

The Digital City, Smart City or Intelligent City? A Review of the Literature for the Choice of an Appropriate Terminology

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Abstract

Today, new adjectives are appearing to describe the digitally transformed city: intelligent city / sustainable city / Digital City / Cyber City, etc. This article discusses the notion of the digitally transformed city and questions the meaning and significance of the terms used to describe it, based on a review of the trilingual scientific literature (French, English and Arabic), which was carried out using a methodological model proposed by vomBrocke and others. The result is then examined through the prism of several criteria. The analysis of the various definitions, allows us to advance that the concepts from the point of view of their definition remain somewhat vague and especially polysemic of which none is “universally recognized”. Nevertheless, it emerges that the intelligent city, smart city and the digital city are the most widely used terminologies, the meaning of which is rarely specified. The terms intelligent/smart city are basically more marketed products and evocative slogans. Nevertheless, the digital city is running out of steam today, overtaken by the bottom-up innovation movement, unlike the smart city, which has had the merit of following an upward trajectory, sometimes carried by national or international institutions. In conclusion, the city described as “intelligent”, “digital” or “smart” is a tangible reality, expressing a new adaptation of the urban system to a new context that of the inclusion of ICT in urban practices. Moreover, this adaptation requires more and more the development of new skills and competences to accompany its implementation. An approach that will inevitably continue to enrich the urban vocabulary with other new concepts.

Key words: intelligent city, smart city, digital city, literature review, terminology. Introduction.

INTRODUCTION

Since antiquity, the ideal city has been embodied intellectually and materially in utopias¹. These were urbanistic conceptions aiming at the harmonious and perfect (ideal) conjugation between the human being and his establishment. In the 19th century, utopias proliferated with the objective of thinking of a renewed, modernized and peaceful city. Among the most significant projects: Charles Fourier’s phalanstery, Robert Owen’s utopian cooperatives, Ebenezer Howard’s Garden Cities, etc. The reflection carried out by the architects of the end of the 19th century leads to the notion of urbanism, a term that appears in the bulletin of the Société Neuchâteloise de Géographie (volume XX, 1909-1910, p. 213 and following²). This quest in the 21st century, following the industrial and post-industrial society of the 19th and 20th centuries, is marked by several variations: multiplication of Pharaonic projects, and utopias with claims of equality and social justice. For example, Neom (Laurent MARTINET, 2017), Masdar and Seasteading. Nowadays and in a more pragmatic time and less inclined to idealism, via electronics; the city can be endowed with intelligence and even virtualized, a way to project the hopes of an ideal city so coveted.

The introduction of ICTs in the process of making the city at various phases: design, production, governance and urban management has intensified in recent years with the introduction of various concepts: the smart city (intelligente/ الذكية) and the digital city (numérique / الرقمية), propelled by the arrival of new city’s actors: large companies from

¹ Representation of an ideal and flawless reality, Utopia is a word coined by the English writer Thomas More in his book Utopia published in 1516. It is a founding book of utopian thought.

² Bernard ECREMENT and others, 'le Xxe Siècle ; De La Ville A L'Urbain. Chroniqueurbanistique et architecturale', Urbanisme N°309 (Paris, 1999), pp. 20–130.

the telecom and software sectors: IBM, Cisco, Oracle, etc. This research paper addresses the notion of the digitally transformed city. Nevertheless, the multiplication of adjectives qualifying this city has led us to question the use of one locution in relation to another and what the trend will be in the future.

RESEARCH GOALS

The goals of this trend analysis of the use of a particular concept associated with the city and the digital world are to discover the geographical areas most interested in the themes in the world; by country and geographical area and the prediction of the number of future searches for a particular term through a search engine optimization tool (SEO).

METHODS AND TOOLS

Research Problematic

Digital technology, as a powerful lever for transformation (Moreno, 2015), growth and time management, is now being deployed in cities. It brings many hopes: improvement of citizens' lives, increase in the attractiveness of territories, quality of administration management, etc. New adjectives are appearing to describe the city transformed by digital technology: smart city, sustainable city, digital city, cyber city, etc. *Ville numérique* (The digital city) or *ville intelligente* (smart city) are the new concepts used in the French language to promote and disseminate the use of information and communication technologies (ICT), this is also the case in Arabic: *المدينة الرقمية* or *الذكية المدينة*.

These initiatives testify to the massive incursion of digital networks into the daily lives of city dwellers through the use of the Internet to access the various services and resources of the city. These initiatives testify to the massive incursion of digital networks into the daily lives of city dwellers through the use of the Internet to access the various services and resources of the city. Increasingly important in the lifestyles of today's society, they are becoming an essential component for the operation of infrastructure (environmental, urban) and social inclusion (participation in public debates and life in the neighborhood).

Main Question and Research Hypothesis

The advent of digital technology has had a profound impact on practices, particularly urban practices. As urban planners, this situation challenges us and raises questions: the use of terms as diverse as they are varied to designate this reality complicates its understanding. Therefore, it seems appropriate to us to focus on the "paradigms" of the digital city/smart city/intelligent city to show their complexity and the extent of its possible variations.

In this context, the main question to be asked is: What current and future use for the digital city/smart city/intelligent city paradigms? The answer to this question will be the cornerstone of this research. Also, the prediction of the expected results allows the formulation of the following hypotheses to be tested as an assumed answer to our research question:

- The city described as "digital", "smart" or intelligent city is a reality, expressing an adaptation of the urban system to a new context that of the inclusion of ICT in urban practices, to accompany its projects in the face of new technological waves.
- In a context of globalization and hegemony, firms from the telecoms and software sectors, in a bid to standardize, would favor their concept over others.
- The importance of the use of the English language in scientific research around the world will accentuate the use of the "smart city" concept, supported by multinationals and governments.

Conceptualization of the Subject

Through the diversity of their uses, digital technologies have become one of the key elements of the contemporary urban utopia, and occupy a central place in urban strategic projects, projects that sometimes materialize in the architectural space of the city in the form of digital urbanism (Moriset and al., 2005). Notwithstanding this massive use of various concepts associated with the city and the digital by the various speakers of the discourse on the "digital city/smart city", the fact remains that the definition of the "digital city/smart city" remains vague, polysemous and sometimes even confusing. As Stéphane Lelux³ said in his speech at the workshop on the digital city, led by the Mission Ecoter⁴ as part of

³ President of TACTIS (consulting firm in digital development)-France.

⁴ Training organization approved by the Ministry of the Interior and for professional training-France.

the Odebit⁵ trade show: “It’s a bit like the Spanish inn: everyone presents the digital city with what they bring to it! In fact, for him, there is not really a definition in the strict sense of this concept. Like the digital city, the smart city has the same problem of definition, the concept “remains rather vague” according to Marie Schippers(Schippers, 2012).

Therefore, it seems essential to us to know the trend for this paradigm, while shedding new light on future perspectives.

Although research has already been done to shed light on this issue, such as that done by Annalisa Cocchia (Cocchia, 2014) entitled “Smart and Digital City: A Systematic Literature Review”, a review based solely on an English-language bibliography. Also, this postulate pushes us to invest other references in other languages, notably French and Arabic, in order to widen the linguistic and semantic field used. In other words, the leaders of the discourse on the digital city or the smart city all describe the same thing and their divergences are only positions in the field of urban planning.

The combination of ICT and urban space has given rise to an entity that designates urban futures under different terms, some of which are more nuanced, such as: the adaptable city, the frugal city, the malleable city, the sustainable city, the green city, the fertile city, the mobile city, the resilient city, the cybernetic city, the city 2.0, cyborg urbanism, city.com, city of knowledge, omnipresent city, sustainable city, ... etc.

RESEARCH METHODOLOGY AND TOOLS

For this part, we will be interested in the evolution of the number of searches for a concept over time by using Google Trends⁶ (a tool from Google Labs) to calculate the number of searches made by Internet users and mobile users on the Google search engine over a given period of time, with the possibility of viewing this data by region and by language. The choice of the search engine is not fortuitous, since it is the leader in the world according to StatCounter⁷.

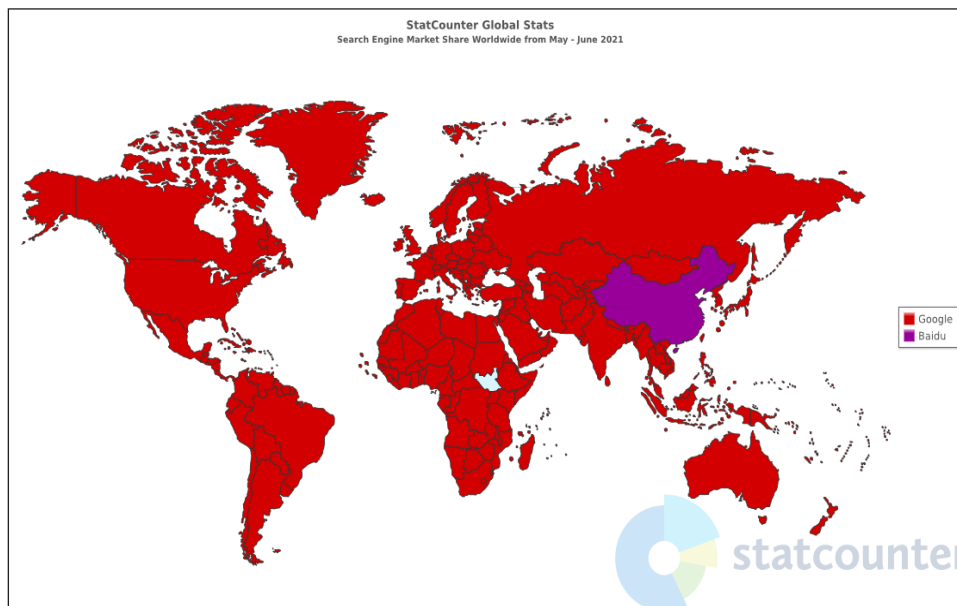


Figure 1. Market share of search engines worldwide (Source: <https://gs.statcounter.com>)

The second part will be dedicated to the validation of the data. This tool also allows to know the search trends around the most requested keywords.

Research Strategy

As the values of the research in Arabic language are not significant compared to others, the research will be split into two parts:

- 5 Odebit” exhibition, an event for local authorities and companies in France.
- 6 Google Trends is a website by Google that analyzes the popularity of top search queries in Google Search across various regions and languages. The website uses graphs to compare the search volume of different queries over time.
- 7 Statcounter, ‘Search Engine Market Share Worldwide | StatCounter Global Stats’, Statcounter, 2021 <<https://gs.statcounter.com/search-engine-market-share#monthly-202105-202106-map>> [accessed 9 June 2021].

- a- Research for the concepts ville intelligente, ville numérique, digital city, smart city and ciudad digital;
- b- Search for the two concepts in the singular and plural form (المدينة الذكية, المدن الذكية) which are just the respective translation of: ville intelligente/smart city and ville numérique/digital city.

RESULTS

For the first step (Fig 2, Fig3), corresponding to a keyword search for the period 2004-2022 (2004 being the reference year for this tool given the lack of data for the previous years), clearly shows the progression of the “smart city” concept, taking the lead over the other concepts from 2009 to the present day, including for the African Region (see Fig 4), and the progressive decline of searches made on the Google engine for the other concepts.

The tool also allowed us to make keyword queries and thus to spatialize the search by concept in the world.

This analysis showed the geographical extent of the use of the concept “smart city” compared to the others.

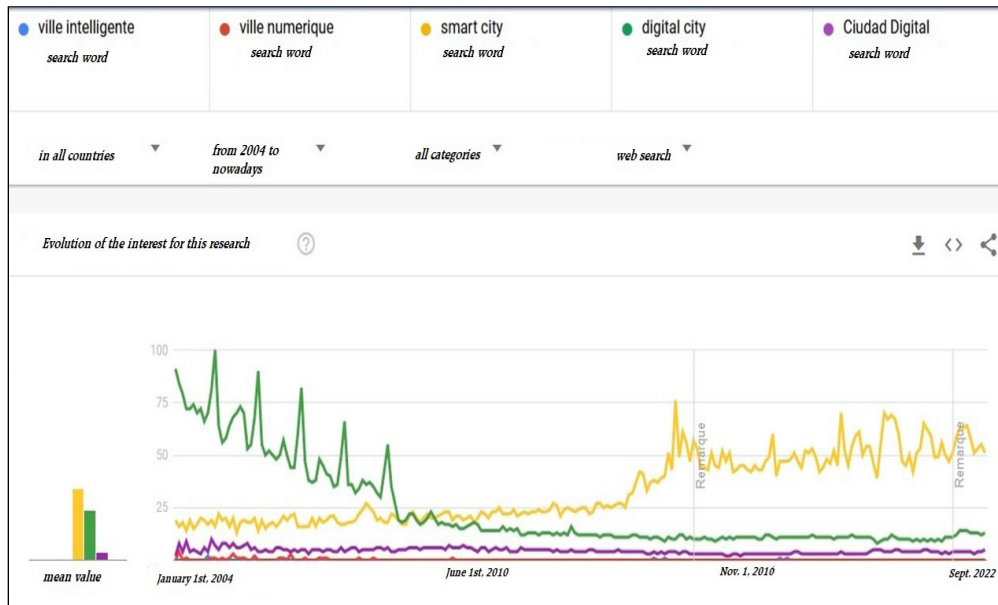


Figure 2. Evolution of searches for a given keyword (English, French, Spanish) in a region and for the period 2004-2022 (Source: trends.google.fr, October 2022)

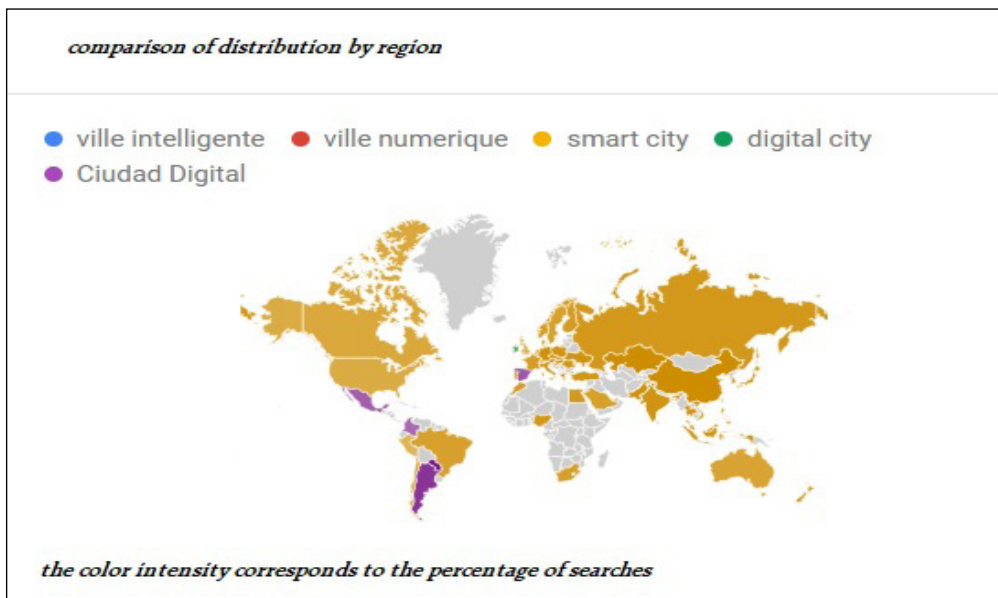


Figure 3. Evolution of searches for a given keyword (English, French, Spanish) in a region and for the period 2004-2022 (Source: trends.google.fr, October 2022)

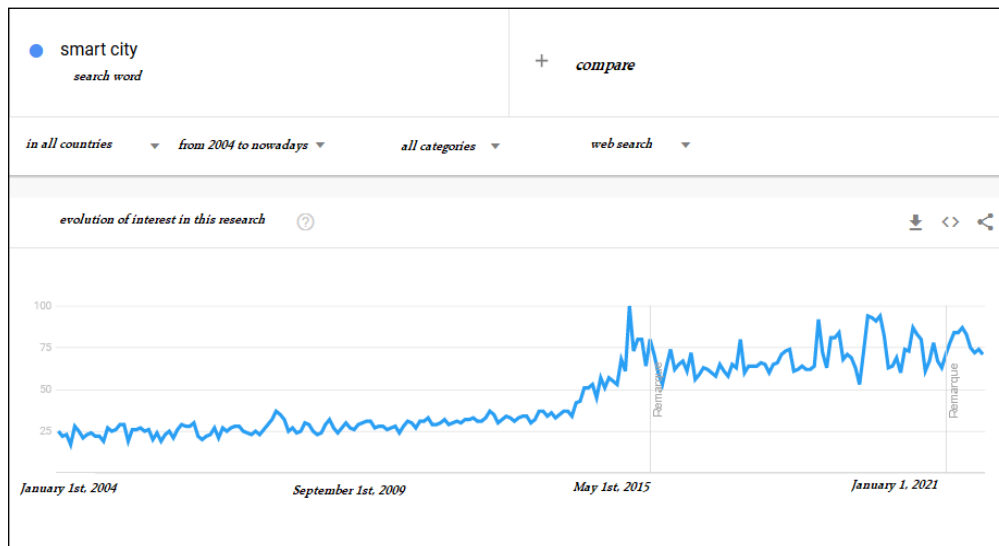


Figure 4. Evolution of the interest in the concept: smart city (Source: trends.google.fr - October 2022)

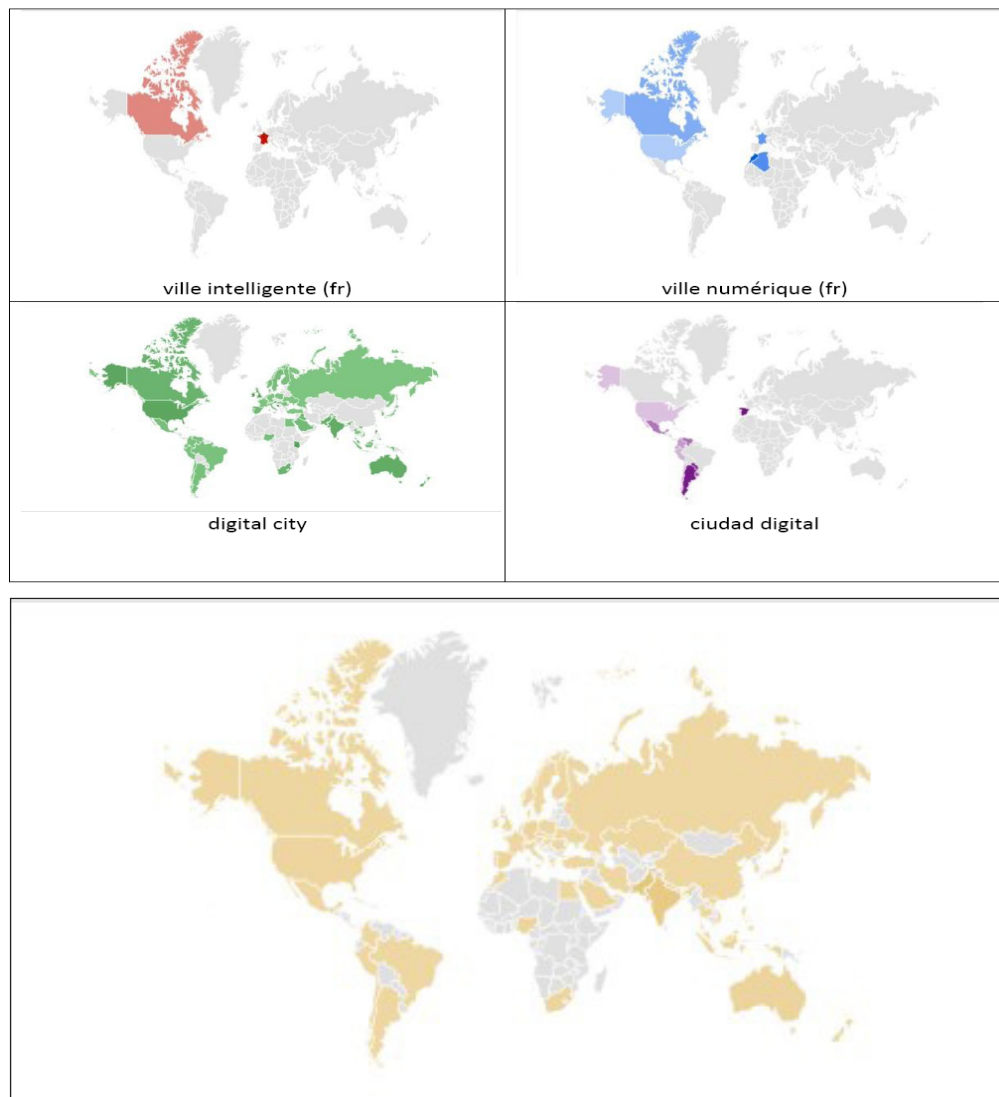


Figure 5. Interest by region for keyword search: ville intelligente (intelligent city), ville digitale (digital city), digital city, smart city and ciudad digital (Source: trends.google.fr - October 2022)

For the second step, the analysis of the evolution of the search for the two concepts in Arabic see (Fig 6, Fig 7)), relating to the evolution of searches for a given keyword (in Arabic) in a region on the site: trends.google.fr, showed that the use of the concept (المدينة الرقمية : digital city) is more used than that of (المدينة الذكية : smart city) from 2004 to the present day, as illustrated on (Fig 6).

The identification by geographical region of the use of the two concepts indicates that the concept of digital city is more sought after in Saudi Arabia than in other countries like Algeria and Palestine (see Fig.11). For the other countries (Syria, UAE, Morocco and Egypt) it is only recorded the queries for the concept (smart cities المدينة الذكية).

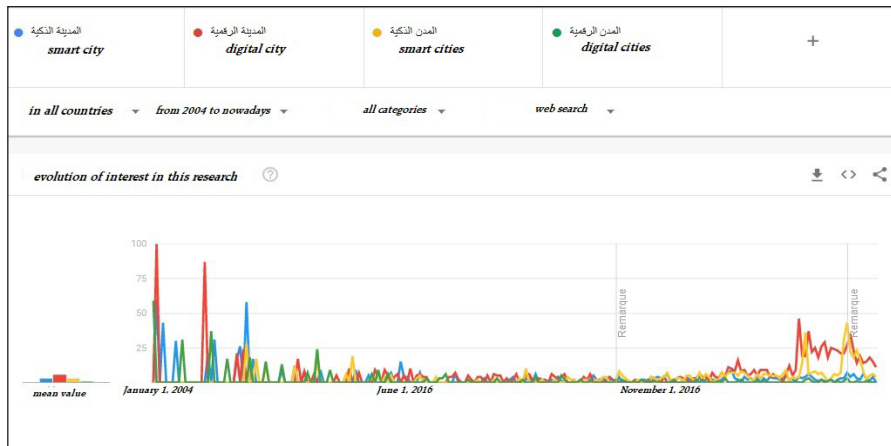


Figure 6. Evolution of searches for a given keyword (in Arabic) in a region and for the period 2004-2022 (Source : trends.google.fr- October 2022)

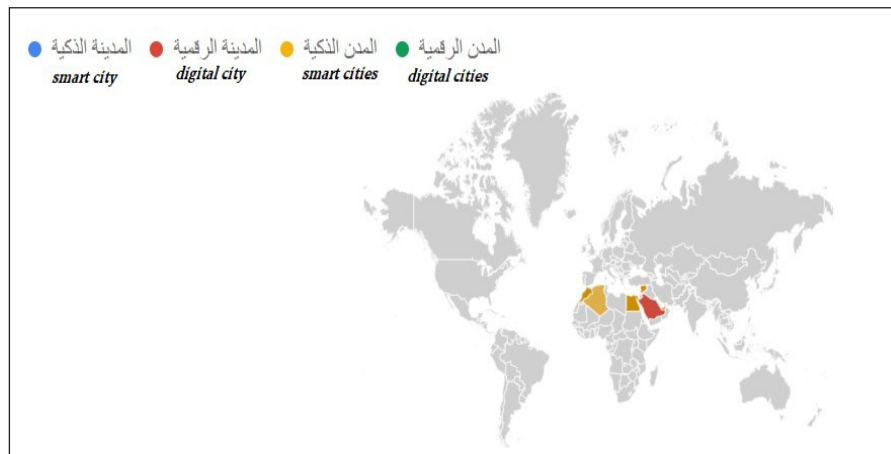


Figure 7. Evolution of searches for a given keyword (in Arabic) in a region and for the period 2004-2022 (Source: trends.google.fr-October 2022)

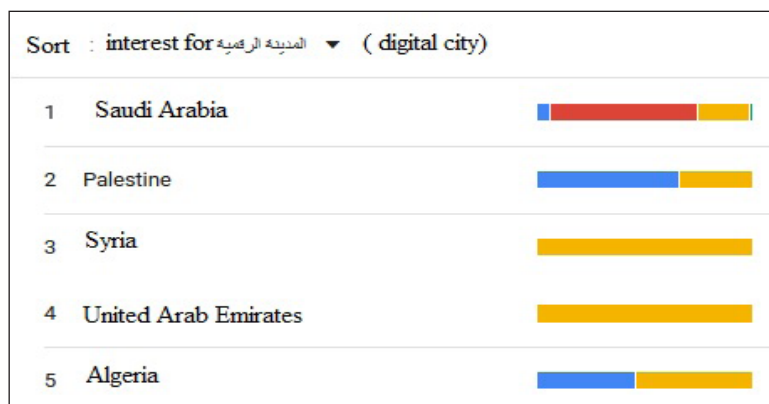


Figure 8. Comparison of the distribution by region based on a sort by the word: المدينة الرقمية (digital city)

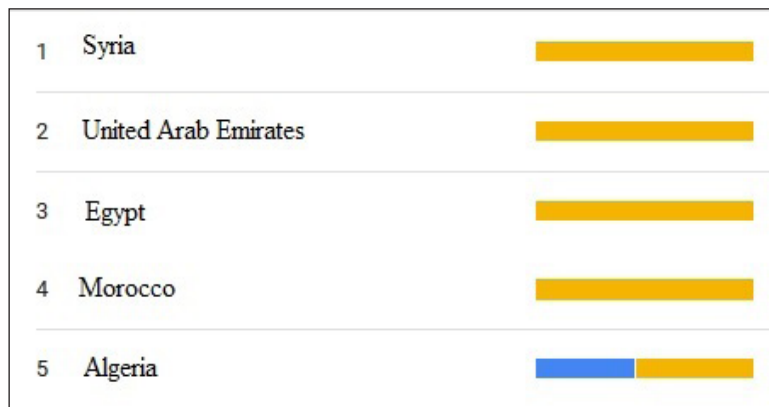


Figure 9. Comparison of the distribution by region based on a sort by the word: المدن الذكية (smart cities)

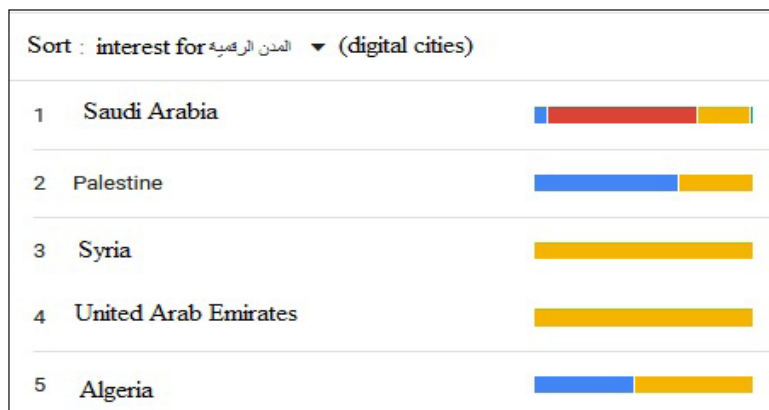


Figure 10. Comparison of the distribution by region based on a sort by the word: المدن الرقمية (digital cities)

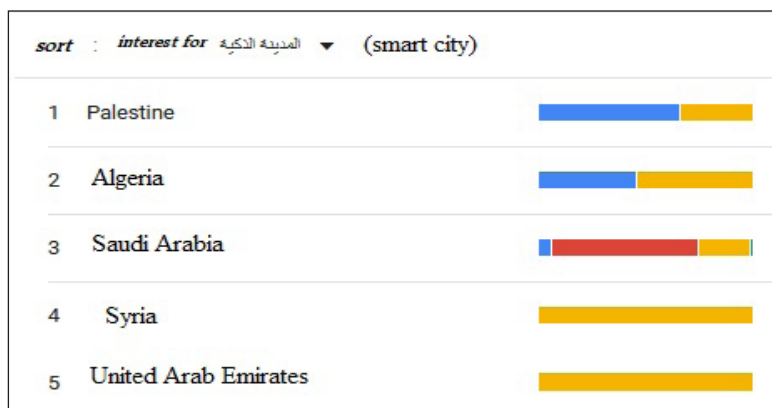


Figure 11. Comparison of the distribution by region based on a sort by the word: المدينة الذكية (smart city)

DISCUSSION

The use of concepts is more conditioned by the language of the research. Thus, the concept of “ville intelligent/smart city” is more present in French-speaking countries than that of “ville numérique/digital city”. Apart from English-speaking countries, the concept “smart city” is present in all countries despite the language used (see Figure 5). Nevertheless, keyword searches in the Google search engine for the concepts of Smart City/Ville intelligente and Digital city/ville numérique in both theoretical and empirical research have been on the rise. Nevertheless, the digital city/ville numérique is running out of steam today, overtaken by the bottom-up innovation movement (see Fig 2), unlike the smart city/ ville intelligente, which has had the merit of following an upward trajectory, sometimes driven by national or international governments, institutions or political bodies, such as the EU, which funds smart city projects in Europe. A verification for the above and thus confirm our hypothesis, a search for various phrases on the Google Scholar engine covering two periods (2004-2018) and (2004-2021) has clearly demonstrated the dominance of the concept “smart city” in its singular and plural form.

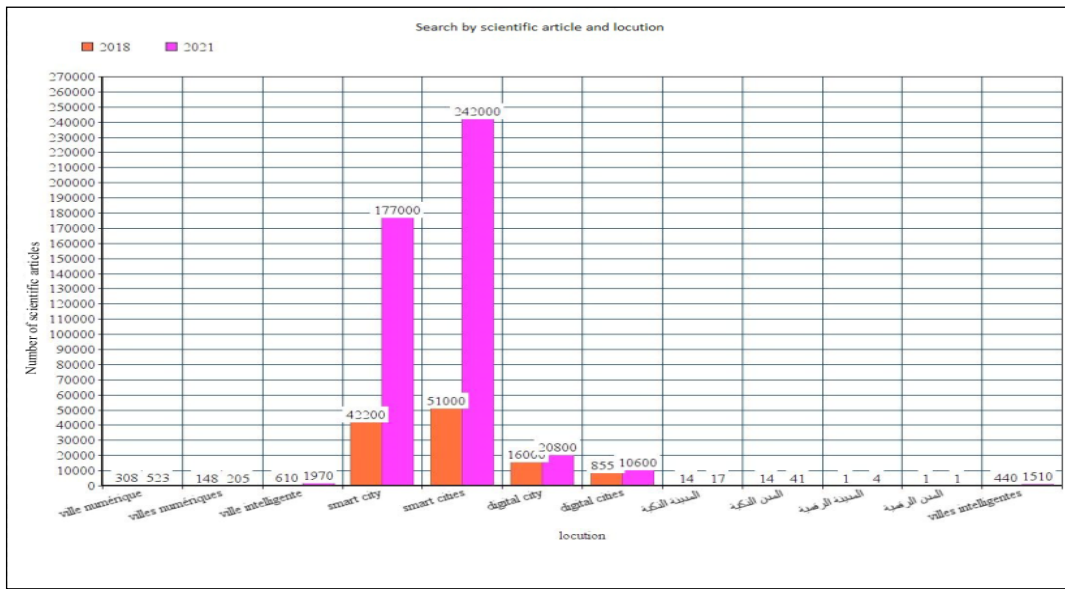


Figure 12. Search for articles by locution on Google Scholar between 2004-2018 and 2004-2021 (Source: Google Scholar, formatting: author on www.onlinecharttool.com)

CONCLUSION

The cross-referencing of the various summaries relating to the concepts (digital city/ ville numérique and smart city/ ville intelligente) gives the following finding:

The different terminologies agree on the same designation namely:

Making the city more livable where performance in urban management and services and development are in focus through the integration of digital data via information and communication technologies in an intelligent system capable of modeling the city.

The analysis of the various definitions put forward by their authors allows us to advance that the concepts from the definitional point of view remain vague and polysemic, none of which is “universally recognized yet” as indicated by Annalisa Cocchia (Cocchia, 2014), Vito Albino (Albino et al., 2015) and M. Schippers (Schippers, 2012). Nevertheless, from the analysis of the trilingual scientific literature and the related titles, it appears that Smart City/ ville intelligente and Digital City/ ville numérique are the most used terminologies to designate an ideal of a city of the future. This analysis also shows that the smart city and the digital city are the most recurrent terms, whose meaning is rarely specified. Nevertheless, all these definitions relating to the city of the future have a common denominator: Information and Communication Technologies (ICT), considered as “complementary levers that can be mobilized for each of the urban issues” (Cyril Neveu & Bethouart, 2007) and the foundation, which has enabled the virtualization of the city and “without which it is difficult to make our cities truly more intelligent” (Pisani, 2015). This analysis also revealed a certain “collusion” in the definitions, namely:

- Some authors consider that the ville intelligente is only the French translation of the smart city concept, while others consider them as distinct entities, each with its own specificity;
- Others see a chain of events where smart cities/ villes intelligentes are the continuation of digital cities/ villes numériques and a transition from an information society to a knowledge society.

In this analysis based on a multilingual literature, we note that the writing related to the concept of digital cities present a certain uniformity by highlighting the digitalization of the city through the integration of the potential of ICT to improve the functioning of the human, technical and functional components of the city system. On the other hand, the concept of a smart city, while carrying objectives of sustainability, good governance, collaboration, economic efficiency, well-being, etc. seems to carry within it heterogeneous and sometimes even questionable ideals. According to these objectives, everything could be considered as intelligent! With its emphasis on technology, it is first and foremost a digital city. “The smart city is the latest of many expressions that have arisen in history to describe the complex relationship between cities and ICT” (Eveno et al., 2014).

It is also important to point out that the commercial projects of global IT companies, multinational infrastructure providers and system integrators are the main carriers of smart or digital projects. The commercial aspect of these firms justifies the location of smart cities or digital cities in the world, which remains dependent on the level of economic and scientific development of a country “the Smart City market is largely dominated by North America. [...] Next, Asia, the Middle East and Africa are the most promising markets, especially because of the growing need for large-scale infrastructure. Europe does not achieve the same results”(Gaetan, 2016), this, on the one hand; the attraction of the financial potential offered by this opportunity has called upon the branding and marketing mechanisms of its firms to better sell a dream, on the other hand. This observation obliges us as scientists to take some distance from this well-marketed⁸ product in order to better understand it without falling into the unconscious endorsement of an archetype of a vision in which the human being seems to be absent and/or the ancient cities are relegated to second place in terms of interest, even when “the cities were not “stupid” before”(Sabine BLANC, 2017).

The facilities offered by the new information and communication technologies (ICT) in general and the Internet contribute to the “erosion of borders and the erasing of territorial partitions”(Dupuy, 2005), reducing a connected or interconnected world to the image of a global village. This leads us to question the adequacy of the concepts of smart city and digital city with the urban realities of today, when these ICTs are applied to a diversity of urban forms that cannot be confined in a typology (city, agglomeration, urban region/employment area, metropolis, megapolis, megalopolis...). This immeasurable space denotes a simplified representation of the city of yesteryear, which some people wonder if it should still be called a city(Choay, 1994).

This new approach that carries an innovative idea for an urban ideal to the indicative of urban entities around the world is a response to a state of affairs that raises the worst scenarios for man, his habitat and his environment. Also, the idea of a city adapted to new changes (increased urbanization, climate change, etc.) had to carry a certain intelligence through the use of ICTs that would be able to promote a shift from a functioning of urban services by silos, in favor of an integrated management in which the data on each sector can be crossed with each other. Nevertheless, the purely technological approach to the city, giving “the illusion that technologies are capable of inducing, by themselves, an economic, social and sustainable development of cities”(Besson, 2016), has not given rise to a consensus in the scientific community(Vanolo, 2013) because of the marginalization of the citizens in the smart city system. According to Karine Dugnin-Sauze, vice-president of “GrandLyon”(France) in charge of innovation and new technologies, quoted in Jean-Pierre Gonguet’s article, the intelligent city, from a semantic point of view, is totally incomprehensible and even proposes to stop using the term “intelligent city”. This lack of attention to the citizen in this process of change has led to skepticism(Hollands, 2008) towards intelligent city technologies, which are seen as a means of surveillance, technical lock-in, outsourcing of public power and control for “private” status providers.

This marginalization of citizens can only be solved by the involvement and social adhesion to the project and the respect of private life, which remain an important limit that must not be crossed, since “cities are overtaken by the movement of innovation from below. It is the users who invent new services through new social practices.

This overview has also allowed us to shed new light on the current situation (theoretical and technical) and, by implication, on future prospects. The analysis confirms the usefulness of the approaches for an urban ideal in view of the current situation. The term intelligent/smart city are basically more a marketing product and evocative slogan, built on ill-defined conceptual approaches, although the “implementation” of the concepts of smart city /intelligent city and digital city/ville digitale in both theoretical and empirical research has been on the upswing. Nevertheless, the digital city is running out of steam today, overtaken by the bottom-up innovation movement, unlike the intelligent city, which has had the merit of following an upward trajectory, sometimes supported by national or international governments, institutions or political bodies, such as the EU, which funds smart city projects in Europe.

In this euphoria generated by the spectacular development of ICT, the semantic field and lexical field relating to the future of cities have been directly impacted by a daily enrichment of innovations. Following the example of the report “the intelligent city: models and goals” published by the metropolis of Lyon, where mention is made of three major models that make it possible to group together different ideals of the intelligent city: techno-city, contributive city, e-city. (VIÉVARD, 2014).

8 In 2011, the multinational IBM registered the trademark “Smarter Cities”, which is a turning point in the struggle for visibility that ICT companies have been engaged in. (Marketer) Promoting through marketing methods.

The emergence of new concepts leads us to question the durability of the use of one concept over another to designate this imagined future or one under construction in which the combination of city and ICT is the founding element. In our opinion, the urban system is the place where 50% of the world's population lives and will be home to 70% in 2050. This means that this system has adapted over time and that «the genius of urban logistics has been practiced for nearly 6,000 years. In fact, the first «urban revolution», according to the expression popularized by the Australian archaeologist Vere Gordon Childe, dates back to the 5th millennium BC, in Mesopotamia.

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Also, the integration of the potential and advantage of ICT in the various modernization processes through smart city/ smart projects should never be considered independently from the other components of a city (or region), but the continuous effort to find the best know-how for future operations.

This continuous adaptability of the urban system to various changes will inevitably continue to enrich the urban vocabulary with other new concepts.

In conclusion, the city described as “digital” or “intelligent” is a tangible reality (Charles, 2013) of the inclusion of ICT in urban practices. Moreover, this adaptation requires more and more the development of new skills and competences (IoT advisers, IoT designers, IoT technicians and logisticians, BIM coordinators), to accompany its projects in the face of new technological waves. (Deleneville, 2016)

Proof that this adaptability is also invited in Africa, the organization of events on this continent (Algiers smart city-2018, Smart City Expo in Morocco-2016, Bizerte Smart City in Tunisia-2017, Benin Smart City-2016, Cairo Smart Cities-Egypt-2016, etc.

ACRONYMS AND ABBREVIATIONS

ICT: Information and Communications technology

SEO: Search Engine Optimization Tool.

IT : Information Technology

IOT : Internet Of Things

EU: European Union

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