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The Dynamics of the Smart City Development: From the First Wave Model to the Third Wave Model

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ABSTRACT

This research investigates the progress and dynamic of Smart City (SC) in Lyon Metropolis. Three SC models are suggested based on several measures, such as benchmarking concept, actors, formulation, governance, and smartness performance indicators. To grasp the context, this study optimized the data from 40 in-depth interviews with public and private actors. It is then tailored to recent documents and literature studies regarding Lyon SC activities in recent years. During the initial wave, the Local government was the primary initiator, employing IBM's techno-centric models as the reference. The second wave model saw the city of Lyon SC strategies as a Living Lab for high-tech innovations run by state companies. In the third wave, a strong presence of digital platforms integrated into urban systems determined a new SC model. In the third stage, it identified seven key performance indicators of digital platforms that established their role as SC actors: (1) direct civic engagement, (2) daily need services, (3) sharing economy, (3) real-time services, (4) time value, (5) city coverage systems, (6) green transportation, and (7) city network coverage.

1. INTRODUCTION

The "Smart City" idea can be seen as a fuzzy concept—meaning it lacks a precise, universally agreed-upon definition. While the term has become popular in urban planning, technology, and policy discussions, its ambiguity stems from varying interpretations across different fields. Many definitions of an innovative city center on integrating technology (sensors, big data, AI, etc.), which makes the concept broad and adaptable. However, cities are complex socio-technical systems, and this focus on technology can sometimes overshadow urban life's human, social, and environmental aspects. A prominent scholar and historian of urbanism and technology, Antoine Picon has argued that the Smart City concept lacks roots in traditional urban planning history [1]. Picon's [1] critique highlights a key issue: the disconnect between the technologically driven vision of smart cities and the theoretical and historical foundations of urban planning.

Despite critiques like Antoine Picon's, cities worldwide are indeed integrating the intelligent city concept into their urban planning and development strategies. This reflects a growing recognition of digital technologies, data analytics, and automation's potential in addressing contemporary urban challenges. Cities are using Smart City technologies to enhance urban services, promote sustainability, and improve the quality of life for their residents. The implementation of smart cities has indeed evolved to become an integral part of the social systems of cities, going beyond its original technology-centric focus. Early innovative city initiatives, often characterized by a technocratic approach, emphasized the role of data, sensors, and digital infrastructure in improving efficiency and urban management. However, as imaginative city concepts have matured, there has been a significant shift toward a more holistic, human-centered approach, where technology is used to enhance social, cultural, and community life rather than being an end.

From these points of view, this research aimed to demonstrate the dynamic of Smart City implementation in Lyon, France. By employing in-depth interviews with dozens of stakeholders of public sectors and private intelligent city initiators, this research shows that the formulation of SC in Lyon is experiencing interesting dynamics of change that need to be discussed to increase intellectual property related to SC.

Initially, at the beginning of the establishment of the SC program in the City of Lyon, it was identified around 2010-2012 that the IBM, Cisco, and Siemens models became one of the main benchmarks where the "Lyon Smart City Manager" made modifications in terms of its territorialization in the City of Lyon. The City Government's initiative focuses on technological infrastructure to achieve sustainable development performance indicators (green energy), with experimental mechanisms in specific urban zones as the main character. Furthermore, around 2012-2017, the

contextualization of SC implementation began to shift, and the everlasting global benchmark, the Silicon Valley model, became once again a parameter to develop the Lyon SC orientation. At this stage, actors such as State Companies, the EDF and the ENEDIS, the French National Energy Company, and dozens of French High-Tech Companies are the leading players where the City of Lyon defined SC as a Living Lab ecosystem for high-tech industrial innovation. Still, in its second wave, the main foundation lies in Top Down's techno-centric development to strengthen government and industrial technological tools.

Furthermore, Lyon's SC contextualization experiences an unprecedented turn in the third stage. It can be identified the strong presence of such digital platform actors in 2014 that gained momentum during COVID-19 until recently. It leads to recognition of the existence of the Urban Digital Platform, which offers community-based, Citizen-centric services and a Sharing Economic model with the whole integration into city networks. The presence of sectoral digital platform services such as Uber, Air BNB, Deliveroo, Lyft, or Hello Fresh food delivery & grocery platforms is an inseparable part of the SC in the City of Lyon. This research ultimately provides material for discussion and encapsulates era after era changes in the contextualization and conceptualization of SC. It becomes an opportunity for urban researchers to keep pace and retrace the progress and dynamics of SC from the perspective of actors, substance, scale, and level of functionality.

2. THEORETICAL FRAMEWORK

The meeting in 2005 between former President of the United States Bill Clinton, then promoter of his foundation dedicated to the fight against climate change on an international scale, and the leaders of the Cisco company, during which Clinton allegedly asked how we could mobilize business technology in the service of the fight against climate change is often presented (including by researchers from a critical research perspective) as one of the triggering elements of the movement in favor of intelligent cities [2]. The meeting quickly gave rise to the "Connected Urban Development (CUD)" program in which the company Cisco invested approximately 25 million dollars over the following five years to install in the three cities of San Francisco, Seoul, and Amsterdam multiple control devices that concern energy consumption in urban spaces. Several "sensors" are developed and installed, for example, near traffic lights, to quantify the consumption of stationary vehicles. The initial wave of Smart Cities (SC) emerged in the early 2000s with the pivotal involvement of IT industry giants like IBM, Microsoft, Siemens, and Cisco [3]. This prompted cities worldwide to transform urban planning into a "Smart" paradigm. SC has evolved into a universally endorsed strategy for contemporary urban development [4]. IBM publicly voiced this endorsement, advocating for cities to adopt interconnected digital technology as the fourth infrastructure, comprising interconnected networks capable of high-speed data exchange. Global IT companies such as IBM, Siemens, Cisco, and Microsoft persuaded municipalities worldwide to integrate SC initiatives to increase government capacity to monitor the cities in real time [5]. Indeed, SC initiatives have become integral strategic programs for city governments [6]. Despite the need for a universally agreed-upon definition of what SC necessarily represents in terms of planning and development among scholars [1], the global practical framework broadens its meaning to encompass the extensive integration of ICT into existing city infrastructures. Characteristics such as ICT devices, real-time connectivity, Internet of Things applications, and engaged citizens typify SC.

Given the diverse promoters contributing to the development of SC, whether public actors or private entities, it becomes challenging to formulate a singular perspective or definition of what constitutes a SC. From a critical standpoint, the current narrative surrounding the SC is primarily influenced by corporate ideologies and a technocratic view of urbanism. It relies heavily on advanced technology provided by global IT industries and is sometimes fragmented into transport and mobility, energy sectors, finance, and digital public administration. Implementing SC initiatives tends to follow trends, with wealthier cities often having greater access to form partnerships with major IT companies [7].

As a result, many scholars argue that SC should be understood within specific geographical contexts, each with its unique resources and attractions, highlighting the inevitable issue of geographical disparities in innovative city development. The emergence of SC introduces a new dynamic in the relationship between the public and private sectors. Both sectors enthusiastically engage in fragmented approaches to SC practices, leveraging technical innovations and utilizing ICT features in unprecedented experiments [8]. Furthermore, SC has become a prominent fixture in the global urban agenda, prompting cities worldwide to integrate it into their routines as part of the international city network circuit [9].

3. METHODOLOGICAL APPROACHES

This study used the qualitative approach as a crucial technique to demonstrate the scientific procedures. Operationalizing the theory-based method, Directive Qualitative Content Analysis is the focus of this study. The first step in contextualizing SC is to define it as a novel concept in urban and regional planning [10, 11] and elaborate on the disparate literature on SC from different disciplines. Nonetheless, this study confines itself to the SC domain created by academics from esteemed urban planning schools.

Subsequently, defining the field study and its significant boundaries and identifying the leading players and stakeholders were essential aspects of this investigation to construct a qualitative, in-depth interview method. The main goal was to reverse Lyon Metropolis's early embrace of SC programs by Lyon Smart City managers. The research was enhanced by attending events, symposiums, seminars, public hearings, expositions, and public discussions around intelligent cities hosted by different stakeholders, which became an area to delve into the fuzzy network of SC initiators ranging from public actors to industrial actors and other organizations [12].

The crucial material came from frequent meetings, conversations, and in-depth semi-directive interviews with essential actors identified previously. Figure 1 details the complex organization of the research.

Additionally, as mentioned earlier, the methodology made it possible to choose responders from a pool of public and industrial entities to contextualize Lyon SC projects. An in-depth, directed interviewing technique was used to interview forty respondents from different institutions, which helped to construct and structure the progress of the SC model. The

interview was conducted offline and online between 2016-2019 and 2021-2022. The choice of respondents in this article was classified into three categories. The first category was the Smart City Division within Lyon Metropolis, considered the most legitimate entity for Smart City development from the public sector. The industrial and intergovernmental stakeholders, especially EDF, were chosen from the external actors, as, at the time, it was the prominent group of interest in experimenting with Smart City in Lyon. The third was digital platform actors, who later cemented their essential place within digital actors in Lyon. Table 1 shows the list of respondents in this research with their specific position.

To better grasp the context and validate the data, two or three interviews with some actors were conducted to fill in the gaps in knowledge, validate a subject, or ensure the accuracy of previously gathered data. After collecting the in-depth interview data, the "coding" technique was used to range and classify the topics based on their order. Figure 2 demonstrates the steps taken in this research data analysis.

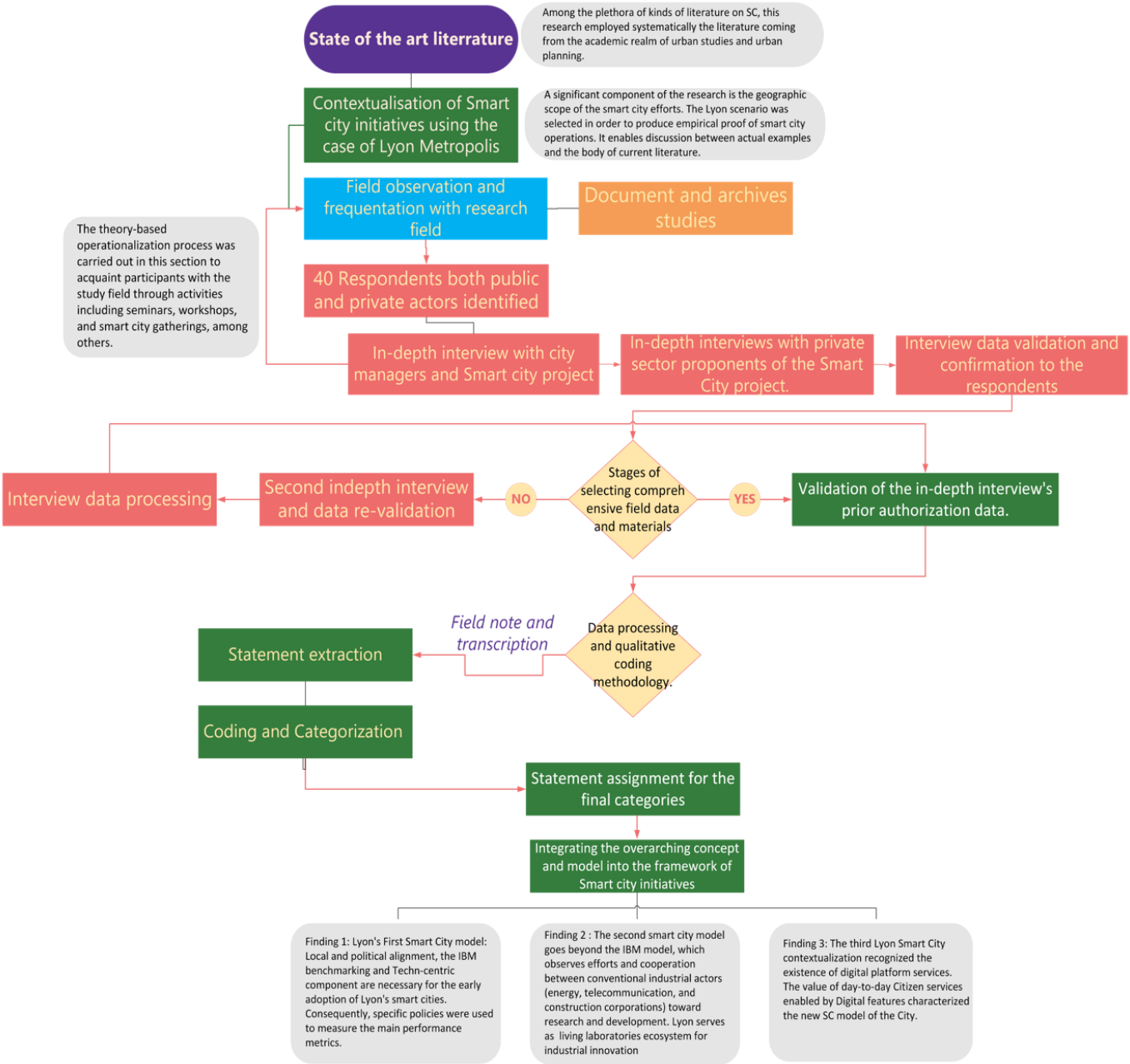

Figure 1. Organization of the research

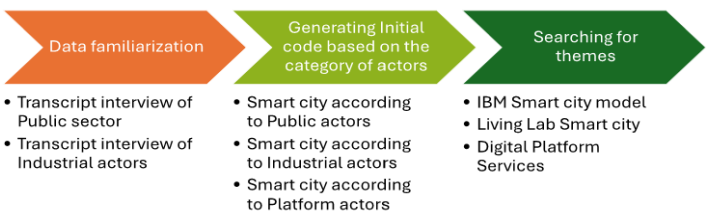

Figure 2. Data analysis process

Table 1. Respondents to the in-depth interview

Industrial and Intergovernmental Stakeholders	Lyon Metropolis	Digital Platforms
1. Senior national management of EDF **2. Senior management of EDF Auvergne Rhône Alpes** **3. All stakeholders linked to Smart Electric Lyon (SEL) Project** **a) Initial instigators of the SEL project** **b) SEL Contributors** **c) Director of SEL and his team** **d) SEL Consortium** **e) SEL University Partners** **f) Partners of the SEL Competitiveness Cluster linked to the subject of Energy Transition – Tenerdis** **4. ENEDIS (responsible for the development of Linky in the GreenLys project)** **5. ENEDIS (National Directorate of Data Governance)** **6. Digital Director of EDF Commerce** **7. Task Force for Smart Grid - Directorate General Energy – European Commission** **8. Department of Investments for the Future - Network and Renewable Energies Department (ADEME)**	1. Office of the President of the Metropolis 2. The elected officials carrying the different themes: a) Innovation, Smart Metropolis b) Energy c) Sustainable development d) Thermal renovation of housing 3. Deputy General Director 4. Urban Development and Living Environment Delegation 5. Energy Mission 6. Energy master plan 7. Artelys, Lyon City partner consultant 8. Department of Territorial Strategies and Urban Policies 9. Economic development, employment & knowledge 10. DINSI, Diretorat of Open Data Initiative 11. Lyon Metropolis Smart City Project Manager and Staffs	1. TUBA Lyon 2. La FING (Foundation Internet of New Generation) 3. Deliveroo 4. Uber

4. DISCUSSION

4.1 The IBM techno-centric mode in the first wave of Lyon's Smart City

The Smart City initiative in Lyon was not recently traced. In 2011 and 2012, a few years after the first campaign to promote the SC, the Urban Community of Lyon Metropolis - initiated this program by creating a new position profile entitled Project Manager to define the SC strategy. This initiative reveals Lyon Metropolis's consideration of the SC subject.

The exchange with the first project manager of the Lyon SC allowed us to identify the methods of implementing this project closely; it is necessary to be attentive to the influence of the Optimod Smart City project on this reflection. In 2012, the President of the Grand Lyon, in collaboration with IBM France, a leading advocate for SC initiatives, signed a partnership agreement for the Optimod'Lyon project. This project also involves Renault Trucks, academic institutions INSA Lyon, and the LIRIS lab. Optimod'Lyon is a Smart urban mobility initiative to enhance passenger and freight traffic flow. The project aims to achieve this by creating a centralized platform consolidating various urban mobility data, including network topology, estimated travel times, and air quality information. Utilizing this data, the project aimed at developing three innovative services: one-hour traffic forecasting, a mobile application encompassing all modes of transportation, and a tool designed to optimize urban freight logistics.

Concerning Lyon Metropolis, the existence of the Optimod project contributed to facilitating the institutionalization of the SC into the Metropolis Governance system, and the recruitment of an experienced project manager guaranteed the development of Lyon's SC agenda.

"As for my trajectory for this new position within Lyon Metropolis, after seven years spent in a consulting firm and IBM, the Smart City Project Manager position for defining the strategy of the Smart City of Lyon Metropolis constituted a real challenge for me, having always been interested in public policies. When I arrived, the project had not been implemented, and no political point of view had been developed. The work, in collaboration, first consisted of seeing how a public policy could be built based on this notion of 'Smart City' itself and to define it better by figuring out IBM and other IT industry models: what should be addressed? To what ends should it be pursued? What should be the benchmark for our action in Lyon to ensure this was not just a concept?" [*Extract from the interview with the first Project Manager of the intelligent city of Grand Lyon. Interview conducted in 2016*].

One of the hypotheses formulated about early SC integration into Cities worldwide suggests, as researchers emphasize heavily, the global extension of the mobilization of IBM, Microsoft, or Cisco [13]. We find it legitimate that the influence of these industrial actors is in the Lyon Smart City Project Manager orientation of the SC.

The preexistence of such a benchmark from IBM and Co. and its apparent proximity to the "Smart City" made it possible to conduct the programming of this latter project with excellent territorial visibility, which is not the case in most cities that enter partnerships with industrial suppliers such as IBM and Cisco [3].

"We had to rely on projects and a whole inventory of everything, which echoed the presuppositions of the project in one way or another. With the help of the dedicated Lyon Metropolis service, we nourished our thinking with significant media monitoring. In the beginning, Lyon Metropolis was supported by the consulting firm CHRONOS and ITEMS, a national consulting firm that helped us do international benchmarking; we also had the insight of large companies like IBM, Siemens, and Cisco since some of the first initiators of Lyon Smart City were having worked with them before being stationed in Lyon Metropolis. For example, the vision of IBM's Smart City was very relevant, and we were inspired by it. However, it needs to be adjusted. It is also very quickly understood that the culture of Lyon and the project's objectives differed from those of IBM. The cities of Montpellier and Nice had chosen to work exclusively with IBM. Still, Lyon

Metropolis did not want a single company or private operator as a contact to avoid being trapped in a solution-obliging technique from one player. If we look at what is happening today in Montpellier, the Smart City, it is blocked and not moving forward. Not because IBM completely locked down the system, and that's precisely what Lyon didn't want; I am delighted to have participated in this decision". [Extract from the interview with the first Project Manager of the intelligent city of Grand Lyon].

As an underline, in this analysis, the Smart City Project Manager in Lyon emphasizes a person's cultural and social capital [14] in defining public goods, such as the SC policy of Lyon. The role of the Lyon Metropolis SC Project Manager as the leading actor facilitated the birth of a reflection on the SC within Lyon Metropolis.

"It should be noted that this expertise is not achieved, in our case, either due to the skills of an expert benefiting from an academic focus on the subject or through direct outsourcing of the skills. As was the case, the industrial promoters of the Smart City were expected here, with the growing intervention of experts directly from IBM in constructing the "Smart City" in Rio de Janeiro. Here, we are dealing with an initiative that follows an "inductive" mode to try to redefine a Smart City from its primary promotors (IBM, Cisco, Siemens and Microsoft), with local actors distancing themselves from the original description of the Corporate 'Smart City' emanating from the industrial sector. The Lyon SC initiatives integrated took the momentum to be aligned to reduce carbon emissions. When we look closer at the first idea of IBM Smarter Planet, the IBM SC concept isn't necessarily devoted to the city but to a broader array, even in the Oil mining sector, which is so far from the city. The Optimod Projet, Lyon Confluence Smart Energy-Climat are made in Lyon, combining the matter of sustainability theme and the one of Smart" [*Extracted from the interview with the first Project Manager of the intelligent city of Grand Lyon, the interview was conducted three times, in 2016 and 2017*].

Contrasting to the model of promoting the SC by private actors alone, the Lyon point of view contextualizes industrial views to bring them into resonance with a broader context. It draws up a program of the more complex SC that does not primarily respond to industrial imperatives. This structuring distinguishes the Lyon example and distances it from the model of large industrialists [15]. Nevertheless, the IBM model was the centroid point for the SC orientation, although the array of the first concept of IBM Smarter Planet goes beyond city matters.

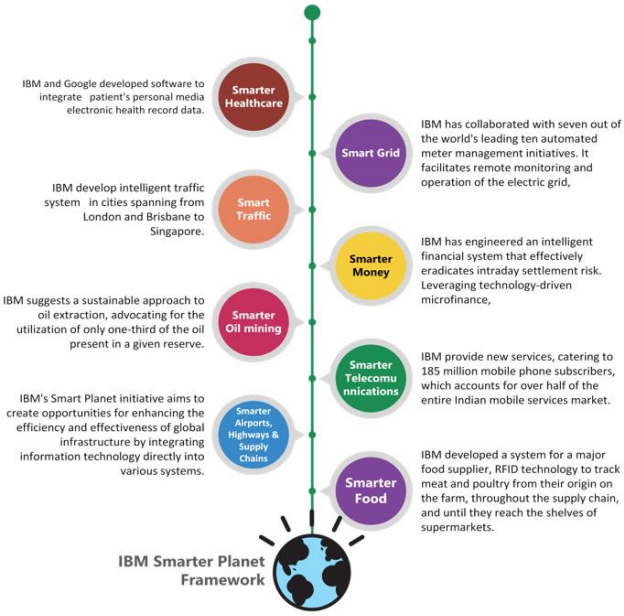

Figure 3. The earlier concept of the IBM Smart City: IBM Smarter Planet

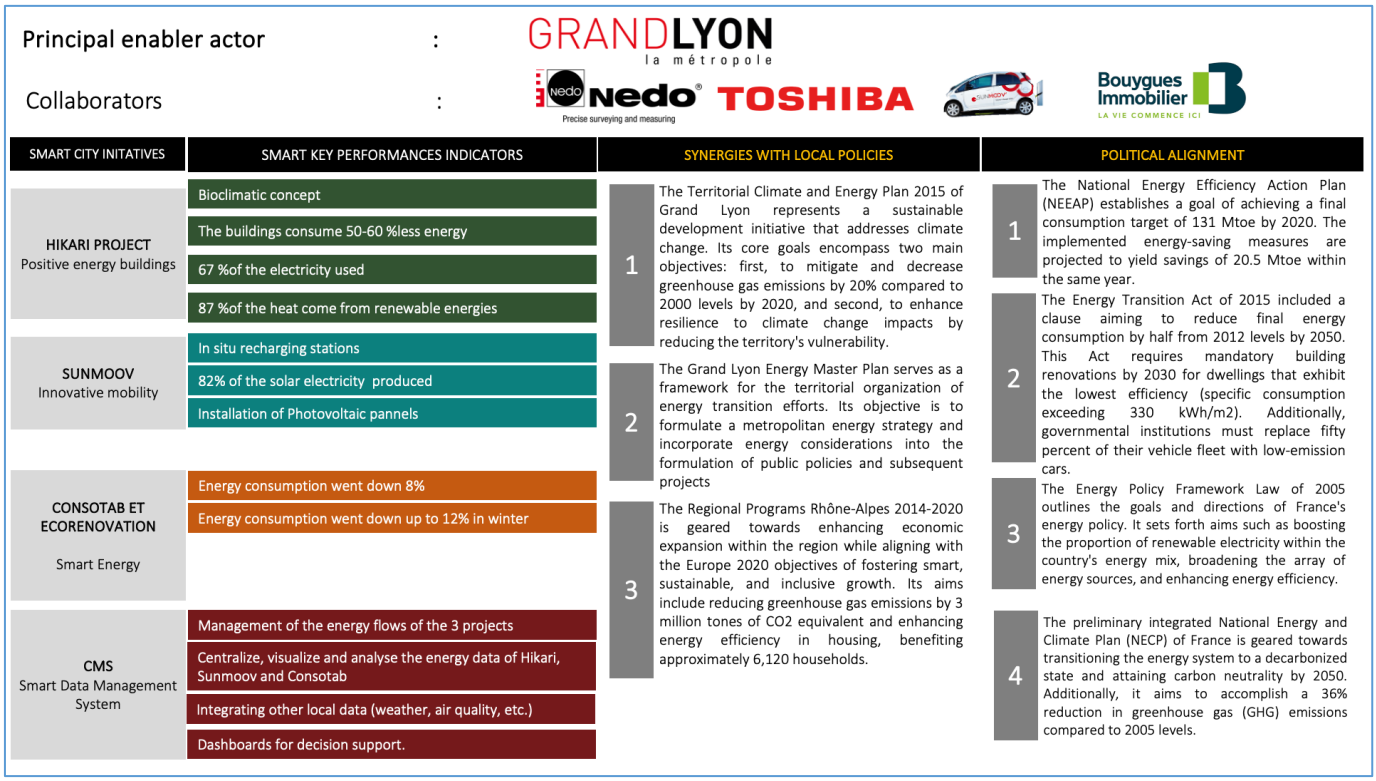

Figure 4. Lyon 1st Smart Cities model - Lyon Confluence - Smarter Together

Figure 3 demonstrates the earlier idea of the IBM Smarter Planet, officially published in 2007-2008, which shows the array of IBM SC concepts that didn't focus solely on cities. Different studies have discovered that the notion of a SC has spread massively since its first formulation. It has been naturally reformulated and supplemented to the extent of the actors' diversity and the territory's history, excluding the large companies mentioned above [16, 17]. These elements are the subject of criticism by researchers who question the influence of dynamics such as benchmarking in implementing the SC locally [18, 19].

Apart from the Optimod Smart Mobility project, in the same year, Lyon took proactive steps to become one of the forefront cities in France, embracing SC initiatives driven by its innovative projects, and it has since continued to progress. Among its earliest and most significant innovative endeavors are the "Silk Square" urban project, which includes sustainable housing, the Gerland economic hub boasting the largest biotechnology laboratories and industries, and the Confluence project "Smarter Together," featuring innovative buildings and bioclimatic design that prioritizes a blend of uses.

Figure 4 identified the characteristics of SC-Project, Lyon Confluence - Smarter Together; the early SC initiatives undertaken in Lyon Confluence. The Smarter Together project demonstration area – represent one of the most extensive urban redevelopment endeavors. These initiatives are characterized by ambitious objectives aligned with the concept of a SC, notably the pursuit of zero carbon emissions. As part of the Smarter Together Project, Lyon is refurbishing existing buildings in the Perrache/Sainte-Blandine area, aiming to accommodate 550 dwellings spanning 35,000 square meters. Additionally, efforts are directed towards local renewable energy production by installing photovoltaic systems and reducing reliance on conventional cars by providing alternative transportation options such as intelligent charging stations, electric-vehicle car-sharing systems, and an autonomous driverless electric shuttle. The project aims to develop and emphasize the initiative to produce a data platform to monitor energy production and consumption within the region and assess the impacts and benefits of measures implemented to achieve the zero-carbon objective. Table 2 thoroughly explains the characteristics of the first SC project in Lyon.

Table 2. The characteristics of the first SC project in Lyon

Leading Actors	The Lyon Metropolis
Project Title	1. Optimod Lyon 2. Smarter Together
Governance	The Grater Lyon Smart City Project Manager
Primary Benchmark	IBM Model
Partners	1. IBM (Smart City promotor) 2. Renault (Logistic Industries) 3. Toshiba (High-tech Industries) 4. INSA and Liris Lab (Academics)
Contextual Model	Dedicated Experimentation project
Geographical Coverage	1. Optimod – The Gerland Economic site 2. Smarter Together – The Lyon Confluence of 35,000 Sqm
Sectors	1. Transport and Mobility 2. Innovative Buildings 3. Energy consumption
Smart City Indicators	1. Optimod Smart City Project a. Open and Real-time Data Monitoring b. one-hour traffic forecasting c. mobile application encompassing all modes of transportation d. Optimalization of urban freight logistics. 2. Lyon Confluence Smarter together Project a. Open and Real-time Data Monitoring b. Smart charging stations c. Electric vehicle d. Car-sharing systems e. Autonomous driverless electric shuttle
Policy Objectives Alignment	Lyon Zero carbon emission Policy
Citizens Role/Engagement	Not defined/Not Engaged

Furthermore, the first SC models initiated by Lyon Metropolis, just like other French cities, were heavily linked to the aim to equip the municipalities with fully digitalized tools benefiting the new terms that came along with SC, such as Digital Transformation Open Data and Big Data [20-22]. Not only in French cities but this early SC development identified in some European cities from early 2000 to 2015 proceeds to the principal idea of the E-Government, the use of ICTs for public administration [23]. The new practices of the SC from early 2010 were in their infancy in terms of its socio-technical processes associated with SC, concentrated on the production of digitalized public policy tools [24]. At this stage, the principal contextualization of the first wave of the SC was the continuity of the Socio-technical urban regime, which some researchers described as a Data-Driven Government [25] combined with the extensive penetration of such powerful industries like IBM, Microsoft, or Cisco.

This digital instrumentation processes the influences of discourses E-governance on how Information Technology (IT) has been conceived in recent SC initiatives output, in which, in many French cities, public administration is one of the areas most affected by new digital technologies in the city and specific themes like governance.

Considering the literature dialogues above, the first SC model, its contexts, and concepts inherited the transformation toward digitalized public administration tools to better control

cities [26]. The focus on information technology (IT) and municipal digital instrumentation limited the SC spectrum to the top-down model with technocratic actors involved in the project.

4.2 Lyon as the high-tech living lab ecosystem. The second wave of Smart City initiatives

In the history of Lyon Metropolis in terms of industrial innovation, this emerging notion of a "territory favorable to innovation" strongly echoes that of the "Enterprise Spirit" of the economic governance of Lyon Metropolis [27]. It is identified here that Smart City becomes necessary for the Metropolis to maintain global coherence in its action: firstly, to transcend the concept usually sold off the SC to public services and, thereby, translate it into concrete public action, but again of the interest of the Lyon Government tools to position itself within global city rankings.

Lyon has always ardently defended the policy of "Urban Spectacular or the City of Even*,"* which aimed at decorating the city's image. Lyon managers are seizing the opportunity that the SC offers them to strengthen the image of territorial marketing in the eyes of industrial players despite the divergent debates concerning its integration. Lyon, if expanding the SC program to the Metropolis's different competencies ensures both the coherence of its conduct and its anchoring, internationalization, and territorial marketing remain the significant challenges for the Metropolis, and the "Silicon Valley" model remains an essential reference in the eyes of the presidency about this project.

The literature makes little reference to "Silicon Valley" as a model of Smart City integration. The term "Silicon Valley" is sometimes used to illustrate sizeable intelligent city projects such as Masdar, Bangalore, Songdo, etc., without assessing their degree of proximity. We assert that the SC concept retains a principle like that of contemporary urban development - which involves the "economy-geography" strategy - to that of Silicon Valley as an old global benchmarking identified in the 1980s [28].

Some researchers working in smart cities do not wish to keep the name "Silicon Valley" as an updated reference [29], arguing that if Silicon Valley was once an empirical and ideal reference for cities around the world that wanted to develop this model to integrate the headquarters of companies with significant capital into urban spaces [30]. A relationship has since been established between the ideas of Silicon Valley and reflection on contemporary urban development.

In this part, we wish to demonstrate to what extent the idea of an urban ecosystem based on the Silicon Valley model is a legacy received by "classic" political leaders and, in our case, by the president of the Metropolis of Lyon. The idea was to blend the Silicon Valley idea into SC strategy before creating a favorable and attractive Living Lab High Tech ecosystem for private companies.

"The Smart City is one of the central subjects on Lyon President's agenda. It is not the only one because Lyon Metropolis has a lot of competencies. The advantage of the Smart City (...) is that it can bring together all the skills of Lyon Metropolis. It is a way of understanding the functioning of the territory in all its dimensions. We noted that the project met the following three criteria: energize the ecosystem and promote the growth of the ecosystem for businesses, serve the citizen who is at the heart of the process and without whom all this would be meaningless (...), and make it a point of attractiveness, which is indeed the case since we receive international delegations who come to ask us how we work on the subject. This is about mixing all the dimensions and, at the same time, developing the digital economy aspect and making it a real engine for attractiveness. This is often how the Metropolis operates in its policies." [*Interview with the "sustainable city, Smart City" advisor from the office of the President of the Metropolis, November 2018 and 2019*].

For the President of the Metropolis, the urban techno-political vision was the densification of the territory in high-tech companies, which is synonymous with the agglomeration of large IT industrial groups, as is the case for Silicon Valley in Paolo Alto in California. The Silicon Valley approach means that Lyon's new SC approach aims to create the city's ecosystem as a testing ground for high technologies. This choice results from the policy it has pursued for years to attract businesses to the region.

Consequently, the City of Lyon teamed up with National Companies such as EDF, ENEDIS, Bouygues, and Orange to launch a new concept for the SC program based on a high-tech incubation model. Later, the project was concretized through the Smart Grid and Smart Meter pioneer project of the EDF, called Lyon Smart Electric (SEL), supported by the *Electricité de France* (EDF), with a vital budget coming from ADEME, of almost 600 million euros. It is one means, among others, of attracting economic resources to the Lyon region.

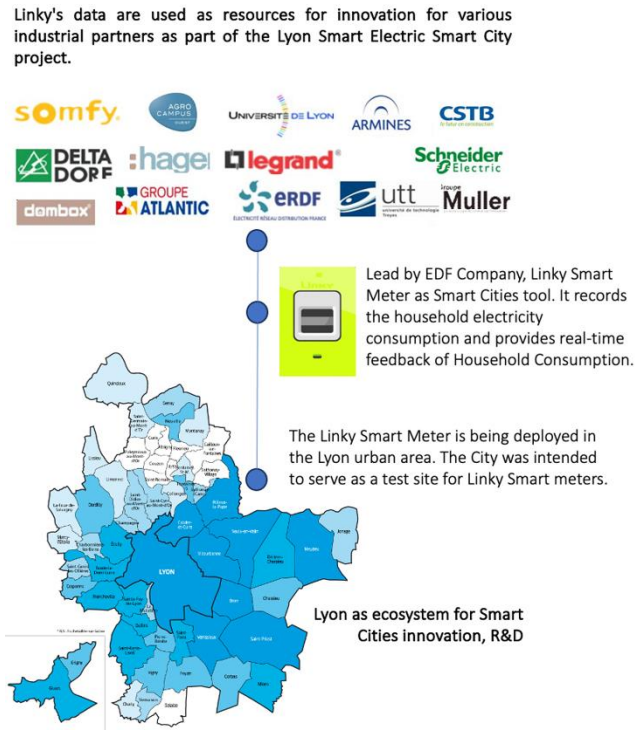

Figure 5. Lyon second wave SC model: Lyon territory as "Silicon Valley" for Industrial technology innovation

It should be noted that the SC theme was integrated into this agreement at the time of signing. Therefore, the SEL is the driving force behind this inclusion of the SC on the Lyon metropolitan agenda, employing the spirit of Silicon Valley: Lyon is a promising territory for high-tech innovation and experimentation. Figure 5 illustrates the SC-Project of Lyon Smart Electric, led by the EDF group, termed the Industrial Consortium Smart City project, aimed at emulating the Silicon Valley model.

Two experimental strategies are developed at the heart of the SEL consortium's mission. One of them, which consists of testing the reception by 20,000 urban households of consumption data produced by the Linky meter, very directly concerns EDF and how the deployment of this meter could, in the long term, modify its pricing policies or, even more improbably, its production planning policies. The prospect of associating new tools on a territorial scale with the Linky network is one of the vocations of SEL, the operation of which follows an R&D model that is characterized by transversal collaboration between the different industrial players. In this type of partnership, these actors seek to develop new knowledge based on territorial-oriented, "a new knowledge focused on the territory" [31]. Several researchers consider it a fundamental transformation in innovation under the SC flag.

Territorial commitment is aimed at translating hypothetical technological solutions into their operational physical materialization, a function of local characteristics that result in the "intellectual capital" patent, often recognized as a "Smart City" specification. As explained by the President Director of the SEL project:

"Linky, as the primary technological instrument, represents a new form of experimentation with high-tech devices leading all twenty technology industries in the city of Lyon. This system was part of a national strategy that saw it extended to all French households, with a target of 80% of households equipped by 2021. The industrial players who experiment can take advantage of the Linky system and test its operation on a city scale. The Smart Electric Lyon platform has become a multi-dimensional arena of Lyon Smart City based on innovation where EDF, local representatives, industrial players, and university players compete." [*Interview with the President of the Smart Electric Lyon, Lyon Metropolis, interviewed in 2017 and 2018*].

It's labeled Smart Electric Lyon, which offers manufacturers the rare opportunity to test their products in the field during their development phase and to guarantee the most suitable functionality even before they are placed on the market. SEL elaborates on extracting the economic niche orientation through the Lyon Living ecosystem. This opens a new reflection on the fact that the SC has revived a model of "Urban practices," the co-production of Urban practices with the collaboration of private actors under SC. The Lyon territory constitutes an essential resource in the economic practice of industrial actors. The progress of the SC initiatives in Lyon has gone beyond the first model. This second wave of SC experience occurred notably after the inauguration of the Smart Electric Lyon project at the end of 2013. Table 3 reveals the characteristics of the second wave SC model in Lyon that distinguished it from the first model.

SEL Project introduced a collaboration with industrial actors to develop innovation and R&D, benefiting Lyon territory as a living ecosystem, in which the household data extracted through Link became raw materials for the consortium member to innovate their products. In this case, the new SC concept has created a partnership between industrial players and local authorities to develop patents for local innovations [32]. This shows the growing importance of the territory as a resource in the current balance of power between industrial and territorial actors engaged in the notion of an SC.

The characteristics of the Lyon second-wave SC model are shown in Table 3. The characteristics of the second wave of SC initiatives in Lyon demonstrated a slightly distinctive model from the first. The governance model, the actors, and the experimental context ornamented the second model. Therefore, the reformulation of the SC at the territorial level played an essential role in the apprehension of the SC dynamics. Like the previous SC model, in the second wave, the nuances of the government tools represented by the EDF project occupied the summit of the project objective. This Top-down form articulates Lyon's ambition to comply with international indicators such as Lyon Zero carbon emission at the European Energy Award (EEA) parameters in which SEL was claimed as one of the territorial initiatives toward zero-emission research and development. This article contests that until the second stage of the Lyon SC initiative, it aimed at producing tools for industrial actors. At the same time, the city of Lyon constituted an R&D test bed. Lyon's second-wave SC spectrum is relatively limited to governmental and industrial actors. The engagement of society was the object of the industrial test.

Table 3. The characteristics of the second wave SC model in Lyon

Leading Actors	Electricité de France (EDF)
Project Title	Smart Grid Project
Governance	A Consortium of Smart Grid – Smart Electric Lyon
Primary Benchmark	Silicon Valley – Research & Development Project, Lyon Ecosystem as High-Tech Living Lab
Partners	1. EDF Group 2. Household Product Industries 3. Telecommunication company 4. Academics
Contextual Model	A dedicated Smart City Project, integrating 20.000 Household Smart Meter deployment
Geographical Coverage	The Urban Area of the Lyon Metropolis (20.000 Household equipped with Smart Electric device)
Sectors	1. Smart Energy 2. Smart Grid – Smart Meter Tools 3. Energy consumption
Smart City Indicators	1. Household Energy consumption awareness 2. Smart Meter devices 3. Household real time energy consumption Data 4. Open and Real-time Data Monitoring both customer and producer 5. Industrial development based on Smart Meter Data 6. Real time data product development
Policy Objectives Alignment	1. Lyon Zero carbon emission 2. Lyon as favorable ecosystem for industrial development 3. Lyon global Smart City positioning 4. European Energy Award (EEA)
Citizens Role/Engagement	Part of City Ecosystem - Households test for Linky Smart Meter

4.3 Digital Platform in the third wave of Lyon Smart City model

After two consecutive forms of the SC initiated by Local government and Industrial actors that entered the champ of the SC, the latest form of the SC in Lyon witnessed the indispensable role of Platform Infrastructure and Sectoral Platform. The Big Five high-tech companies—Google, Facebook, Apple, Amazon, and Microsoft— are known as the heart of platform infrastructure and the online information economy worldwide [31, 33, 34]. Meanwhile, sectoral

platforms provide digital services tailored to a particular industry, such as transportation, retail, or health. Sectoral platforms are essentially "connectors" that link individual users and individual providers; they do not possess any material assets or provide any physical goods, content, or services. One may classify Airbnb, for example, under sectoral platforms. It acts as a link between "guests" and "hosts," both called "users." "Hosts" are micro-entrepreneurs rather than workers or establishments, while "guests" are not typical clients.

The strong presence of Digital Platforms in most big European cities, including Lyon, could be identified as early as 2011-2012. However, the presence of digital platforms on the European continent faced a significant challenge. For example, Uber and Air BnB were courted during 2017-2018 regarding Uber's classification as a Platform Services or Transportation company.

The recognition of Digital platforms as an integral part of the SC actors in Lyon started to gain momentum in 2016 through a report to the Grand Lyon Metropole entitled *Plateformes Numeriques et Territoires. Quels Enjeux pour la Collectivite?* This report covers three important and clarifying issues concerning the role of digital technology in the Lyon territory: the economy of digital platforms, the effects of digital platforms on the territory, and the possible governance model between the Metropolis and digital platform actors. The critical turning point of the digital platform was found during COVID-19. Following the coronavirus crisis, the digital strategy of the Lyon Metropolis has gained importance, with digital tools used to support the daily activities and needs of city dwellers. With restrictions in place and most social and economic activities online, citizens and businesses depended on the internet and connectivity. Thanks to digital infrastructures, the continuity and availability of citizen services have been guaranteed.

More advanced, the policy agenda, namely Lyon, *territoire du numérique responsible* (Lyon as Digitally responsible territory), aimed to create the leading sector of excellence in the Lyon metropolis in terms of percentage of growth; digital technology relies on a cutting-edge environment to meet the significant challenges of the industry. Conferring to the report of the Lyon, *territoire du numérique responsible* (the report was accessed in 2024), this policy movement was marked by several key figures:

Lyon's Digital policy has been shifted toward digital engagement to boost the metropolis, such as creating Lyon's French digital ecosystem in terms of number of jobs, start-ups, training, laboratories, digital jobs among software and game publishers and promoting 1,000 start-ups in the metropolises of Lyon and Saint-Étienne (French Tech One Lyon St-Étienne), for this reason, digital urban platform services have been reconfigured in the field of SC in Lyon. [*Cited from the discourses of Advisor of implementation specializing in the responsible digital sector and the social and solidarity economy, Lyon, responsible digital territory, 2021*].

Today's sectoral platforms form the new spine of Lyon's Smart City. Sectoral digital platforms allow users to access payments, e-commerce, deliveries, ridesharing, and other services within the same app They advocate the daily needs and suitability of citizen-centric, personalized services and on-demand offers based on individual customs. The latest research also indicates that digital platforms significantly disrupt traditional government services, such as Waze [35].

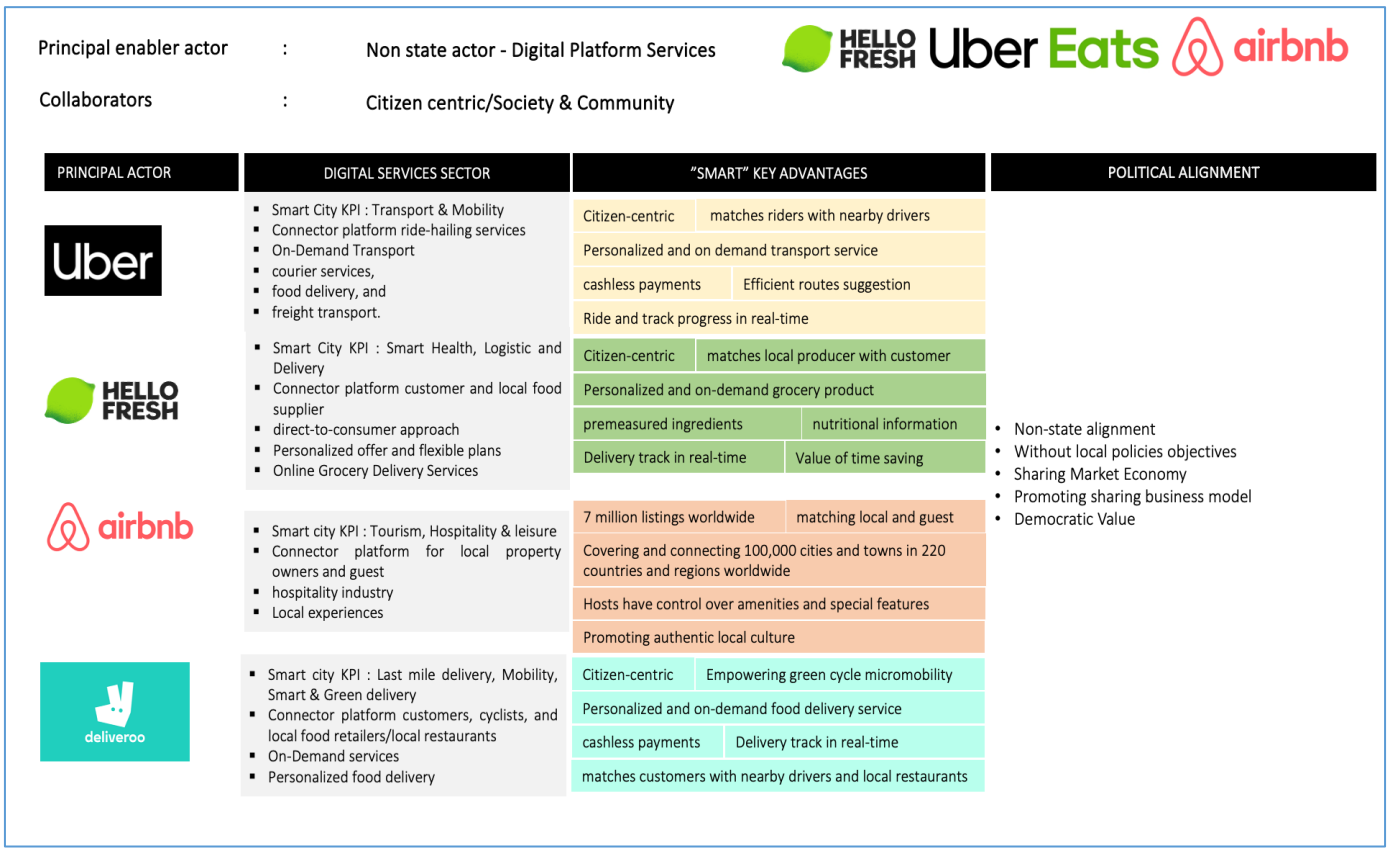

Figure 6. Recognition of digital platforms services in the 3rd wave of Lyon's Smart City model
Source of the images: extracted from various online sources, Air BnB, Uber, Deliveroo, and Hello Fresh, accessed in 2023

In Lyon Metropolis, the strong presence of urban digital platforms has somehow substituted conventional public services [35]. For instance, dozens of digital platform services operate in Lyon's geography, such as Uber, Deliveroo, Checkout, Farftech, Lyft, Eat, Air BNB, etc. From this research investigation, the City Manager's perspectives on Digital Platforms as an integral part of the new SC contextualization are down to several features, such as the ability of the Platform to integrate Direct Civic Engagement, Sharing economy model, Real-Time services, proposing basic needs citizen services, the value of time, the complex features toward city coverage systems, and sustainable features such as the use of bike and non-motorized vehicle as critical point for on-demand meal delivery to gain tremendous momentum [36]. However, it is essential to note an important debate, as pointed out by numerous researchers; despite the problems of the digital economy, such as the employment contract, the reality of a majority of meal delivery workers consists of precarious jobs, long and irregular working hours, lack of social security, low and unstable average salaries [37], but the sharing economy of platforms like that of Uber Eats or Deliveroo are high.

Through the Lyon case, several key advantages of the Digital Platform were identified as the advantages and critical performances that offer a novelty in the contextualization of the Smart City by the City Managers [38]. According to the implementation advisor specializing in the responsible digital sector and the social and solidarity economy, Lyon, responsible digital territory:

"This shift toward recognizing digital platforms as an integral part of SC sees the new dynamic of SC focusing on the core value of day-to-day Citizen services enabled by Digital platforms. Compared to the previous first and second wave, it is argued here the contextualization of the SC has disconnected from its principal promotors (IBM, Microsoft, or Siemens) and instead based on the performances of the services for the citizens provided by the growing presence of digital platform actors". [*Cited from the discourses of Advisor of implementation specializing in the responsible digital sector and the social and solidarity economy, Lyon, responsible digital territory, 2021*].

Figure 6 shows the identification of the critical actors during the rise of the third wave of the SC context, its key advantages, and its essential features.

In France alone, 415,000 people work for digital platforms offering this service. Among the six platforms studied (Uber Eats, Deliveroo, Eat, Stuart, Coursiers Nantais, and Naofood), Uber Eats has 45,000 partner restaurants and merchants and 60,000 delivery people in France. At the same time, Deliveroo claims 26,000 and 22,000, respectively. 39% of delivery people are self-employed (The Fairwork France 2022 report).

Regarding the literature critics, Scholars advocate for a citizen-centric strategy to address the SC agenda to the interests and concerns of the populace. Nonetheless, the goal of raising citizens' quality of life is seen critically in the literature since it is frequently established by Smart City project management without involving the urban public in decision-making [25]. The researcher also examines the citizen's role in SC conceptions to shed light on this matter. In addition, citizen microtransaction patterns provide a better understanding of how "smart" inhabitants engage with their city through economic opportunities offered by Digital platforms or the privilege of real-time day-to-day services provided by digital platforms. Therefore, as citizen-centricity is becoming more and more prevalent in Smart City approaches, it is critical to understand how individuals view their city and what Smart City services they consider most important.

Beyond the socio-technical aspects, the discourses of the City Managers underlined that the Digital platform actors are value-freed, at least from the point of view of political alignment and local policy objectives. A specific dedicated project does not define its characteristics but organically grows from the Digital platform's services. More importantly, the digital platform promotes a sharing economy model that empowers solid civic engagement, which was nowhere to be found in the two previous models. Even though during the fancy time of the SC, digital platform services were not on the agenda of the SC socio-technical discourse in Lyon, the core services of digital platforms started to gain their niche within society's daily needs.

Table 4 resumes the characteristics of the third SC wave model identified in Lyon Metropolis.

Table 4. The characteristics of the third wave of the SC contextualization in Lyon Metropolis

Leading Actors	**GAFAM as Platform Infrastructure and Sectoral Digital Platform Actors**
Project Title	-
Governance	Digital Services Market Systems
Primary Benchmark Partners	-
Contextual Model	The platform society model
Geographical Coverage	The city networks
Sectors	1. Ride sharing 2. Delivery 3. Logistics 4. Hospitality
Smart City Indicators	1. Citizen-centric, strengthening civic engagement based on society's needs. 2. Enhancing access and experiences to the realm of urban life features 3. Empowering citizens through a variety of features such as participation, Sharing the Market Economy 4. Promoting sharing business model and Democratic Value 5. The use of green transportation mode such as bike and electric bike 6. Real time service and the integration of the whole city system into the services of Digital platform
Policy Objectives Alignment	Undefined
Citizens Role / Engagement	Sharing Economy, Daily needs services, Real Time services, City network coverage

However, in the context of the Urban Digital Platform, the Lyon Government does not position itself at the heart of the SC enabler nor as an initiator but merely as a "Territorial Regulator Partner." As noted by previous research, the Lyon Metropolis actors conserve their role as intermediaries that integrate and coordinate the implementation of the government strategy toward the flow of services enabled by digital platform actors on a metropolitan scale. Reflecting the variety of digital services such as ride-hailing, last-mile delivery, food delivery, and hospitality and accommodation,

Lyon Metropolis can exercise the capacity to regulate these actors so that their service propositions are integrated into its political objectives and government agenda.

This discussion argues that the third-wave SC model goes beyond a devoted SC project set by the government or a specific enterprise. At this stage, the typologies of the SC appearances are identified through the organic growth of the digital platform services enabled by the solid and permanent existence of the Big Five and sectoral platforms within Lyon territory [39].

It is important to note for future discussions that while the platform is a powerful metaphor for contemporary societal organization and understanding, it also represents a tangible reality in urban settings, shaping various aspects of urban life. Consequently, platforms play a crucial role in shaping the future-oriented nature of Smart cities in response to societal needs.

5. RESULTS

The results of this research point out the transition from the first wave of Smart City initiatives in Lyon Metropolis. The distinction between each period could be identified through several factors such as its period, the Theoretical Framework, the Leading actors, the Contextual typology, the Project Theme, the Governance model, the Primary benchmark, the collaboration and partnership within actors, the Geographical Coverage, Sectors, the Smartness Indicators sets, the Local Policy Objectives alignment and how the extent to which citizens are engaged. As shown by Table 5, the results of this research are concisely synthesized.

Aside from several key points mentioned above, the rise of digital platforms in the third wave of the SC might be due to the principles of key performance indicators. Based on the insight coming from in-depth interviews, it can be noted here seven key indicators that might be useful for future research, such as the opportunity for Digital Platforms to leverage Direct civic engagement with the sharing economy model, the ability to provide daily needs services in real-time matter, time value, the use of the sustainable features such as green transportation and city coverage systems harnessing the Internet of things. However, those critical performances needed to be studied profoundly.

Table 5. The comparisons of the first, second, and third waves of the SC models

Period	Early Year 2000 to Year 2015	Year 2015 to Year 2019	Year 2020 <
Theoretical Framework	▪ The early Shift from the New Public Management to Digitalized Government ▪ Open Data Government	▪ Place Branding ▪ City Ecosystem as Living Laboratory ▪ Industry 4.0	▪ Society 5.0 ▪ Digital Sharing Economy
Leading Actors	The Lyon Metropolis	*Electricité de France* (EDF)	GAFAM as Platform Infrastructure and Sectoral Digital Platform actors
Contextual Typology			
Project Title	3. Optimod Lyon 4. Smarter Together	Smart Grid Project	
Governance	The Lyon Metropolis Smart City Project Manager	A Consortium of Smart Grid – Smart Electric Lyon	Digital Services Systems based on market development
Primary Benchmark	IBM Model	Silicon Valley – Research & Development Project, Lyon Ecosystem as High-Tech Living Lab	
Partners	5. IBM (Smart City promotor) 6. Renault (Logistic Industries) 7. Toshiba (High-tech Industries) 8. INSA and Liris Lab (Academics)	1. EDF Group 2. Household Product Industries 3. Telecommunication company 4. Universities	
Contextual Model	Dedicated Experimentation project	A dedicated Smart City Project, integrating 20.000 Household Smart Meter deployment	The platform society model
Geographical Coverage	3. Optimod – The Gerland Economic site 4. Smarter Together – The Lyon Confluence of 35,000 Sqm	The Urban Area of the Lyon Metropolis (20.000 Household equipped with Smart Electric device)	The city networks
Sectors	4. Transport and Mobility 5. Innovative Buildings 6. Energy consumption	1. Smart Energy 2. Smart Grid – Smart Meter Tools 3. Energy consumption	5. Ride sharing 6. Delivery 7. Logistics 7. Hospitality
Smart City Indicators	3. Optimod Smart City Project a. Open and Real-time Data Monitoring b. one-hour traffic forecasting c. mobile application encompassing all modes of transportation d. Optimalization of urban freight logistics 4. Lyon Confluence Smarter together Project a. Open and Real-time Data Monitoring	1. Household Energy consumption awareness 2. Smart Meter devices 3. Household Real Time energy consumption Data 4. Open and Real-time Data Monitoring both customer and producer 5. Industrial development based on Smart Meter Data 6. Real time data product development	7. Citizen-centric, strengthening civic engagement based on society's needs. 8. Enhancing access and experiences to the realm of urban life features 9. Empowering citizens through a variety of features such as participation, Sharing the Market Economy 10. Promoting sharing business model and Democratic Value 11. The use of green transportation mode such as bike and electric bike

	b. Smart charging stations c. Electric vehicle d. Car-sharing systems e. Autonomous driverless electric shuttle		12. Real time service and the integration of the whole city system into the services of Digital platform.
Policy Objectives Alignment	Lyon Zero carbon emission Policy	1. Lyon Zero carbon emission 2. Lyon as favorable ecosystem for industrial development 3. Lyon global Smart City positioning in European Energy Award (EEA)	Not particularly defined
Citizens Role / Engagement	Not defined/Not particularly Engaged	Part of City Ecosystem - Households test for Linky Smart Meter	Sharing Economy, Daily needs services, Real Time services, City network coverage
Key Performance Indicators Objectives	1. Digital Public administration tools 2. Big Data and Open Data 3. Real Time Public Decision Tools	1. Industrial investments and Smart City fundings 2. Functionality of Linky Smart Meter 3. Data Collection from Linky 4. Compatibility of Linky with related products of the consortium member	1. direct civic engagement 2. daily need services 3. sharing economy 4. real-time services 5. time value 6. sustainable features such as green transportation 7. city coverage systems

6. CONCLUSION

The experiences of Lyon Smart City, from the first to the third, saw the decline and repositioning of large groups such as the IBM, Cisco, or Siemens model in a logic of sectionalization of urban services. On the other hand, the platforms of the digital economy, by presenting the main characteristics of these actors, the issues and methods of regulating their activity, and their partnership initiatives with public actors, have gained momentum, replacing the critical position of the Smart City actors of the first model.

Comparing the three intelligent city models, the first proposes critical key performance indicators, such as digital public administration tools, big data, and open data real-time public decision tools. The second wave of the Smart City offers specific characteristics such as Industrial investments and Smart City funding, the Functionality of the Linky Smart Meter, Data Collection from Linky, and Compatibility of Linky with related products of the consortium member. The digital platform Smart City model proposes Direct civic engagement, daily need services solutions, real-time services, a sharing economy model, time value, sustainable features such as green transportation as part of the Smart City, and the city coverage systems in terms of physical services.

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