quality of life, with a wise management of natural resources, through participatory governance.	Caragliu et al., 2009
This enables service providers to employ advanced price differentiation and service expansion strategies and achieve new 'best practices in revenue management.	Lacity et al., 2010
A Smart City can link physical capital with social one and develop better services and infrastructures. It can combine technology, information and political vision into a coherent program of urban and service improvements.	Correia et al., 2011
Smart Cities are about leveraging interoperability within and across policy domains of the city. Smart City strategies require innovative ways of interacting with stakeholders, managing resources and providing services.	Pardo and Nam, 2011
Smart Cities are integrated social, physical, institutional, and digital spaces in which digital components improve the functioning of socioeconomic activities and the management of physical infrastructures of cities while also enhancing the problem-solving capacities of urban communities.	Komninos et al., 2012
Smart City is a city which it can combine technologies as diverse as water recycling, advanced energy grids and mobile communications to reduce environmental impact and offer its citizens better lives.	Su et al., 2012
Cities are becoming smart not only in terms of how we can automate routine functions but in ways that enable us to monitor, understand, analyze and plan the city to improve the efficiency, equity and quality of life for its citizens in real-time.	Batty et al., 2012
Technology connects the physical infrastructure, the IT infrastructure, the social infrastructure and the business infrastructure to leverage the collective intelligence of the city.	Luftman et al., 2013
A city is to be smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and high quality of life, with a wise management of natural resources, through participatory governance.	Meijer et al., 2014
The focus is shifting towards services and affordances that offer value to individuals, organizations, and society.	Pang et al., 2014

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As the term "smart city" gains broader currency, there is still confusion about a smart city, especially since several similar terms are often used interchangeably.	Albino et al., 2015
A smart city is a place where traditional networks and services are made more flexible, efficient, and sustainable using information, digital, and telecommunication technologies to improve the city's operations for the benefit of its inhabitants.	Montahy et al., 2016
In the 21st century, there has been a shift from sustainability assessment to smart city goals.	Ahvenniemi et al., 2017
Research on smart cities needs a systematic understanding of the different components of smart city governance, the metrics to measure these components, their envisaged outcomes and potential contextual factors influencing both components and outcomes.	Ruhlandt, 2018
The advancement of various research sectors has shed some light on transforming an urban city, integrating the techniques mentioned above into a commonly known term - Smart City.	Lau et al., 2019
The smart city concept is ambitious and is being refined with standards. Standards are used to help with regulating how smart cities function and contribute to defining a smart city.	Lai et al., 2020
Recent information technology (IT) developments have enabled cities to collect and disseminate important data to improve public service delivery. "Smart cities" allow the public sector to leverage IT infrastructure and smart devices to increase the value of services delivered to the community.	Pelizza, 2020
Realizing smartness in public sector innovation requires sufficient management capabilities, robust technology strategies, and a willingness to explore and adopt new work practices rather than implement emerging technologies.	Tsohou et al., 2020
We discuss the contribution of our analyses to the research on big data (and IT adoption in general) by older people, the digital divide, and technology acceptance and identify potentially effective paths for future research and theoretical development.	Wiener et al., 2020
The concept of a smart city, based on advanced information and communications technology (ICT), emerged to mitigate the impact of rapid urbanization and was considered feasible.	Wu et al., 2021
Security and Privacy in smart cities	Al-Turjman et al., 2022

Source: our elaboration

Table 1 describes how the concept of a smart city has been approached in the last 21 years of literature, both related to the development of cities as a geographical area and urban space, both with public service and to its organization in terms of government dimension by public administrations and private institutions.

2.1. Concept Evolution of Smart City

Despite these differences, some strategic pillars are identified by the authors cited above. The importance of advanced technological networks and infrastructures (Caragliu et al., 2009; Luftman et al., 2013; Meijer et al., 2014; Marino et al., 2021) is detectable in the concept of Connectivity. It predicts STEM expertise, professional education, and background (Correia et al., 2011; Komninos et al., 2012; Pang et al., 2014, Pariso et al., 2019), highlighting the importance of Human Capital in the management of advanced technological networks and infrastructures. A better quality of management supports the development of innovative services for government, governance, and citizens (Giffinger, 2007; Su et al. 2012; Pelizza 2020; Marino 2001) creating a clever use of services. Furthermore, the integration between government, governance, and citizens also makes a competitive business for the firms (Pardo and Nam 2011; Lau et al., 2019; Tsohou et al., 2020, Marino et al., 2022, 2022a) identifiable in the necessity to enhance their technological level. The development and delivery of public services (Batty et al. 2012; Montahy et al., 2016; Tsohou et al., 2020, Di Martino et al., 2020) represent a key factor in realizing a smart city. All these strategic features, summarized in five pillars, highlight a common factor present in the literature given by the relationship between Innovation Technology (IT) and Innovative Services (IS) (Nicolescu et al., 2018; De Reuver et al., 2018, Øvrelid et al., 2019; Lyytinen, 2019; Willcocks et al., 2020,

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Wiener et al., 2020; Pelizza, 2020; Tsohou et al., 2020) declining a new idea of smart city. Following this point of view, the summary of the 21 years of literature is shown in Figure 1. Creating a Smart City can be presented as a continuous circular process.

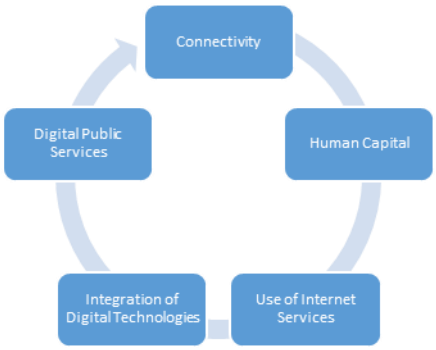

Figure 1. Key Pillars of Smart Cities
Source: our elaboration

Our study is part of this path and in the Journal that began its development. Starting from this assumption, the authors partially reformulate their research questions: (RQ1) Which cities have made the most significant connection between IT and IS in China and Italy? (RQ2) What government decisions in IT and IS do the initiatives to create Smart City? (RQ3) What is the quality of life level in evolving Smart cities? Starting from the three RQs, the authors confirm to investigate Italy and China, two countries so profoundly different at a territorial, cultural and regulatory level, but both very active in creating Smart Cities.

3. Methodology

To evaluate the three RQs, a quantitative approach will be used. A smart city can be presented as a continuous circular process. The Smart city is a complex matrix in which different dimensions are strictly related. The comparison between Smart cities should consider the dimensions in Figure 1: Connectivity, Human Capital, Use of Internet Services, Integration of Digital Technologies, and Digital Public Services.

The connectivity dimension takes both fixed and mobile broadband into account. The Connectivity contains four sub-dimensions, as displayed in Table 3. Connectivity is the premise for developing the relationship between IT and IS; this relationship was clarified by (Nicolescu et al., 2018; De Reuver et al., 2018, Øvrelid et al., 2019; Lyytinen, 2019; Willcocks et al., 2020, Wiener et al., 2020; Pelizza, 2020; Tsohou et al., 2020) and reported in the previous paragraph on the literature review. Human capital: the recent pandemic confirmed how significant digitalization has become to our economies and how basic and advanced digital skills related to human capital can sustain our societies. Human capital contains two sub-dimensions, as displayed in Table 3. Human capital and its sub-dimensions are linked to individuals, organizations, and society. The use of internet services is strategically attractive in a pervasive range of online activities that are possible for those citizens with an internet connection and the necessary skills to benefit from. This dimension contains three sub-dimensions, as displayed in Table 3. The digital community is strictly linked to the adequate development of Internet services. Integrating digital technology allows cities to gain a competitive advantage by improving their services, products and expanding their domains. The sub-dimensions are two, as displayed in Table 3. This dimension, particularly integration, requires management capabilities and robust technology strategies. Digital public services require the supply and demand side of digital public services. The key pillars, pointed out by the literature review and displayed in

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Figure 1 as a continuous circular process, are strategic dimensions the European Commission considers to assess technological and service innovation levels applied to a geographical area. Implementing these dimensions is linked to elaborating the Digital Economic Social Index (DESI). DESI allows us to evaluate the three research questions in the literature review. Following the methodological note (European Commission, 2018) and according to their characteristics, different weights were given to each of the five dimensions, displayed in Table 2.

Table 2. DESI Dimensions and their sub-dimensions

Dimension weights	***Sub Dimension weights***
1 Connectivity 25%	1.1 Fixed Broadband 8,5%
	1.2 Mobile Broadband 5,5%
	1.3 Speed 8,5%
	1.4 Affordability 2,5%
2 Human Capital 25%	2.1 Basic Skills and Usage12,5 %
	2.2 Advanced Skills12,5 %
3 Use of Internet Services 15%	3.1 Content 5%
	3.2 Communication 5 %
	3.3 Transactions 5%
4 Integration of Digital Technology 20%	4.1 Business Digitization 12%
	4.2 E-commerce 8%
5 Digital Public Services 15%	5.1 E-Government 13,5 %
	5.2 E-Health 1,5%

Source: DESI – Eurostat 2020

Based on a methodological note elaborated by Eurostat (2020), the repartition of specific weights follows these criteria: 25% Connectivity and Human Capital. This weight, which represents the highest, has been assigned because it shows the countries' investments in IT (Connectivity) and Digital Economy (Human Capital). 20% Integration of Digital Technology. This dimension captures the use of ICT by businesses. 15% Use of Internet Services and Digital Public Services. These are the last two enabling dimensions, where the first capture the use of the internet by citizens, and the second displays the digitization of public services. DESI will be applied to Italian and Chinese cities, which have the potential to consolidate the processes relating to the establishment of Smart cities. Starting from OECD (2020) Functional Metropolitan Areas in OECD countries and Demographia World Urban Area (2020) applying DESI criteria, 10 cities as metropolitan areas have been chosen. DESI will be used to Italian and Chinese cities, and the total comparison amount to several cities. To be uniform, the comparison develops as a criterion of the comparability of population density, that is, inhabitants/surface (Km2). The cities with similar values have been evaluated by implementing the DESI.

The aggregation of the indicators expressed in the different units in the sub-dimensions and the dimensions of the DESI, table 3, are normalized. In DESI, normalization was performed using the min-max method, which consists of a linear projection of each indicator on a scale between 0 and 1.

$$z = \frac{\mathrm{x} - \min(x)}{\max(x) - \min(x)}$$

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$$DESI(N) = Connectivity\ (N) * 0{,}25 + Human\ Capital\ (N) * 0{,}25 + Use\ of\ Internet\ Services\ (N) * 0{,}15 + Integration\ of\ Digital\ Technology\ (N) * 0{,}20 + Digital\ Public\ Services\ (N) * 0{,}15$$

DESI in line with the literature review, offers a practical operational application to our research questions. Furthermore, it evaluates the predisposition of Italian and Chinese cities to evolve towards a Smart city. It can monitor the Smart City's digital performance and track progress regarding its digital competitiveness. It is a structured index that assesses each Smart city's development state. The data processing was developed using a forecasting software package Statistical Package for Social Science (SPSS 26.0) which allows complete forecasts and analyses with multiple models for the estimation of trends, and methods for estimating regression functions.

4. Results

As stated in the methodology, starting from OECD (2020) Functional Metropolitan Areas in OECD countries and Demographia World Urban Area (2020), the comparison, to be uniform, uses as a criterion, that of the comparability of population density, that is, inhabitants/surface (Km2). Tables 4 and 5 show the cities, texture, inhabitants and population density. Such choice allows us to create comparable significative sampling data that apply DESI.

DESI, applied to the Italian and Chinese cities, selects 10 cities for each Nation, so the total comparison amount to 20 cities. The Italian metropolitan areas are: Torino, Milano, Genova, Bologna, Firenze, Roma, Napoli, Reggio Calabria, Catania, Cagliari. The Chinese metropolitan areas are: Chongqing, Tianjin, Fujian, Henan, Shandong, Jiangsu, Guangdong, Shanghai, Pechino and Zhejiang.

Table 3. Italian metropolitan area

City (metropolitan area)	Surface in Km^2	Inhabitants	Density (Inhabitants/ $Km^{2)}$
Torino	6.827,00	2.277.857	334
Milano	1.575,65	3.218.201	2.043
Genova	1.833,79	850.071	464
Bologna	3.702,32	1.009.210	273
Firenze	3.513,69	1.014.423	289
Roma	5.363,28	4.353.738	812
Napoli	1.178,93	3.107.006	2.638
Reggio Calabria	3.210,37	553.861	173
Catania	3.573,68	1.113.303	312
Cagliari	1.248,68	431.657	346

Source: our elaboration on OECD dataset (2020)

Table 4. Chinese metropolitan area

City (metropolitan area)	Surface in Km^2	Inhabitants	Density (Inhabitants/ $Km^{2)}$
Chongqing	82.401	30.484.300	369
Tianjin	11.760	15 621 200	1.328
Fujian	121.400	38 565 000	317
Henan	167.000	95 590 000	572
Shandong	6.340	29 863 300	4.709
Jiangsu	102.600	80 400 000	783
Guangdong	179.800	113 460 000	631
Shanghai	6.340	29 863 300	4.709

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Pechino	16.808	24 516 000	1.458
Zhejiang	101 800	57 370 000	563

Source: Our elaboration on the Demographia World Urban Area data set (2020)

It is interesting to note that from Tables 3 and 4, above, the 10 Italian cities have a territorial surface and a population significantly lower than the 10 Chinese cities. Nevertheless, the demographic density is comparable to the urban realities of both countries. In line with this result, the authors believe that the DESI and its dimensions and sub-dimensions can be applied to the total of cities in the two tables, 20 cities.

4.1 Connectivity

The Connectivity contains four sub-dimensions, as displayed in Table 3: fixed broadband, mobile broadband speed and affordability. In this dimension, Guangdong, Shanghai and Pechino for Chine and Milano for Italy indicate all the potential to consolidate and develop the implemented smart city. Furthermore, the other Italian and Chinese cities are included in the range between 0,8 and 0,4. Specifically, the remaining seven Chinese cities rank between 0,6 – 0,8. Italian cities Torino, Roma, Genova, Bologna and Firenze rank between 0,6 – 0,4. Although the cities of southern Italy, Reggio Calabria, Catania and Cagliari are between 0 and 0.2 with Naples, another city in southern Italy is close to the range of the others.

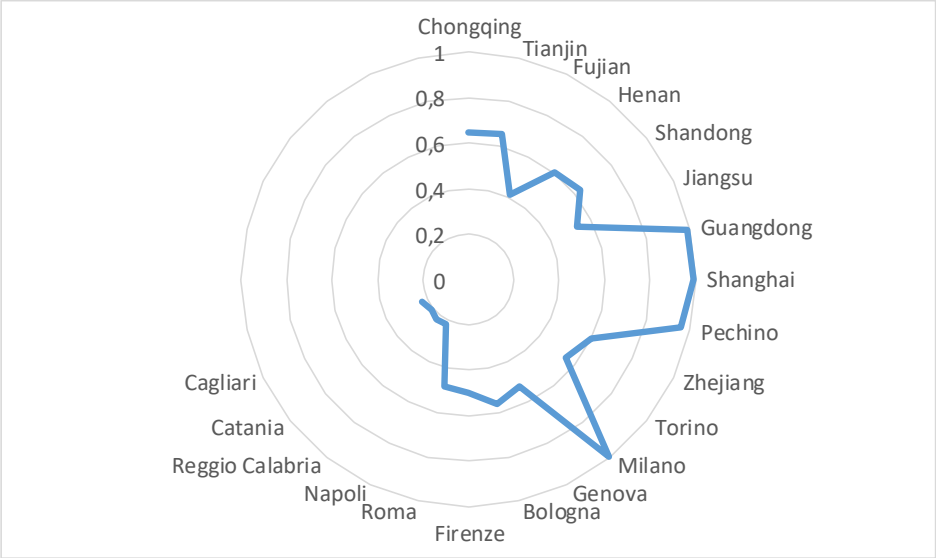

Figure 2. Connectivity
Source: our elaboration

4.2 Human Capital

Human capital contains two sub-dimensions, as shown in Table 3: essential and advanced skills and usage. In this dimension, Guangdong, Shanghai and Pechino for Chine and Milano for Italy display all the potential to consolidate and develop the implemented smart city. Furthermore, the other Italian and Chinese cities are included in the range between 0,8 and 0,4. Specifically, the remaining seven Chinese cities Tianjin, Fujian, Henan, Shandong, Jiangsu, Zhejiang, Chongqing rank between 0,4 – 0,6. Italian cities Torino, Genova, Roma, Bologna and Firenze rank between 0,6 – 0,4. Although the cities of southern Italy, Reggio Calabria, Catania and Cagliari are between 0 and 0.2 with Naples, another city in southern Italy is close to the range of the others.

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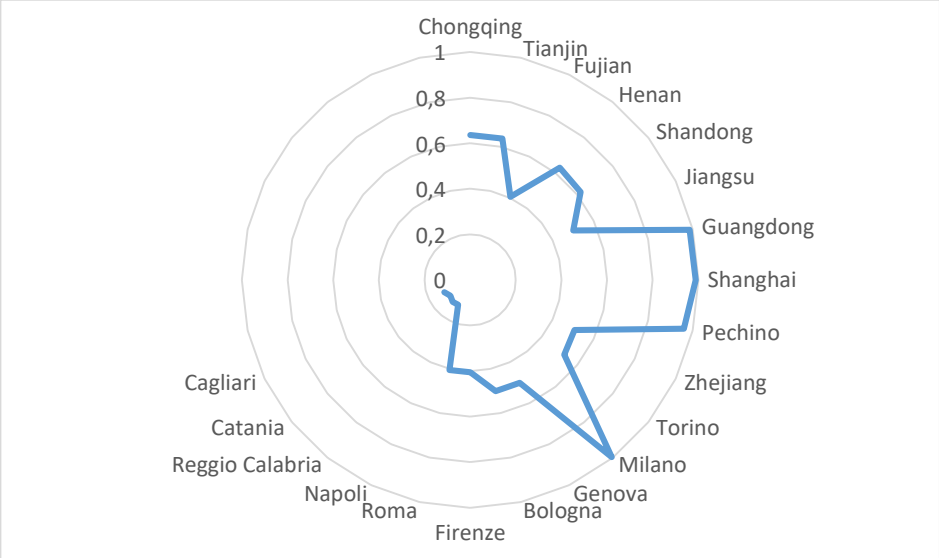

Figure 2. Human Capital
Source: our elaboration

4.3 Use of internet services

The use of internet services contains three sub-dimensions, as displayed in Table 3: content, communication, and transactions. In this dimension, Guangdong, Shanghai and Pechino for Chine and Milano for Italy demonstrate all the potential to consolidate and develop the implemented smart city. Furthermore, the other Italian and Chinese cities are included in the range between 0,8 and 0,4. Specifically, the remaining seven Chinese cities Tianjin, Fujian, Henan, Shandong, Jiangsu, Zhejiang, Chongqing rank between 0,6 – 0,8. Italian cities Torino, Genova, Roma, Bologna and Firenze rank between 0,6 – 0,4. Although the cities of southern Italy, Reggio Calabria, Catania and Cagliari are between 0 and 0.2 with Naples, another city in southern Italy is close to the range of the others.

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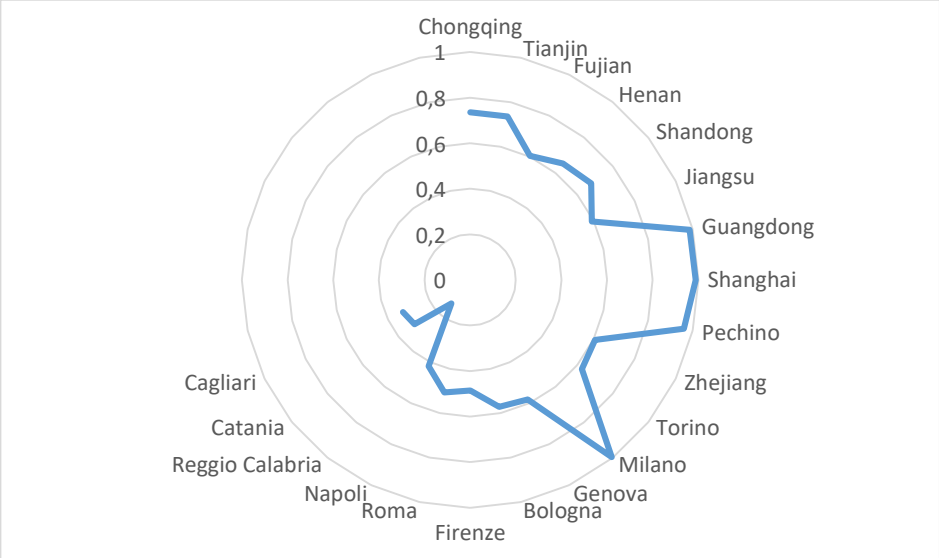

Figure 4. Use of Internet services
Source: our elaboration

4.4 Integration of digital technology

The subdimensions are two as displayed in Table 3: business digitization and E-commerce. In this dimension, Guangdong, Shanghai and Pechino for Chine and Milano for Italy demonstrate all the potential to consolidate and develop the implemented smart city. Furthermore, the other Italian and Chinese cities are included in the range between to 0.8 and 0.4. Specifically, the remaining Chinese cities are distributed as follows: Tianjin, Fujian, Henan, Shandong, Jiangsu, Chongqing close to 0,8 and Zhejiang between 0,6 – 0,8. Italian cities Torino, Genova, Bologna and Firenze, rank between 0,6 – 0,8, Roma rank between 0,4 – 0,6. Although the cities of southern Italy, Reggio Calabria, Catania and Cagliari are between 0 and 0.2 with Naples, another town in south Italy is close to the range of the others.

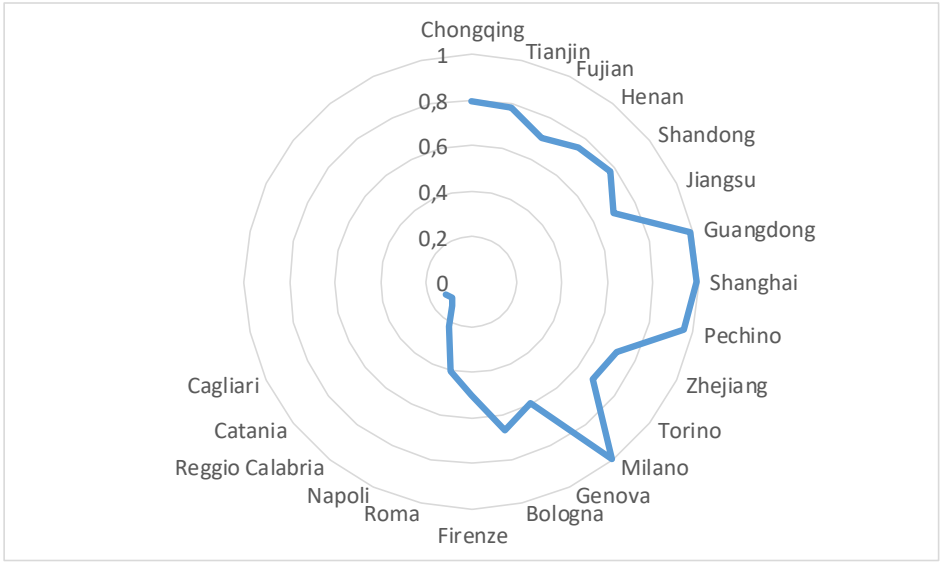

Figure 5. Integration of Digital technology
Source: our elaboration

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4.5 Digital public services

The subdimensions are two, as displayed in Table 3: E-Government and E-Health. In this dimension, Guangdong, Shanghai and Pechino for Chine and Milano for Italy demonstrate all the potential to consolidate and develop the implemented smart city. Furthermore, the other Italian and Chinese cities are included in the range between 0.8 and 0.4. Specifically, the remaining Chinese cities are distributed as follow: Tianjin, Fujian, Henan, Shandong, Jiangsu, Chongqing rank between 1 – 0,8 and Zhejiang between 0,6 – 0,8. Italian cities, Torino, Bologna, Firenze, rank between 0,6 – 0,8 and Rome 0,4 – 0,6. Although the cities of southern Italy, Reggio Calabria, Catania and Cagliari are between 0 and 0.2, with Naples, another town in south Italy, is close to the range of the others.

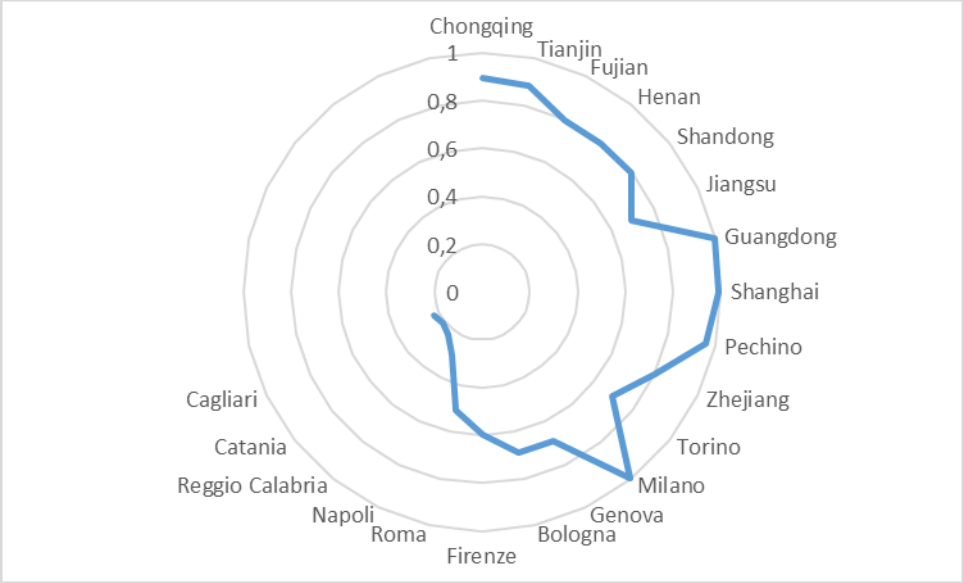

Figure 6. Digital Public services
Source: our elaboration

The subdimensions are two, as displayed in Table 3: E-Government and E-Health. In this dimension, Guangdong, Shanghai and Pechino for Chine and Milano for Italy demonstrate all the potential to consolidate and develop the implemented smart city. Furthermore, the other Italian and Chinese cities are included in the range between 0.8 and 0.4. Specifically, the remaining Chinese cities

The results in Table 5 highlight structured profiles for three Chinese cities and one Italian, with few changes of position in the five dimensions. Firm Smart city profiles are highlighted, such as those of Guangdong, Shanghai, Pechino and Milano, other mediums and a group of cities in southern Italy, Napoli, Reggio Calabria, Catania and Cagliari with a fragile profile and severe bottlenecks to overcome for each of the five dimensions considered.

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Table 5. Smart city profiles'

Cities	Connectivity	Human capital	Use of internet services	Integration of digital technology	Digital public services
Guangdong	✓	✓	✓	✓	✓
Milano	✓	✓	✓	✓	✓
Pechino	✓	✓	✓	✓	✓
Shanghai	✓	✓	✓	✓	✓
Zhejiang	●	●	●	●	●
Torino	●	●	●	●	●
Genova	●	●	●	●	●
Bologna	●	●	●	●	●
Firenze	●	●	●	●	●
Roma	❖	❖	❖	❖	●
Chongqing	●	●	●	●	✓
Tianjin	●	●	●	●	✓
Fujian	❖	❖	●	●	●
Henan	●	●	●	●	●
Shandong	●	●	●	●	●
Jiangsu	●	●	●	●	●
Cagliari	❖	❖	❖	❖	❖
Catania	❖	❖	❖	❖	❖
Napoli	❖	❖	❖	❖	❖
Reggio Calabria	❖	❖	❖	❖	❖

Source: our elaboration

Legend:
✓ = structured profile in relation to DESI;
● = evolving profile in relation to DESI;
❖ = weak profiles in relation to DESI;

Starting from these results and considering the literature review developed, is possible to answer the three RQ formulated in the paper.

5. Discussion

Starting from three research questions formulated in the paper, concerning RQ1 comparison figure 2, Connectivity, figure 3 human capital, figure 4 use of internet services, figure 5 integration of digital technology and figure 6 digital public services, we can observe that the cities have made the greatest connection between IT and IS in China and Italy are: Guangdong, Shanghai, Pechino and Milano. In this context, the strength of Smart cities deriving from the strict implementation of IT and IS (Li et al., 2014; Gaoet al, 2014) is confirmed in 4 cities, one of which is Italian in 10 and always 1 in 20. The remaining cities are positioned in an intermediate range and

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the specific investments particularly for Chinese cities and related metropolitan areas. These specific investments are linked to speed and affordability for the connectivity dimension, advanced skills for the human capital dimension, communication, and transactions for internet use. Integrating digital technology and digital public services in the 10 Chinese cities present good profiles with possible room for improvement. Still, they can be classified as actions that are mostly carried out. Compared with the Italian reality, this profile of the 10 Chinese cities shows that only Milan follows the trend. The other 9 are positioned in an intermediate profile, with the need for specific investments in all sub-dimensions, with a strategic focus on the cities of southern Italy where the technological delay highlights a strong digital divide with the rest of Italy and with the trends of Chinese cities. In this area, there is not a robust implementation of IT and IS as a development process, and the absence of this strategic action determines heavy economic and social disadvantages. Following this consideration, it is possible to argue that these cities have not made the greatest connection between IT and IS. The RQ2 comparison of the five figures lets states that the government action realized sufficient management capabilities (human capital) and robust technology strategies (integration of digital technology and use of internet services) (Pelizza 2020; Tsohou et al., 2020), has been realized in a minimum number of the 20 cities evaluated. Failure to achieve these dimensions can be analyzed either as a decision-making absence by local governments or as a weakness in implementing decisions. This double explanation becomes clear if we look at the current achievement of results by, for example, the cities of southern Italy, 4 cities: the complete absence of the development of Smart cities. Beyond these extreme cases, as regards Italy, except for Milan, the remaining 5 have a weak profile in the different dimensions, particularly for dimensions 2, 3, 4. The response to RQ2 highlights a large area of improvement for most cities and a high distance concerning the 4 good practices; therefore, the government decisions linked to IT and IS to create Smart City are weak, poorly coordinated, and to be developed. The main weakness of this implementation by local governments is the absence of collecting and disseminating large amounts of data to improve their public services delivery (Willcocks et al., 2020). The RQ3 comparison of the five figures states that the quality of life linked to implementing a Smart city has been achieved in a limited number of cities. In a world economy that highlights the growth of the digital economy, both in the production and consumption market and innovations that quickly make products, procedures and processes obsolete, cities such as those of southern Italy must recover from the gap well and quickly. A deep and settled gap over time precludes a decent quality of life. In cities where the process of creating Smart cities has advanced, the quality of life is high. In particular, the dimension digital public services (figure 6) with sub-dimension E-Government and E–Health, highlight interesting profiles for Guangdong, Shanghai, Pechino and Milano. In these cities, the level of quality of life has been achieved. In most cities, almost all Italian, included in the range between 0.6 and 0.2, there is a need for continuous and constant improvement work by local and national public decision-makers to implement actions that improve the inhabitants' quality of life. Information capability and value creation strategy (Wiener et al., 2020) represent two trajectories for the local governments of these Italian cities to strengthen their Smart city profile or create it. The answers elaborated from the three research questions can be summarized as follows: a Smart City is an integrated system that interacts with human capital using ICT-based solutions. It aims to create digital development and high quality of life based on a multi-stakeholder, municipally-based partnership. Starting from this synthesis, it can be observed that the Italian and Chinese Smart Cities have the importance of innovation in common. The results also show that the Italian and Chinese Smart Cities differ according to how the investments in infrastructures, the government and the services provided by the Smart City are configured. Examining the results, the authors noted that the crucial aspect on which the Italian and Chinese experiences diverge is the cause-effect relationships that give rise to the Smart City. In this regard, it is interesting to note that beyond this synthesis, Italian cities have a profile of weakness regarding the digital divide Di Martino, et al., 2020). The studies on the digital divide, starting from a technological point of view, highlight the strategic role of IT and the strategic services role of IS, indicating the lack of opportunities and well-being in the absence of this process. The IT-IS process is a complex social process. Failure to carry out this complex process fuels the breadth of the digital divide. The gap is given both by the absence of investments in infrastructure and Connectivity and the absence of investment in human capital in terms of advanced and basic skills. Moreover, the digital divide is linked to a gap identified as a social issue. The information society's development is incompatible with cities

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characterized by the digital divide. Digital poverty feeds economic poverty and vice versa. These poverties structure a vicious circle from which it is difficult to escape, not impossible but difficult (Van Deursen et al., 2019). This approach is more complex than the digital divide as a technological divide and grows the concept of the information society. In this case, reflecting on the economic and social development and accumulation of knowledge to distribute is strategic. Whole regions of the world, such as southern European Countries, Italy included, and internal regions of China, which have digital poverty, are on the fringes of the information society and distribute a fragmented, non-systemic material and knowledge wealth. The government must overcome the function of those who provide services, paying attention to the public sector reform in which the digital divide is a strategic bottleneck to improve access to communication between stakeholders. In this logic, implementing a Smart city means evolving from being an overseer providing direction for an enabling environment to one that creates actively equal opportunities for all. This is the design of inclusion. A new logic of thinking focused on inclusion is required, particularly in this phase, that will not be short. The need for a research agenda on the digital divide emerges from the answers to the three research questions. This gap must be declined in its different technological and social-economic dimensions.

DESI, applied to the Italian and Chinese cities, selects 10 cities for each Nation, so the total comparison amount to 20 cities. The Italian metropolitan areas are: Torino, Milano, Genova, Bologna, Firenze, Roma, Napoli, Reggio Calabria, Catania, Cagliari. The Chinese metropolitan areas are: Chongqing, Tianjin, Fujian, Henan, Shandong, Jiangsu, Guangdong, Shanghai, Pechino and Zhejiang.

6. The research agenda

The smart city offers many opportunities, but many challenges have yet to be solved. The Research agenda linked to the digital divide underlines multi aspects that have yet to be resolved. We need to fully enact a transition to a modern model of cities, which must mandatorily envisage that full social, economic and digital inclusion must be achieved. The phenomenon must be investigated and studied in all its parts to propose appropriate solutions.

7. Conclusion

The concept of the Smart City presents everyday actions in the 20 cases evaluated but also assumes different characteristics. The different economic-political-social contexts condition the success factors, leaving room for further studies and research. From the international literature on Smart Cities, it is possible to notice a dichotomy between what is proposed at the academic level and the empirical reality analyzed: at the theoretical level, reference is often made to an approach that sees in the national strategy, Smart city guidelines to be declined in the cities, the key winning element, while at a practical level, there are more frequent cases of smart cities that follow an approach that does not include national guidelines, but starting from specific local experiences, implementation paths are activated. This approach needs to manage its resources better and, in the cases of Italian cities, causes severe delays in investments in infrastructure and, therefore, in the large dimension of the digital divide. In this regard, bridging this dichotomy between national guidelines and specific local experiences is essential. In this logic, the topic must still be studied and deepened to create an accumulation of knowledge suitable for understanding the future development of Smart cities.

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