UNIVERSIDADE ESTADUAL DE CAMPINAS

Instituto de Geociências

LUCAS PINTO SEIXAS

# THE IDEAL OF SMART CITY IN CAMPINAS (SP): URBAN SPACE, GEOTECHNOLOGIES AND SOCIO-SPATIAL INEQUALITIES

# O IDEÁRIO DE *SMART CITY* EM CAMPINAS (SP): ESPAÇO URBANO, GEOTECNOLOGIAS E DESIGUALDADES SÓCIO-ESPACIAIS

CAMPINAS

2023

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DISSERTAÇÃO APRESENTADA AO INSTITUTO DE GEOCIÊNCIAS DA UNIVERSIDADE ESTADUAL DE CAMPINAS PARA OBTENÇÃO DO TÍTULO DE MESTRE EM GEOGRAFIA NA ÁREA DE ANÁLISE AMBIENTAL E DINÂMICA TERRITORIAL

DISSERTATION PRESENTED TO THE INSTITUTE OF GEOSCIENCES OF THE UNIVERSITY OF CAMPINAS TO OBTAIN THE DEGREE OF MASTER IN THE AREA ENVIRONMENTAL ANALYSIS AND TERRITORIAL DYNAMICS

Orientador: Prof. Dr. Lindon Fonseca Matias

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UNIVERSIDADE ESTADUAL DE CAMPINAS
INSTITUTO DE GEOCIÊNCIAS

**AUTOR**: Lucas Pinto Seixas

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**ORIENTADOR:** PROF. DR. LINDON FONSECA MATIAS

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*A Ata de Defesa assinada pelos membros da Comissão Examinadora consta no processo de vida acadêmica do aluno.*

Campinas, 06 de dezembro de 2023.

**DEDICATION**

*This work is to all those who dedicate their lives fighting for social justice in the cities around the world*

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Yours Faithfully,

Lucas Seixas


*(London, 27/02/2023)*

**“***seja marginal*

*seja herói”*

**Helio Oiticica – 1968**

## RESUMO

Ao longo das últimas décadas, o capitalismo globalizante atingiu, em função de seu alto estágio de desenvolvimento tecnológico, novos e disruptivos modos de produzir o espaço, por meio de alterações no trabalho, na mobilidade, nas formas de morar e governar diferentes esferas. Especialmente em referência ao espaço urbano, o ideário de *smart city*, baseado em aplicação de tecnologias a diferentes estruturas urbanas, passou a reunir múltiplos processos sócio-espaciais e a ser reivindicado pelo Estado e por companhias digitais e indústrias de tecnologia como solução para inúmeros problemas urbanos. Com o papel central da informação nesse capitalismo neoliberal, sistemas automatizados controlados por algoritmos necessitam de bases de dados georreferenciados robustas, constituídos como *big data* e proporcionando *big analysis*. Ainda que as raízes históricas e epistemológicas do ideário estejam conectadas a concepções de relação com espaço eurocêntricas da modernidade, em função das pressões globalizantes do capitalismo em seu atual estágio, as *smart cities* se fazem presente em múltiplos contextos geográficos, como o caso de Campinas – SP. O presente trabalho, com base numa interpretação dentro do materialismo histórico dialético do espaço geográfico e entendendo o espaço urbano como fruto de tensões dialéticas de seus agentes produtores, pretende investigar o conceito de *smart city* e suas distintas definições, formas, conteúdos e processos sócio-espaciais, compreender o papel exercido pelas geotecnologias no ideário de *smart city* e analisar o caso de Campinas, definindo as abordagens conduzidas pelos principais agentes vinculados à ideia de *smartness* e suas consequências para o espaço urbano e produzir Coremas, tanto como parte do processo de compreensão como para representar o espaço campineiro.



**Palavras-chave:** Smart cities; geotecnologias; espaço urbano; Coremática; Campinas-SP.

## ABSTRACT

During the last decades, globalizing capitalism achieved, due to its high technological development, new and disruptive ways of producing space, by affecting labour, mobility, housing and governing. Regarding urban space, the ideal of smart cities, based on applying technology to different urban structures, started gathering multiple socio-spatial processes, claimed as solution to different contradictions, mainly by State and digital and technological platforms. With the core role played by information in this new capitalist scenario, automatized systems controlled by algorithms need a sturdy georeferenced database, to enable a series of structures to function, constituted as bigdata and producing big analysis. Although the historical and epistemological roots of the ideal of smart cities are connected to modern European relationship with space, because of capitalist globalization, smart cities are present all around the world, even in quite difference contexts, including Campinas – SP. Therefore, this research based on a historical dialectical materialist approach to geographic space and urban space as a product of dialectical tensions among agents producers, aims to investigate the concept of smart city and its distinct definitions, forms, contents and socio-spatial processes, to understand the role played by geotechnologies in the ideal of smart cities and in the specific case of Campinas as well, to analyse the case of Campinas, defining the approach held by the main identified agents acting in this matter and its consequences to urban space and produce chorems both as an investigation method and spatial representation.



**Key words:** Smart cities; geotechnologies; urban space; chorematic; Campinas-SP.

## LIST OF FIGURES

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## LIST OF ABBREVIATIONS

| | |
|---|---|
| EPA | Environment Protection Area |
| ASCL | Arts and Social Sciences Library |
| BEPE | Research Internship Abroad Scholarship |
| CATI | Department of Comprehensive Technical Assistance |
| CEPAL | Economic Commission to Latin America and Caribe |
| CAPES | Coordination for the Improvement of Higher Education Personnel |
| CIATEC | Technological Development Company |
| RMC | Campinas Metropolitan Region |
| CNPEM | Energy and Materials National Research Centre |
| CODETEC | Technologic Development Company |
| COHAB | São Paulo Metropolitan Habitation Company |
| COVID-19 | Coronavirus |
| CPFL | Paulista Energy Company |
| DEPI | Integrated Development Office |
| DER | Department of Roads and Highways |
| Embrapa | Brazilian Agricultural Research Corporation |
| EMDEC | Campinas' Municipal Development Enterprise |
| FAPESP | São Paulo Research Foundation |
| FECFAU | Faculty of Civil Engineering, Architecture, and Urbanism |
| FTI | Food Technology Institute |
| GDP | Gross Domestic Product |
| GeoGet | Applied Geotechnologies for Territory Management |
| ICT | Information Technology Centre |
| IDB | International Development Bank |
| IE | Institute of Economics |
| IFCH | Institute of Philosophy and Human Sciences |
| IMA | Associated Municipalities Informatics |
| ITAL | Institute of Food Technology |
| LNLS | Sincroton Light National Laboratory |
| NEPO | Elza Berquó Population Studies Centre |
| NRW | Natural Resources Wales |
| QGIS | QuantumGIS |
| SANASA | Water and Sanitation Provider Society |
| SciELO | Scientific Electronic Library Online |
| SP | São Paulo |
| RMSP | São Paulo Metropolitan Region |
| UN | United Nations |
| UNECE | United Nations Economic Commission for Europe |
| UK | United Kingdom |

**SUMMARY**

## INTRODUCTION

Developing any analysis of the production of space will need enormous effort and several challenges will emerge. Nevertheless, the dialectical relationship among space, society, and nature imposes multiple material needs, shaping the ways of the world, as proposed by David Harvey (2016). One crucial perspective to have in mind is that the current stage of globalizing capitalism demands massive natural, human, and economic resources, functionating on a global scale: the way (geo)technology enables factors, financial centres and even crop fields to be administrated or controlled from multiple different locations elicits new spatial conflicts.

To maximize big companies' profits, even complex production systems are currently spreading throughout peripherical contexts, carrying particular ways of producing the urban space. Predictions at the beginning of the 21st century, as shows Mike Davis (2005), stated that the urban growth for the next decades would be concentred in peripherical countries and create several mega or even hyper[1] cities. Late data show that these predictions have indeed been confirmed: in November 2022, when the world reached 8 billion people, eight out of ten of the biggest cities in the world are either in China[2] or in the world periphery, according to World Populations Review (2022). This scenario shows quantitative and qualitative shifts in urban living and studying.

Flexibility allows new agents and processes to influence labour, housing, mobility, and planning and increases the competitiveness in urban environments, as on the one hand, cities compete for attracting investments and on the second hand, big tech companies, markedly Gamam and Natu[3] create massive private big data infrastructures and control multiple urban aspects, increasing socio-spatial inequalities due to high level of exploitation or rising cost of living.

Although the current and future urban world "face" is year by year drifting away from its European roots, as Henri Lefebvre (1999) shows, due to the central role played by West Countries, even with very different urban problems, the mainstream solutions put forth by hegemonic agents are based on challenges and perspectives faced or proposed in central contexts. The smart city ideal is part of this broad global agenda: an integrative and consensual

[1] According to Davis (2005) mega cities are the ones with more than 8 million inhabitants and hyper cities have more than 20 million.

[2] To define where would China be in this approach is quite complex, as the country comes from years of intense growth, becoming maybe the most important economy in the world, although it is not part of "West", thar use to dominate "development".

[3] Google, Apple, Meta, Amazon and Microsoft and Netflix, Airbnb, Tesla and Uber.

widespread set of programs, projects, and goals to tackle (not only) urban problems. On the other hand, alongside these packs of policies, come through different mechanisms, a neoliberal agenda as a solution to urban problems.

Campinas – São Paulo/Brazil is marked by socio-spatial inequalities and is inserted in this context, as local authorities have been promoting investments in specific programs to make the city "smarter" and the mentioned big tech companies are widely influencing urban life. During the 20th century, multiple investments by different agents took place at the city and created and environment that enabled the ideal of smart cities to become a goal, even with highlighted socio-spatial inequalities and many contradictions. However, specifically since 2015 with Strategic Plan to Science, Technology, and Innovation (PECTI) and 2019 with Strategic Plan Smart City (PECCI), the ideal of smart city has influence over millions of inhabitants and interacts with industrial, commercial, scientific and populational centres.

Nevertheless, even in this scenario, Brazilian geography has been struggling and neglecting to track these shifts and most of the knowledge produced regarding smart cities comes from other fields. This knowledge tends to be primarily focused on technological advancements, the creation of urban-scale technological devices, the dissemination of neoliberal governance perspectives, and the widespread propagation of "mass-produced" master or strategic plans. Departing from a dialectical historical materialism, this research analyses the concept of smart cities since its origins, how it arrived in Brazil and the consequences to urban space it had.

To answer the questions to which set by this project, we decided to turn to choremathics, approach to cartography developed by Roger Brunet (1986). This was proved an interest choice, as prevented us from falling in a few contradictions or entrapments. First, one of this work's essential ideas was that, yet sometimes important, data are not the solution for urban problems and conflicts, as groups of urbanists, politicians, planners and *cartographers*[4] insist. Being so, we couldn't present regular and traditional maps without, albeit superficially, raising suspicions.

Second, we have a particular perception on how cartography is studied, applied and understood in Brazilian geography: the prominence that positivistic approach has in our science makes it seem like the only possible way to use maps to represent (and create) what we call geographic space. Despite very inspiring, this enquiry is not our focus here. However, avoiding leaving this step of academic formation without contributing to decrease this disparity, we

[4] Cartography is a field of knowledge intensely disputed by multiple actors and agents that aim to define its meaning, use and values. We explore this issue on Chapter 3.

decided to bring chorems – because we are convinced of their potential and want them to be more known in Brazilian geography.

## MASTER'S DISSERTATION OBJECTIVE AND STRUCTURE

During the period as master's candidate at Institute of Geosciences, Unicamp, the stablished research objective can be summarized in the following definition: To recognize the transformations in the urban space of Campinas, São Paulo, related to policies and actions within the context of "Smart Cities" by multiple agents involved in urban space production and identify the role of geotechnologies in this process.

Given such perspective, the current work aims to set a critical frame on this theme, investigating the origins, the spatial processes linked with smart cities, how they have been applied in Brazil and especially in Campinas. How to define smart cities? Where does this concept come from? What agents tend to claim this mode of urban intervention? What consequences do the cities face when related to the smart city ideal? How does GIS relate to these concepts? What consequences Campinas sees from adopting this package?

In the following chapters we try to find answers, albeit incomplete, to such questions. To do so, Chapter I – "*Materials and methods: framing the smart city ideal in Campinas (SP)*" presents multiple steps taken in order to produce the current research. Chapter II - "*The ideal of smart city and the production of space: towards a geographical perspective*" contains explanations on the rising of smart city ideal and the emergence of neoliberalism, goes to the origins of the concept and tracks the transformations it suffered during time and the special features it assumed during decades and presents our approach to frame the smart city ideal and its consequences to urban space through a geographical perspective.

Next, Chapter III - "*Geography and smart cities: GIS, urban models and socio-spatial contradictions"* analyses the role played by geotechnologies in hegemonic models for applying the smart city ideal, setting the dialectical dimension of the relationship between space and GIS and present the most influential authors in current smart urban interventions. After this most sturdy theoretical part, Chapter IV – "*From North to north: planning and operating the smart city in Campinas*" analyses the case of Campinas, understanding how the processes mentioned in the previous chapters appear in Campinas, focusing first on how the state acted to shape the production of space towards the ideal of smart city and then showing the outcomes to urban space in Campinas. In Frame 1 we better explain the structure of the present document, relating the chapters with specific objectives and subchapters.

**Frame 1 -** Commented Summary

| Chapter | Specific Objective | Content | Subchapters |
|---|---|---|---|
| 1.Materials and methods: framing the smart city ideal in Campinas (SP) | Describe the methods, methodologies, procedures and approaches used during the research to reach the objectives. | Present the studied area in its particular geographical context, reinforcing the importance of our approach and the relevance of our studies regarding Brazilian and international contexts. Furthermore, describe methodological steps developed during the research to answer the stablished goals. | 1.1 Campinas as keyword<br>1.2 Procedure method: framing the smart city in Campinas<br>1.3 Reading urban space through chorems: procedures and outcome |
| 2.The ideal of smart city and the production of space: towards a geographical perspective. | Understand the insertion of the smart city ideal linked with dense technology investments as solution to urban problems. | Bibliographic review on broad geographical contexts and processes linked with the increasing relevance of the smart city ideal, starting with economic transformations and investigating the origins, development and consequences of smart city applications, showing different moments of smart city reality and debating how the role played by state and hegemonic capital changed with time. Lastly, the chapter wonders on challenges and outcomes of understanding such subject though a geographical perspective. | 2.1 The capitalist production of space in the 21th century: neoliberalism and urban space<br>2.2 Smart Cities, a definition: the enlightened utopia and the future of cities<br>2.3 Platform capitalism, platform urbanism: technologies, risks and the future of smart cities<br>2.4 Approaching Smart cities through a geographical perspective: |

| | | | |
|---|---|---|---|
| | | | challenges and possibilities |
| 3.Geography and smart cities: GIS, urban models and socio-spatial contradictions | Portray the role played by geotechnologies, especially GIS in "smart" urban contexts and debate how different agents use it and the different consequences to urban space. | The chapter presents the research's perspective on GIS and how it relates to geographical space and specially in "smart urban" cases, discussing also the intersection it has with planning and brings some important proposals found in literature, which wield influence in strategic and master plans in different scenarios, having data and a constant tool to underpin the models. | 3.1 GIS and space: framing the debate<br>3.2 GIS and the smart city: big data, real-time, and the positivistic approach<br>3.3 The spatially enabled smart city: challenges and limitations |
| 4. From north to north: planning and operating the smart city in Campinas | Comprehend how (which initiatives, programs, features) the urban space in Campinas shapes and is shaped by the smart city ideal and how different agents act in this context. | In this chapter, we analyse how the state acted to shape production of space in Campinas linked to the ideal of smart cities, and the answers given through PECCI (2019) and PECTI (2015) (presenting both programs, itemizing agents, initiatives, programs). After that, we briefly explain the territorial formation process in Campinas linking the urban space with technological vocation under a materialist perspective, highlighting current socio-spatial contradiction in Campinas, analysing the current transformations in space linked to the ideal of smart city. | 4.1 Making a city smarter? PECTI, PECCI and the state as urban space producer in Campinas<br>4.2 Brazilian Silicon Valley? Campinas' territorial formations under uneven development |

# CHAPTER 1:

# MATERIALS AND METHODS: FRAMING THE SMART CITY IDEAL IN CAMPINAS

*I like to be "people" because, uncomplete, I know that I can be conditioned, but, conscient of the uncompleteness, I know that I can go beyond it*

**Paulo Freire** (1996, p.21).

This chapter is the part of text where we try to summarize and explain to our pairs how did we produce the results within this research. We present a few initial information about Campinas, about our theoretical influences and describe our steps on field, interviews, bibliographical collection and review. Besides this, it is important to present arguments on method and on how this research is inserted in the scientific relations among researcher, knowledge and methodology.

Departing from a historical dialectical materialist approach, we understand that there is not a division between researchers and the world surrounding, and the conceptions we employ are resulting from material insertion of the researcher, that created his social worldview/perspective (Löwy, 2000). Further, we consider the production of space as a totality, what makes the research an unavoidable sequence of choices, as we have deadlines, limited funds and team. This idea revels the importance of what Freire (1996) explains on *uncompleteness*. To better present his writings:

> I like being human because, as such, I finally realize that the construction of my presence in the world, which does not happen in isolation, free from the influence of social forces, which cannot be understood outside the tension between what I inherit genetically and what I inherit socially, culturally, and historically, has much to do with myself. It would be ironic if the awareness of my presence in the world did not already imply the recognition of the impossibility of my absence in the construction of one's own presence. I cannot perceive myself as a presence in the world, but at the same time, explain it as a result of operations completely foreign to me. In this case, what I do is renounce the ethical, historical, political, and social responsibility that promoting support for the world places on us. I renounce participating in fulfilling the ontological vocation of intervening in the world. The fact that I perceive myself in the world, with the world and with others, puts me in a position facing the world that is not that of someone who has nothing to do with it. After all, my presence in the world is not that of someone who adapts to it but that of someone who inserts themselves into it. It is the position of someone who strives not to be just an object but also a subject in history (Freire, 1996, p. 21).

Based on these assumptions, we start presenting Campinas in its particular features and how they allow us to get conclusion and learn about the production of space.

### 1.1 Campinas as keyword

Campinas (Figure 1), located in the state of São Paulo (approximately 100 km distant from São Paulo, capital) had, in 2022, according to IBGE (2023) 1,139,047 (one million, one hundred thirty-nine thousand and forty-seven) inhabitants. Campinas is seat of the second most significant metropolitan region (RMC) (in terms of population and GDP) in the state, with numbers that represent 3,342,707 inhabitants[5], distributed over 20 municipalities, according to estimates made by IBGE (2021). Table 1 shows Campinas' indicators compared with RMC and RMSP.

**Table 1 -** Campinas' indicators compared to RMC and RMSP (2022)

| | Campinas | RMC | RMSP |
|---|---|---|---|
| Population (hab) | 1,223,237 | 3,342, 707 | 20,743,587 |
| Area (km²) | 707 | 3,791 | 7,944 |
| GDP (R$ billion) | 65 | 221 | 1600 |
| Municipalities | - | 20 | 39 |

Source: IBGE (2023a), SEADE.

As this economic hub, Campinas' GDP in 2020 represented the amount of R$ 65 billion (IBGE, 2023a). Economically, the main activity developed in Campinas during the last decades is the provision of services, but the municipality also has a representative industrial park, that historically strongly shaped Campinas' development and since 1970, has been focused on technology-intensive or innovative activities, as shows Baldoni (2019). As proposed by Diniz and Gonçalves (2005), economic activities linked with high technology or innovation need to be established in territories with good accessibility in terms of transportation and scientific infrastructure.

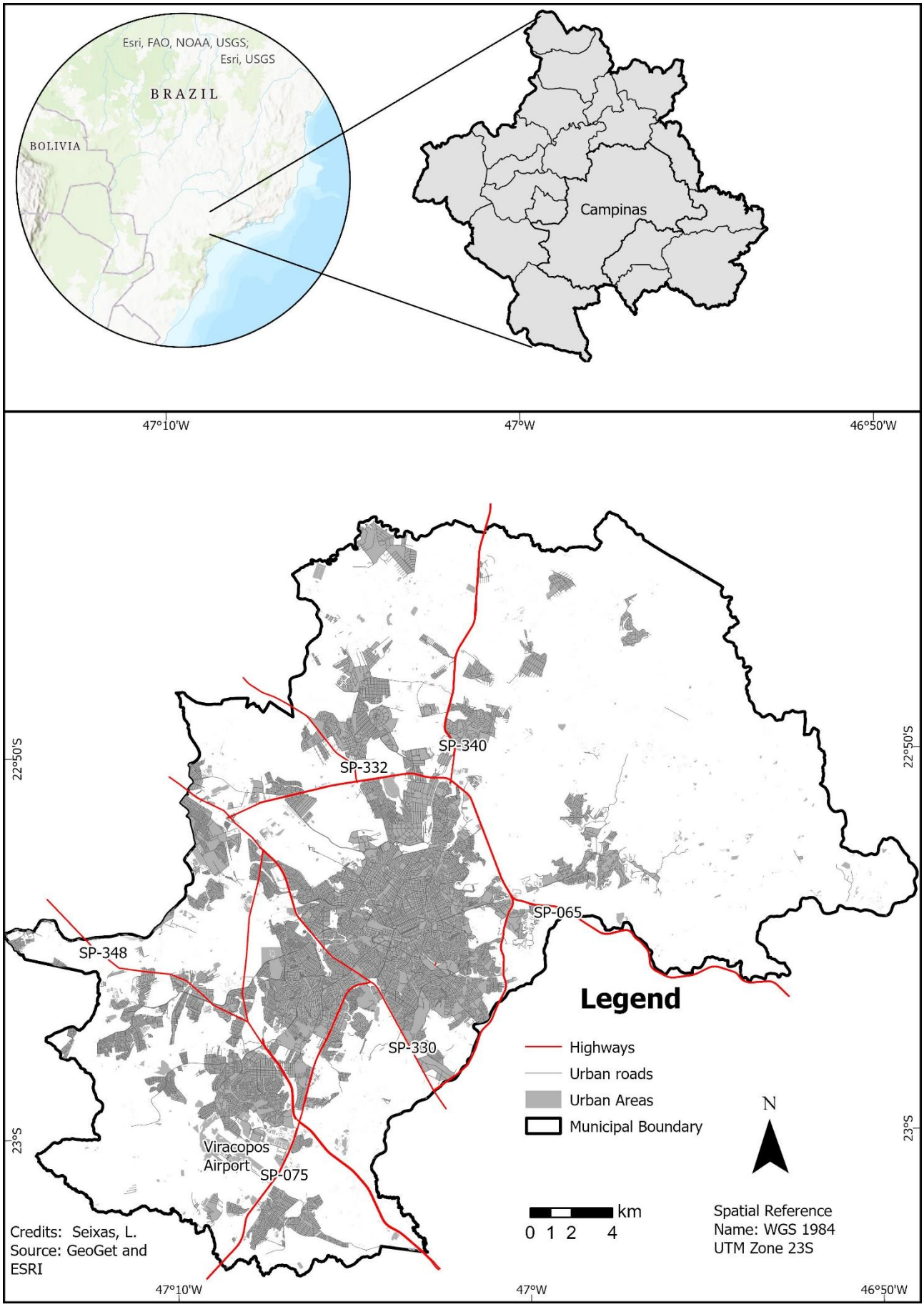
Campinas' accessibility counts on important highways, some of which are even part of complex productive structures in the region, as shows Mesquita (2011), which assigns their role in the spread of industrial factors. SP-330 or Anhanguera Highway, SP-348 or Bandeirantes Highway link Campinas to the Metropolitan Region of São Paulo (and to Brasília-DF), while SP-101 (Don Pedro the First Highway) connects Campinas to Paraiba Valley, a quite important

[5] Value obtained by the sum of the estimates made to each municipality.

region on the state. Besides this, multiple highways play an “urban” mobility role, as the metropolitan region dynamics brings the need to travel between cities to thousands of hundreds of citizens daily (Agemcamp, 2019). Still linked to accessibility in Campinas, the proximity to Viracopos Airport is highlighted, enabling the transport of people and products, reaching 112,189 tons in exportations in 2020 (Viracopos, 2023). Guarulhos International Airport (even though is not located in Campinas or RMC, it can still be considered near, about 150km from Campinas) to compare, has a projection to handle 285,000 tons in 2023 (GRU Airport, 2023).

Recently, the local authority in Campinas, consulting by IMA, alongside politicians, entrepreneurs, and scientists joined the Smart City inquiry, by drawing up a few Strategic Plans, in which a series of urban policies are described. These plans aim to transform Campinas into "the city of knowledge" and "the city of innovation". In this case, as we further analyse during this research, the smart city ideal in Campinas works as a new approach to a consolidated policy. The development of the “smart initiatives” in Campinas is focused on investments in technology (with a particular concern about Geotechnologies) like in fiber-optic network, public free wireless Internet stations and the building of an infrastructure capable of handling big data. Besides that, Campinas is also a place for different expressions of the smart/platform urbanism, as we intend to demonstrate within this research. This scenario requires the conduction of a critical analysis of the current determinants of the ways of production of space in Campinas in the context of Smart Cities policies and narratives, mainly because of the risks and contradictions linked to this process.

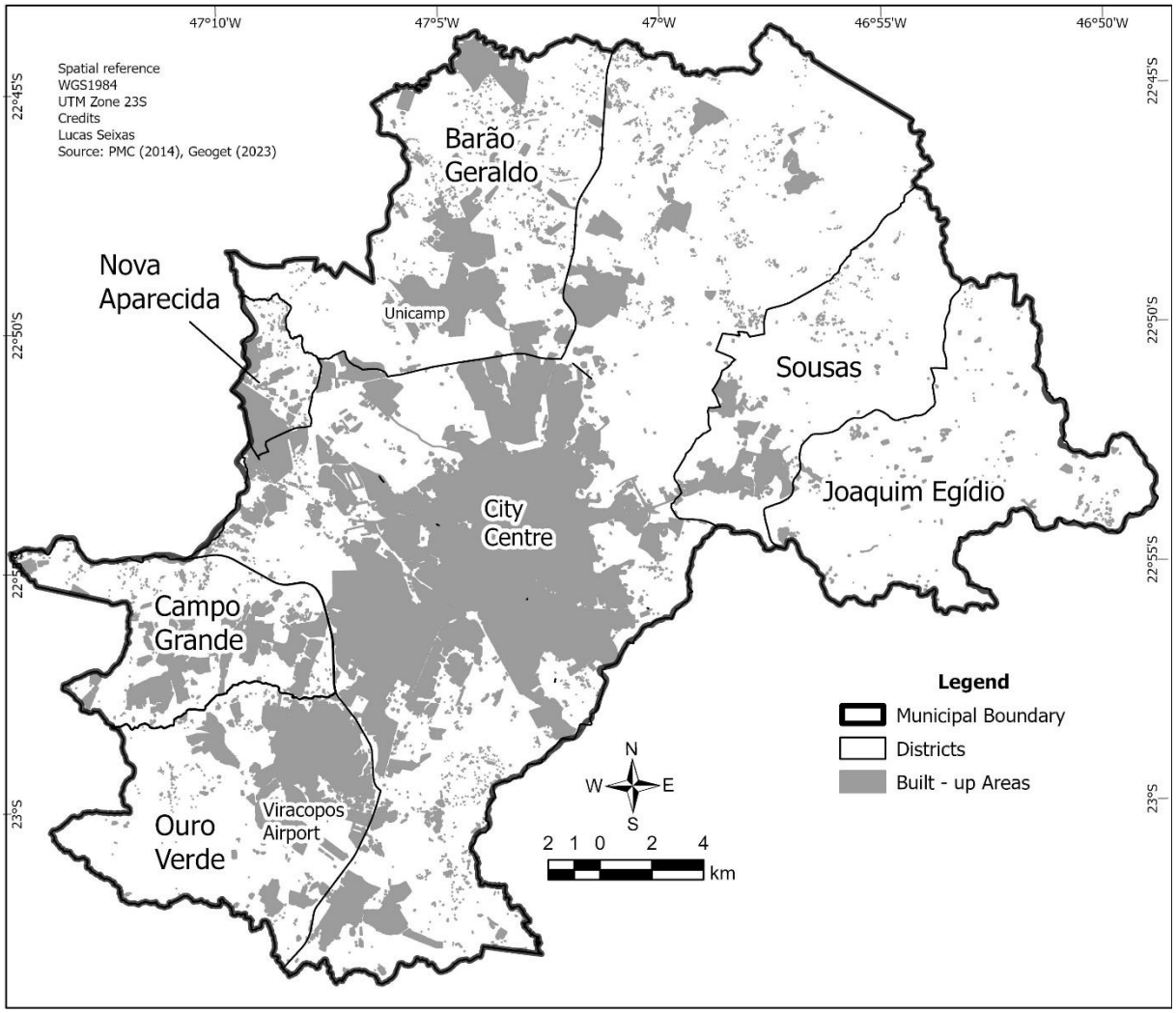
**Figure 1-** Campinas Location Map




Source: GeoGet (2023). Made by the author.

Campinas also have important districts and other administrative boundaries that, in some cases, correspond to particular territorial formation processes. As deeply explaining all of them is beyond our scope in this research, we give a short context on these parts of the city, after Figure 2.

**Figure 2** - Campinas' Districts and administrative boundaries




Source: PMC (2014), GeoGet (2023). Made by the author.

Now we focus on explaining shortly each of the highlighted districts or divisions, proposed by Campinas (2023):

- **Barão Geraldo:**

This site was considered a district in 1953, moment when the landlord of what was, at the time, *Rio das Pedras* farm, decided to create allotments to speculate and make profit from real estate market, as coffee plantations had declining production and profit (Pupo, 1983; Ribeiro, 2000). In the next decade, during the 1960s the district had the biggest occupation jump: the construction of Unicamp (in a main campus, opened in 1966 (Portal Unicamp, 2023) as part of a broad development project in Campinas, that we focus on Chapter 4.

According to Caldeyro (2005), Unicamp campus attracted many endeavours to Barão Geraldo (housing, stores, basic services, markets) and during the 1970s, PUCCAMP brought its campus to Barão Geraldo (PUCCAMP, 2023). In the next decades, as argue Silva (2008) and Silva and Matias (2017), the district was consolidated with fortified enclaves, as defined by Caldeira (1997), marked by a strong real estate speculation. Silva and Matias (2017) also show that Barão Geraldo, together with Sousas and Joaquim Egídio (both in north Campinas) became throughout the last decades, one of the focus of urban sprawl in Campinas and even in a metropolitan context, towards Jaguariúna - SP and Paulínia – SP, axis first proposed by Caiado and Pires (2006).

Years later, the same subject was analysed by many other researchers, whether regionally or municipally, like Martins (2014), Cisotto and Vitte (2014), Nascimento (2016), and Silva (2020), that confirmed the deepening of the processes mentioned before, with Unicamp continuing developing great influence on urban patterns. Currently, HIDS took the debate to a new perspective, under influence of sustainable development and foreign capital, as we argue in Chapter 4.

- **Sousas and Joaquim Egídio:**

This district started to have urbanized areas and activities during 19$^{th}$ century, acquiring the District status in 1896, mainly due to Mogiana Railway, used to drain agricultural production. The most intense urbanization process, however, started in the 1950s decade, when a few allotments and fortified enclaves started in the area. In the 1960 a COHAB was built in Sousas. Later the districts started to develop a profile to be place of expensive housing mainly in fortified enclaves, with most part of its trade value coming from the idea of "living surrounded by nature". Although both districts are located inside an EPA, important roads in Campinas and RMC are just a few minutes, giving quick access to and enormous area (Fernandes, 2009). EPA was created in 2001 by Municipal Act. N. 10.850 (Campinas, 2001)

covering from Sousas district, Atibaia river, and the municipal boundaries with Pedreira and Jaguariúna.

Not much research was developed focusing on urban or economic aspects of Sousas and Joaquim Egídio, and the most part of what was produced about Campinas in general terms only confirms the private allotment and expensive housing pattern that we previously presented. The current work will bring a few new outcomes of production of space in both districts linked with the ideal of smart cities.

- **Campo Grande and Ouro Verde:**

According to Rolnik (2015), Campo Grande (as well as Ouro Verde), both in south Campinas represent the most vulnerable areas in Campinas and RMC, with low incomes, massive COHAB's, low standard housing – the analyse made by Nascimento (2013) confirms these affirmatives. According to Mestre (2009), the most part of enterprises in south Campinas were part of a public initiative to move the poor people to the periphery. Nascimento (2013) argues that, despite the lack infrastructure, the urban and commercial areas in these districts are so that consists in subcentres.

According to Silva and Matias (2017) these districts, as one of the urban expansion axes in Campinas, rely on a few avenues to continue with its growth: Av. John Boyd Dunlop, Av. da Saudade and Av. Isaura Roque Quercia. Campo Grande is limited by Bandeirantes Road and Capivari River. Although its occupation dates from 1960s, both districts only received this status in 2014, moment when 40% of Campinas inhabitants were living there, about 400 or 500 thousand people (Pacífico, 2015).

Cunha and Jiménez (2006), observing the mentioned dynamics and controversies among different parts of Campinas, proposed the existence of a "poverty ridge" in Campinas, which included Ouro Verde and Campo Grande, as well as other neighborhoods and urbanized areas in Campinas, for instance Campo Belo or Parque Oziel. Studying Campinas and its structural reproductions of inequalities, in this case specifically the violence against women, Rossetto (2022) shows that the motto race, gender and class (Crenshaw, 2017) is crystal clear in territory – South region of Campinas have the majority of cases and the minority of care facilities.

Despite these characteristics, these areas also received quite important investments to the local economy, like Viracopos Airport or Shopping das Bandeiras (shopping mall). In this case, an important contradiction emerges and tells us a lot about Campinas' insertion in uneven development: in periphery, the local impact of the investment is as small as it is possible,

avoiding as much as possible to create structures do developed locally. The benefits don't stay in territory.

In the hegemonic smart city's tale, these areas and districts doesn't seem to exist. But they do and play a core role so other areas can dream about San Francisco, London or Nordic development. We try to picture the role of this areas in smart cities, again, on Chapter 4.

- **Nova Aparecida:**

Nova Aparecida district was founded in 1964, when the neighbourhood Aparecida gained the status of District. Similarly, to the case of Campo Grande and Ouro Verde, this district has its origins linked to public initiatives of housing estates, COHABs mainly during the decade of 1980, decade when population living in *favelas* achieved the highest value (until that moment), reaching 8,5% (not only in Nova Aparecida) (Mestre, 2008). Again, it was not easy to find literature specifically about Nova Aparecida, so we had to take information from regional analyses that included this area.

When Nascimento (2013) produced great data on social inclusion and exclusion, we observe that Nova Aparecida is divided between the values of -0,250 and -0,001 and –0,500 and -0,251.[6] To compare, for instance, most part of Barão Geraldo achieved values between 0,501 to 0,750. In general terms, then, we can state that Nova Aparecida is a working-class district with lack of some infrastructures.

Based on this quick context of the districts that, together with the other areas, compose Campinas, we argue that the city presents a very fragmented urban[7] space. Sociospatial[8] fragmentation is defined by Sposito and Sposito (2020) in multiple analytical sections: *i*) centre, centrality and mobility; *ii)* everyday life and spatial practices; *iii)* public spaces and *iv)* production and consumption. We *did not* use this concept as a core frame during the research, but we believe that it can help us to explain the urban space in Campinas in general terms.

The central argument defended by the authors (Sposito, Sposito, 2020) is that sociospatial fragmentation includes material elements as well as symbolic elements, objectives

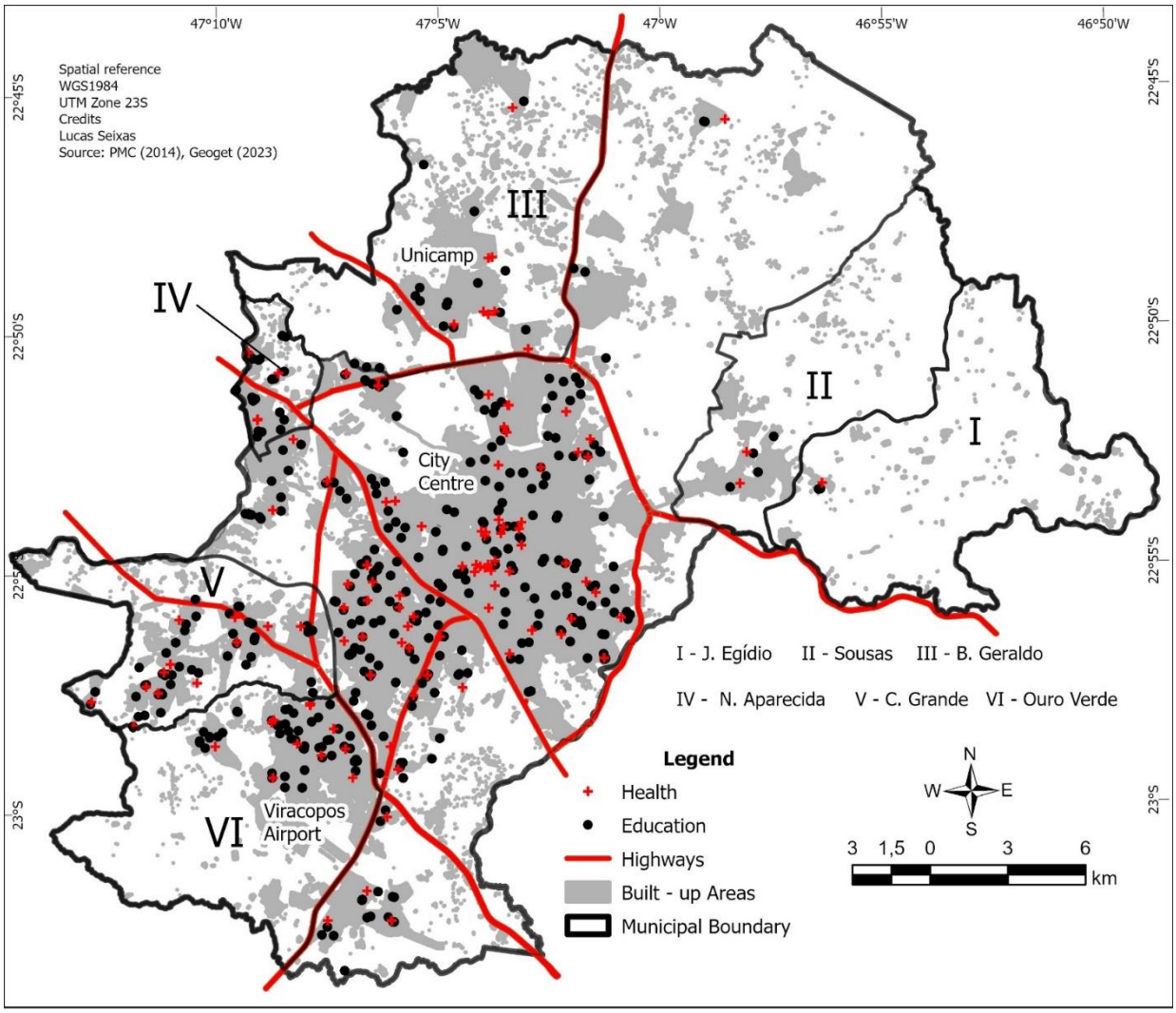
[6] Nascimento (2013) produced a map revealing social inclusion and exclusion in RMC. The analyses were underpinned in a very qualified cartographic approach, using appropriate scales, using data from demographic census produced by IBGE (2010). The variables used to compose the social index presented by him were: income autonomy, human development, equity, housing quality. The values obtained had their range between -1 (worst case) and 1 (best case).

[7] We could say urban-regional space, as Campinas is the centre of a metropolitan region. However, we prefer to say only "urban" due to our approach in this research, focused on smart city development.

[8] We adopt socio-spatial (translation to socio-espacial) according to Souza (2018). But in this case, as Sposito and Sposito (2020) use sociospatial, we decided to accept.

and subjective aspects. Campinas, in multiple of these terms, can be understood as and fragmented urban space, as it has multiple centralities (Barão Geraldo, Campo Grande, traditional centre), either physically or economically almost independent with limited transportation infrastructure, focused on private vehicles. Regarding public services, a similar pattern can be observed. Figure 3 shows public services in Campinas.

**Figure 3** - Main Public Services in Campinas (2023)




Source: PMC (2014), GeoGet (2023). Made by the author.

We decided to bring these brief explanations on the urban space in Campinas to give a general idea regarding the question: from what urban context are we departing while trying to understand how the ideal of smart cities relates to this specific case? Of course, we are far from totally understanding it, since it would take hundreds of pages just to brief mention the major processes that lead the city to its current characteristics. However, our intention was to

convey that Campinas, inserted in a multiple scale reproduction of centre-periphery dynamics, presents a urban space marked by: *i)* socio-spatial fragmentation; *ii)* highlighted socio-spatial inequalities; *iii)* various public policies that actively produced the space to have such features. In other parts of the text, we explain other important features more carefully, showing other processes that lead to the current relationship with smart cities.

The materialization and embodiment of this reality in Campinas bring multiple risks, impacting millions of people's life. On the other hand, we understand that Geography consists of a powerful means to further understand consequences, warn agents and influence the reproduction of space toward less uneven scenarios. Researching in a context so full of variables can bring important results, enabling us to apply relevant theoretical concepts and observe a significant empirical case.

### 1.2 Procedure method: framing the smart city in Campinas

To start writing this report one first question emerged: in which language will it be written? It was possible to find arguments to support both options: either Portuguese or English. I am convinced that scientific production is always connected with a personal trajectory and an ideological column and as a Marxist, I understand that academic production should be closely linked to working-class interests so it can be transformative and make exploitative relationships obsolete (Löwy, 2000). Writing in English, in this case, could impair the local impact. Besides that, as a Brazilian, it is undoubtedly true that writing in Portuguese will always help me in expressing my ideas and thoughts. These perspectives should lead me to choose Portuguese. However, a few other matters had a bearing on the decision for English.

First, I understand that an academic career is an opportunity to keep constantly learning and practicing new skills and knowledge and to wider frames and approaches. The opportunity I had to spend 6 months in Cardiff, Wales, to improve multiple aspects of my research should also be reflected on the community with whom I dialogue. Bearing in mind the fact that the current intermediate step of evaluation can strongly contribute to qualifying the outcomes at the end of the Mastering process, the possibility to dialogue either with the local or with overseas community will play a core role.

Moreover, as our method, upheld by the literature review, shows, it is implicit in this report as well as in future products that the way the socio-spatial relations under capitalism shape the production of space, for instance, in Campinas, is strongly and unevenly connected to how these relations are set all over the world, although each case has its particularities.

Therefore, using English as our language allows us to share and compare our findings widely with the scientific community and, yet not everyone, with the most number possible of people interested in a better urban world.

Generally, the most fundamental literature regarding the current research's scope was neither produced nor translated into Portuguese, which makes knowledge on the field to be rare. The vast majority of what is written on the subject relates more specifically to cases in central contexts, like the UK (London, Milton Keynes, Glasgow); cities in continental Europe like Barcelona or Amsterdam or Asia, like Singapore. This makes the focuses of these writing different from the material context we face in Campinas. Trying to minimize the negative impacts of my choice (*i.e.*, lack of local attachment), I decided to participate in different congresses and symposiums in Brazil and intend to publish a few outcomes of the research in Portuguese.

### 1.2.1 Finding literature procedures: systematizing, reading and writing

After defining themes and objectives, follows one of the most important methodological steps to developing this research: choose the literature to be employed. The intention was to build an approach capable to deal with the complexity of the theme through a critical perspective, considering elements from a general scale, dealing with broad current capitalist processes and also bring the most essential texts about Campinas. To reach this goal, the procedures of selecting what to read counted on multiple sources. Among other cases, the main ones were: *i)* dialogues with the supervisor and the research group (meeting, collective reading); *ii)* the multiple lectures the researcher took part on; *iii)* meetings with specialists and researchers on the field[9]; *iv)* systematic literature search, using several keywords.

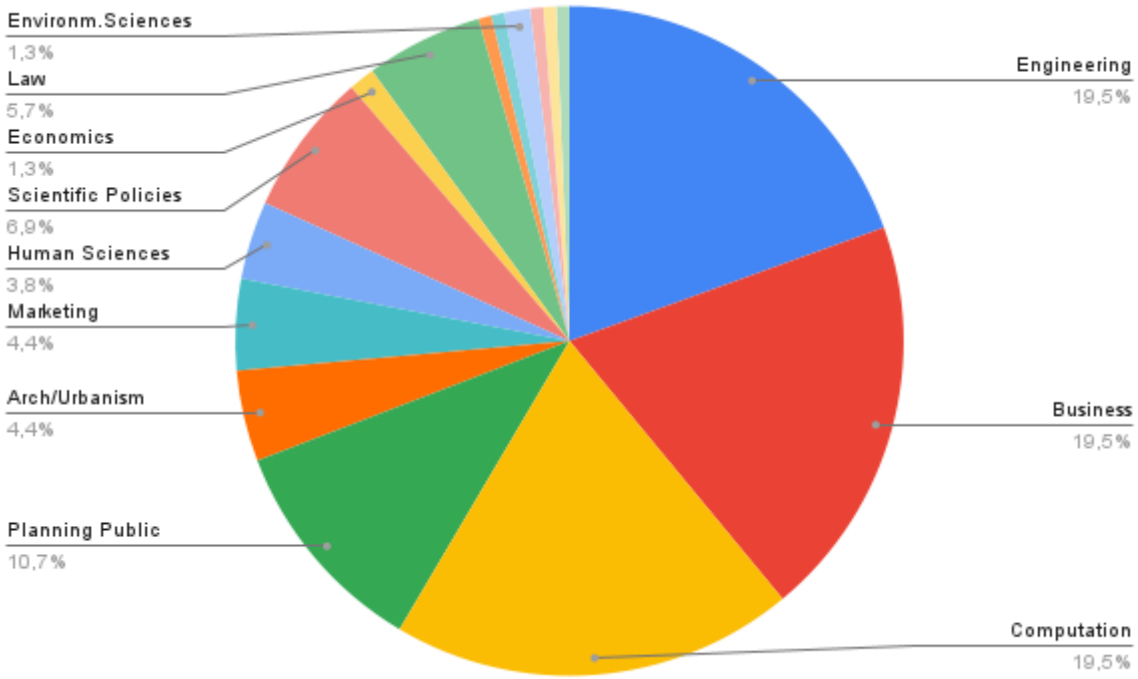
During the initial searches, a first challenge arose: when the words "smart cities" or even "*Cidades Inteligentes"* were applied as keywords or filters in libraries or thesis repositories, results tended to show a focus on technology development or technocratic governance studies[10]. A minority of research dealt with public policies evaluation. From a geographical perspective, in Brazil, very few things were found. Chart 1 shows the areas with

[9] Mostly during BEPE period in the UK.

[10] It doesn't mean that we have only searched for this two key-words, neither that we have only used CAPES repository as source. Our research applied several different searches, containing multiple different words in many different repositories. Searching for "Smart Cities" and "Cidades Inteligentes" in CAPES repository was only chosen to built this specific chart, aiming to have a broad "picture" of the research scenario in Smart Cities in Brazil.

the most thesis or dissertations produced linked to smart cities in Brazil. Geography is far from one of the most common results, although the debate on smart cities is also spatial.

**Chart 1-** Available researches containing "smart city" or *"cidade inteligente*" in CAPES repository in 2022 (%)




Source: CAPES' repository. Organized by the author.

Manifestly, a comprehensive literature search includes more than just these two-word searches. In this sense, the initial survey and selection focused on creating a theoretical and methodological framework to lead the understanding of the production of space, and afterwards, the ideal of smart city through a critical and reflexive approach. Focusing on the development of a *geographical* analysis, the research doesn't relinquish claiming and applying concepts like geographic space or socio-spatial development[11], using Souza (2008; 2018) a reference. This framework relied extensively on David Harvey's (1989; 2001; 2006; 2015), Neil Smith's (1990; 1992), Henry Lefebvre's (1991; 2002), Ana Fani Carlos' (2017; 2020), and Sandra Lencioni's (2008; 2020) writings.

To expand the understanding of GIS and its roles in the current urban space production, the most influential works found, matching the framework, were John Pickles

[11] In Portuguese, this word is written "*desenvolvimento sócio-espacial*", making specific reference to ways of overcoming inequalities and lack of socio-spatial autonomy.

(1995; 2004); Sarah Elwood (2008; Mitchels; Elwood, 2008) and Rob Kitchin (2014; 2015; 2016; 2019). Matias (2003; 2004; 2018) and Sheppard (2005) also helped to build the understanding of a dialectical and critical relationship between GIS and society. The cartographic production featured in the research relies on specific scientific procedures, as described by Zeiler (1999), Crampton (2010) and Longley *et al* (2015).

Regarding specifically the debate on smart cities, the most influential authors were Greenfield (2013), Hollands (2008; 2015), Söderström (2008; 2020), Vanolo (2014) and Kitchin (2011; 2018; 2019). During the research trajectory, specifically during the period as visiting student at Cardiff University, I came across debates on relations between smart cities and smart urbanism with platform economy, society and urbanism. This debate is (shortly) presented in the research, and to manage this convergence of processes, the main references were Sarah Barns (2020); Woodcock and Graham (2020), and Srnicek (2017).

Finally, to understand Campinas and its geographical constraints, the discussion proposed in this research relies on a multiple references, like Baldoni (2014; 2019); many of them researchers that took or still take part in GeoGet, such as Fagundes (2017), Nascimento (2013), Martins (2014) or Farias (2020). Besides that, a lot of research have been produced at Unicamp, aiming to understand the historical, social, economic or geographical development of Campinas, either at IG or other institutes or faculties, such as IE, IFCH, FECFAU or NEPO.

The sources used in this work were books, papers, reports, thesis, dissertations, official documents and handbooks. Materials were collected in two different types: physical and digital. In the first case, the main collections visited were IG's at Unicamp, SGP's and ASCL at Cardiff University. In a few specific cases, I used the technical budget to buy crucial references unavailable on other sites. In these cases, I produced notes and abstracts digitally, to store the most important information, following procedures described by Votre *et al* (2010).

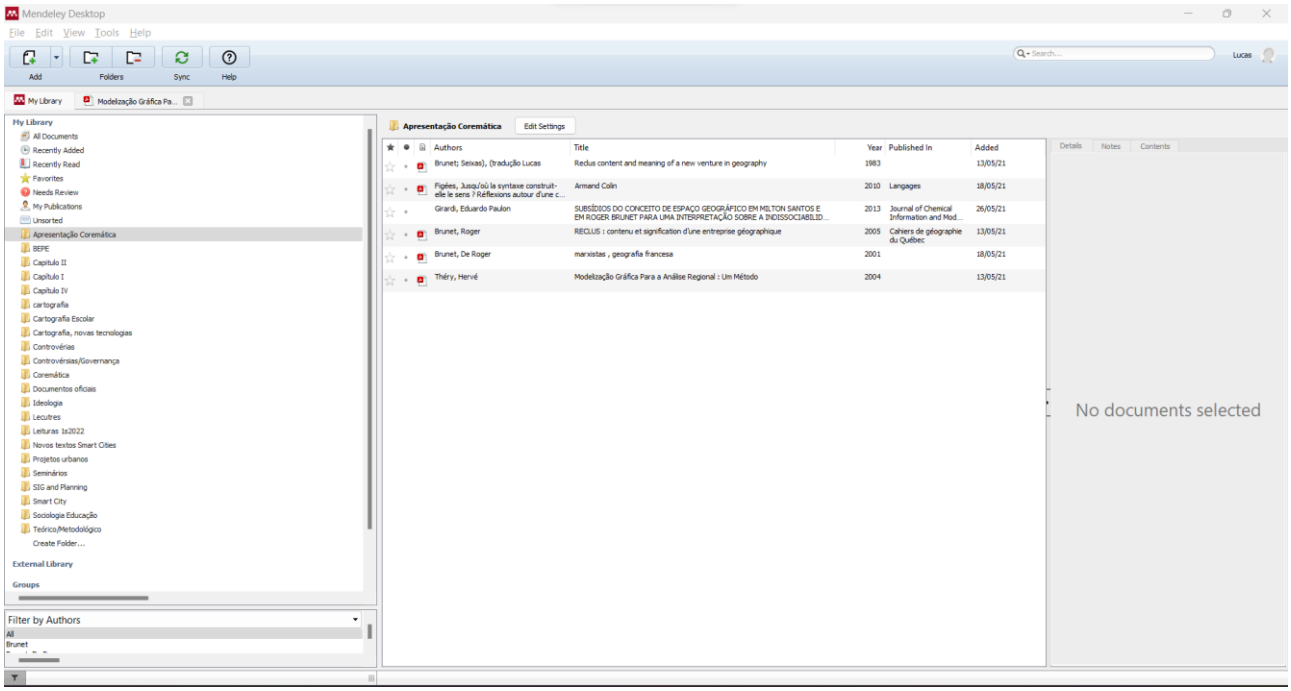
Another significant step was the reviewing of Campinas Strategic Plan to Science, Technology and Innovation (PECTI, 2015) and Strategic Plan Campinas Smart City (PECCI) (2019), which made it possible to reflect on the case and organizing a frame showing the main intended interventions in Campinas urban Space in the context of the smart city ideal.

Digital bases represented the eminent part of collected materials[12]. Scientific journals, official websites were the most important source. To search for the most relevant literature, we utilized various indexed databases, including SciELO, SCOPUS, Web of Science, and Cardiff University Digital Library. All collected materials were stored and organized at the

[12] It is important to reinforce that this research was developed remotely during the first year (2021), due to COVID-19 pandemic.

software Mendeley, as it allows notes, and summaries and has multiple other organizational facilities. Figure 4 shows Mendeley's interface.

**Figure 4-** Mendeley's Interface




Source: Personal collection.

### 1.2.2 Comparative Analyses

From 01/09/2022 to 28/02/2023 the current research included a comparative analysis with the case of Cardiff, Wales, while the student was visiting The School of Geography and Planning, Cardiff University, as means to qualify the methodology to apply in Campinas in return. The School of Geography and Planning, at Cardiff University (UK), has contributed a lot to the present research theme in the latest years, through research projects, publications and by hosting conferences on the subject. Many important articles were published by the School of Geography and Planning lately, mostly by Prof. Dr. Oleg Golubchikov (who supervised the research during this period) focusing on sustainable urbanism, digital transitions and smart urban energies strategies, that although are not the exact same subject, enabled many dialogues during the period abroad (Thornbush, Golubshikov, 2021; Golubshikov, Thornbush, 2020; Golubshikov, 2020).

The project abroad had to establish this comparison between Brazilian and Welsh contexts involving smart cities projects, focusing on the case of Campinas (São Paulo/Brazil) and in Cardiff (Wales) as an objective, understanding this comparison as key to qualifying the

approach, either theoretically and practically the socio-spatial aspects of Cardiff related to the Smarty City context and with the increasing of the technical content of the urban space could help highlight contradictions in Campinas.

Aiming to better understand how the ideal of smart cities was shaping production of space in Cardiff, we accomplished the following procedures:

- Analysing Strategic Plans and their connections with Smart Buildings increasing in Cardiff, debating the main characteristics of two recent documents elaborated by the local authority in Cardiff related to adapting urban space to fit in more "smart" models.
- Tech urban infrastructure and partnership with private companies, mainly focused on the case of partnership with OVO Energy, linked with electric individual mobility in Cardiff.
- Private and public digital services, exploring and briefly comparing some public and private initiatives to offer digital services and show our concerns about such topics.

### 1.2.3. Cardiff, Smart City: a brief report

More specifically in Cardiff, in terms of strategic plans linked with the ideal of smart city, there are two important documents. The first one is the Strategic Plan Central Cardiff Enterprise Zone (Cardiff, 2018) and the other is Cardiff Smart City Roadmap (Cardiff, 2021). In terms, each of them touches some of the fundamental aspects of the ideal of smart city. For the Strategic Plan Central Cardiff Enterprise, the focus is to create an Enterprise zone, which according to the local authority consists in: "designated geographical areas that support new and expanding businesses by providing a first-class business infrastructure and support and each has a focus on one or more key business sectors" (Cardiff, 2018 p. 2).

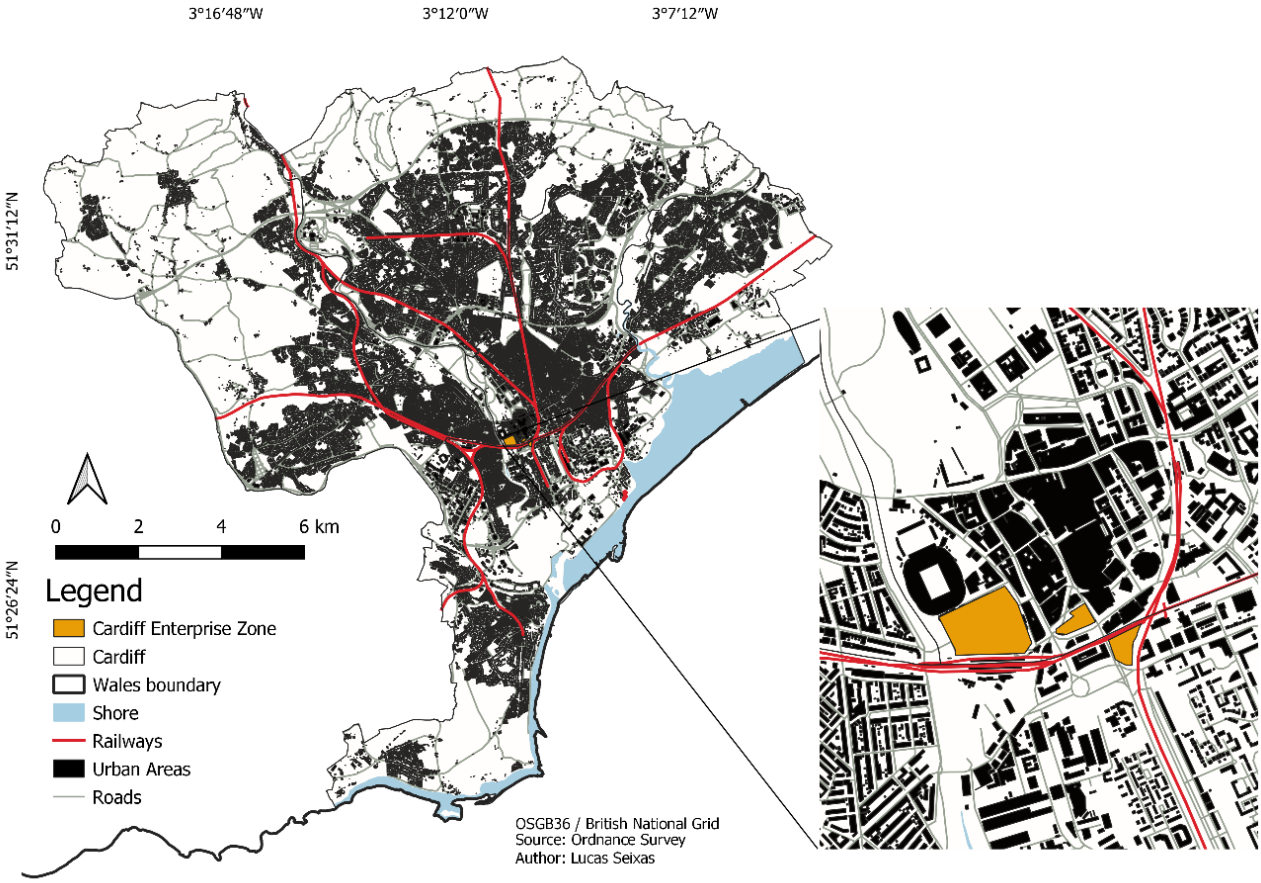
This public and private investment focuses on equipping urban space with technological content that enables the companies to fast communicate in their organizational infrastructure, whether internally or externally. It is important to reinforce that this project focused on central areas in Cardiff changing its economic profile, introducing new financial activities where tourist and commercial business domain. As appears on Cardiff (2018, p.2) the intention is to increase the capability of the city to compete internationally.

We observed a connection between the smart city ideal in Cardiff with typical capitalist development actions. But the peculiarity, in this case, is observed on different scales: the supposed smartness comes from ICT infrastructures that might not even be seen from the outside – which in our perspective represents a deepening complexity in capitalist reproduction,

linked with tech fetichism (in sense that the mechanisms that control reproduction of space become more and more complex).

Although the "smart" features may seem unnoticed in the area, the intervention brings the urban landscape to a different paradigm, associating forms with bright, transparent, and clear buildings with supposed flexibility (Arantes, 2009) in work, private decision-making, and public actions over territory. Figure 5 shows the areas with these new smart buildings in Cardiff, revealing disjointed urban forms in the area and Figure 6 shows pictures of the mentioned buildings.

**Figure 5** - Recent interventions in urban space linked with Smart Buildings in Cardiff




Source: Ordnance Survey (2022), Wales (2018). Made by the author.

**Figure 6 -** Class A buildings in Cardiff Enterprise Zone

Source: author's collection. Obtained in field (2023).

Those areas whether in this specific case or as a general tendency, concentrate decision-making centres and equips the hegemonic agents with high-speed communication systems, big-data analyses and amplify the power of these to control other aspects of urban space. The area works as an interconnection network centre, typical of post-modernist and neoliberal capitalist urban space. The consulting company Deloitte holds a partnership with the local authority in this case and has even an office in the transformed area - as pointed out by Teixeira and Silva (2019), Deloitte (alongside other similar companies), which has more than 225,000 employees worldwide, plays a core role in capitalist *modus operandi* due to the power over urban databases and the influence over strategic investments and interventions.

Figure 7 (obtained in fieldwork) shows a key factor of this urban intervention: the connection of the chosen areas to be transformed into technology-intensive services with another important transport modal: the train lines. In case, hegemonic agents take control and benefit from focusing on areas with the high public interest. Frame 2 summarizes core aspects of Cardiff Enterprise zone.

**Figure 7** - Cardiff Enterprise zone and Train Station

Source: Author's collection. Obtained in Field (2023).

**Frame 2** - Cardiff Enterprise Zone summary

| | Actions |
|---|---|
| Main Action | Building edge infrastructure with public funds focused on business development |
| Flagship | Competitiveness and high-quality jobs creation |
| Strategy | Capitalising on features held by the city |
| Links with Smart City | The liberal conception of incentive to competitiveness in cities through technology |
| Public actions in the territory | Development of Class A offices (mixed use); Improvement to Transport and ICT infrastructure |
| Main impacts | Landscape change, Resource's transference to private sector, private influence over decision-making |

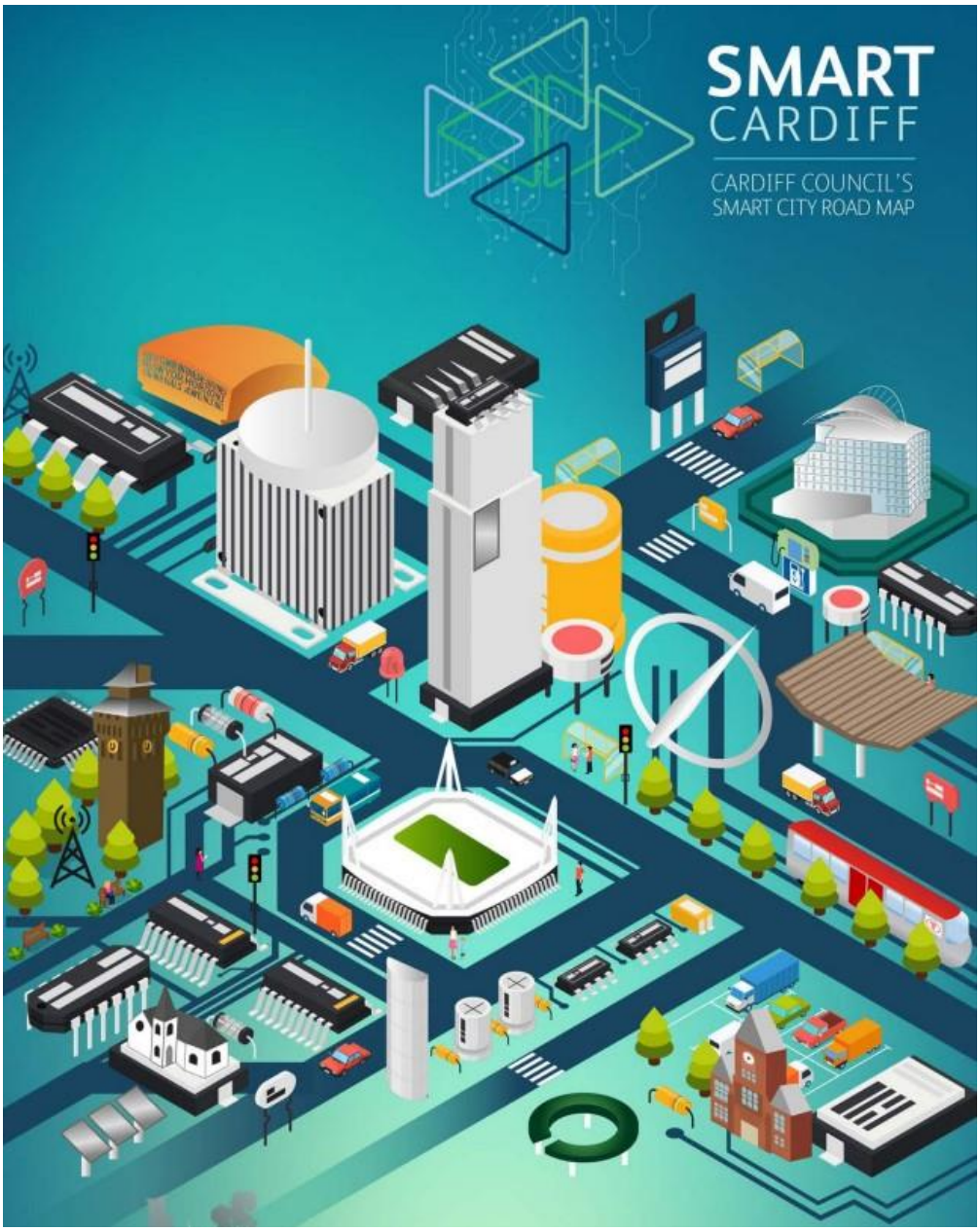
Source: organized by the author based on Cardiff (2018).

The second analysed document, Cardiff Smart City Roadmap consists in an operational plan to intervene in urban space in Cardiff made by the City Council (Local Authority) and has long-term goals linked with political and economic issues in Wales, since the city has become a capital in the last century in a context of increasing Welsh nationhood (Johnes, 2012). The flagship is that a capital city needs to be technologically enabled to attract investments and generate economic growth and normative development.

The proposal on the roadmap to achieve these goals is divided into 5 priorities: its approach through five axes of action: *i)* the collaborative city, *ii)* the data-driven city, *iii)* the connected city, *iv)* the mobile and sustainable city, and *v)* the healthy city. Although - as we intend to better discuss - the smart goals in Cardiff can be contradictory, the Cardiff Smart City roadmap has a sturdy conceptualization of a smart city compared to other cases found in the literature or even with the case of Campinas. The definition of smart city given by the document says: A 'Smart City' is a collaborative space, where people are better connected and the use of digital technologies and data are seamlessly woven into day-to-day activities to enhance the lives of the people living and working within the city, as well as those that visit it. The 'Smart City' is responsive to its own unique challenges and is better prepared to address and prevent any social, economic, health and environmental issues that it may face. (Cardiff, 2019, p. 4).

It is possible to observe that the definition tries to run from technocratic approaches, emphasizing the outcomes for citizens and the community - while, however, it still proposes technology as a solution to future problems matching with many cases mentioned in Chapter 2. We identify this "softer" approach as a consequence of the participation of Prof. Peter Madden in the elaboration. During our conversation, Prof. Madden mentioned that when reached by Municipal Council to develop the roadmap, he suggested that it didn't need a "smart" approach, but this suggestion was not accepted. This case helps to understand the conflicts involving the role played by the state in the ideal of smart cities and, further, it gives us a dimension of the potential held by the "smartness" approach in urban planning. Figure 8 shows the cover page of Cardiff Smart City Roadmap and helps to understand the focus on technology on urban space.

**Figure 8** - Cover Page of Cardiff Smart City Roadmap




Source: Cardiff (2019).

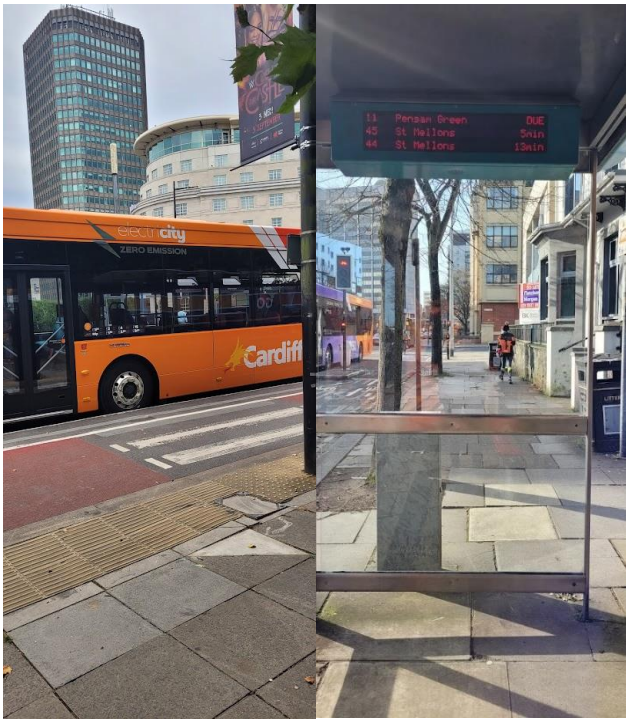
The axes *i* to *iv* meet the most with regular and hegemonic smart cities approaches and views, being part of what we consider to be "the smart city ideal", even through this "softer" approach. However, the fifth axis, according to our hypothesis, represent a more traditional urban action or intervention but appears alongside "smart" policies as a way to compose rather a more inclusive or to emphasize the outcomes to citizens.

The main interventions in urban space planned and implemented by the roadmap were: *i)* Smart street lights; *ii)* smart parking and *iii)* bike sharing scheme and cycleways. These initiatives are common in smart city roadmaps or projects in cities worldwide and across the

UK (Demaio, 2009). Regarding the smart parking scheme, the proposition is to apply sensors providing data to a system showing availability to park and citizens can access the information through an application[13].

Still related to transportation, we identified that bus stops and vehicles in Cardiff are endowed with sensors that show live location. This characteristic is linked with a process we mention in Chapter 3. A famous case in Europe of this "smart" transportation is Dublin, where buses have GPS devices that share location information in real-time (Baptista *et al*, 2012). This is an interesting topic to be compared with Campinas, as Cardiff - even 4 times smaller in terms of population - has this built infrastructure. Even with very dynamic transportation applications and investments, the city can still hold on to a few outcomes for the population related to technology incorporation in urban space. In Campinas, our preliminary search shows that even these basic and sometimes outdated infrastructures are not well developed, which shows a great difference in implementing smart city ideal due to central and peripheral contexts. Figure 9 exemplifies the technology in bus stops in Cardiff.

**Figure 9 –** Electric bus and Bus Stop in Cardiff with GNSS technology




Source: Author's collection. Obtained in Field (2022/2023).

[13] During the period in Cardiff, I tried in different opportunities to access the service, but it was not possible to get the information that supposed should be available. The application only loaded a Google Maps cartographic base.

Sharing bike schemes are also common in smart city projects (Shen *et al,* 2022) and are subject to another enormous number of contradictions and specificities regarding age, gender, race, class, and complex socioespacial inequalities patterns (Olgivie, Goodman, 2012; Duran *et al*, 2018; Wang, Akar, 2019). In general terms, this type of initiative tends to concentrate its users on the young (under 30), educated, and mid-class men (Barbour et al, 2019) and in this case, tend to solve very limited mobility issues, related to this specific public. Figure 10 show bike-sharing stations in Cardiff.

**Figure 10 -** Bike-sharing schemes in Cardiff

Source: Author's collection. Obtained in field (2023).

In this case, we see that GIS, alongside a sturdy material base, is fundamental to such an "alternative" to properly work. The company (OVO) needs data from where some users started the journey and where it ended to charge correctly - it follows the same model as public transport in London (Batty, 2012). Although this correlation started being applied by the state, to amplify control over territory and run specific services, nowadays it is more common with private companies. "Smartness" by linking spatial features through geotechnologies plays a core role in this new urban perspective. Other companies, as well as OVO, use this to offer their services and have an impact in urban structures. In Cardiff, the most highlighted cases are: *i)* uber; *ii)* Spareroom *iii)* JustEat; *iv)* Deliveroo. Frame 3 summarizes Cardiff Smart City Roadmap and Frame 3.3 explains how each application uses GIS and impacts urban space.

**Frame 3** - Cardiff Smart City Roadmap summary

| | Actions |
|---|---|
| Main Axis | Data-driven city; Internet Connection; Transport infrastructure; Health |
| Flagship | Connectivity and data driven city to the capital of Wales |
| Strategy | Smart Cardiff (2020-2022) |
| Understanding of Smart City | Collaborative space with use of digital technology and data to enhance life of citizen |
| Public actions in the territory | LED urban lights, Data store repository, Smart Buildings |
| Private actions in the territory | Deloitte advisory, OVO bikes and energy |
| Role/implications of geotechnologies | • LEDs GPS enabled<br>• Parking system<br>• Create (with CU) a big data model of the city |
| Role/implications of data | • Council has parking database (georeferenced)<br>• Create (with CU) a big data model of the city |

Source: Organized by the author based on Cardiff (2019).

In conclusion, we argue that through the presented approach, we could reach interesting developments. First, it was possible to observe the waves or moments of the ideal of smart city, that we further discuss in Chapter 1: investments in a material infrastructure, digitalization of services, strengthening of the idea of data as solution to urban problems, public and private plans and actions to amplify technological content in urban space.

To approach the case of Cardiff was especially important and contributory, as it enabled, on the first hand, to understand particularities of the ideal of smart city in rather a central urban context. On the other hand, departing from this basis, it was possible to develop on the concept of scale and on the differences to the case of Campinas. In fact, the concept (in an idealist pathway) of smart city is essentially thought in the centre to the centre of Capitalism - and even in those cases, the materialization of processes linked to this concept can strongly highlight the socio-spatial inequalities. In this case, analysing Campinas after the experience in Cardiff will enable to put many of these different processes together, contributing to the understanding of urban space in both cases.

### 1.2.4 Interviews

According to Lima (2016), conducting interviews as part of research methodology refers to a qualitative approach to the object – bearing in mind that the shallow dichotomy with quantitative/quantification often claimed does not stand up, as we better discuss in topic 1.3. With respect to the current research, this methodology was to obtain objective information on institutions, public offices or companies willing to cooperate with the research – never obtaining personal or sensitive information.

We prioritized talking to key-social-subjects, applying the methodology defined by Vasconcelos (2011). Fagundes (2017), working with a similar case adopted the same methodology and presented consistent results. The exercise here was to enumerate producers of urban space, by using urban geography theory to identify them. Rodrigues (2011) frames producers and promoters agents (State, real estate agents, financial capital), defining and decisive agents (World Bank, IMF, think thanks) and indirectly related to capitalism agents ("unauthorized development", "Low-income housing sector")[14].

We start from the assumption that decisive agents would be inaccessible in our case, and also, according to Rodrigues (2011), they have a more pervasive role, which would decrease the value of particular information obtained, as they wouldn't be specific about Campinas. In such cases, we studied their operation through literature review, focusing on discovering how the guidelines are translated into policies. The focus then was on producers and promoters, as we understand in our case, the state and a niche of companies (technological blueprint) as more influential while studying smart cities. Following guidelines proposed by Lima (2016), we choose semi-structured interviews, as it allowed us to prepare a script with possible adjustments during the talk, when necessary. Frame 4 shows the developed interviews during the research period.

[14] The Portuguese word would be "*autoconstrução*", which has a complex meaning, making it hard to precisely translate.

**Frame 4** - Interviews developed during the research[15]

| Chapter | Agent | Interest |
|---|---|---|
| I | Prof. Peter Madden | Took part in Cardiff Smart City Roadmap and is an outstanding academic in urban development in the UK. He shared multiple interesting information about smart planning in Cardiff and the role played by multiple stakeholders in that case, improving the methodology to understand Campinas. |
| | Dr. Miguel Valdez | Took part in Milton Keynes smart city enquiry, on the most famous cases in Europe and in the UK. He strongly contributed to the understanding of the contradictions and difficulties in implementing smart policies. |
| II | - | No interview was conduced related to the content of this chapter. |
| III | MSc. Thomaz Andrade | Thomaz works to National Resources Wales and shared his experience with applying GIS to approach environmental problems. |
| | Dr. Ruth Potts | She is lecturer in Spatial Planning and lately have been querying about digitalization and smart cities in the last research projects and could provide rich debate about Cardiff Smart City Roadmap. |
| IV | Local entrepreneur | Understand how a local researcher/entrepreneur understands smart city policies and what Campinas means in terms of facilities, infrastructure and hindrances. |
| | City hall employee | Works at Strategic Projects and smart cities head office in Campinas, and provided information about the procedures and infrastructures the local authority have to develop smart cities issues. |

Source: Organized by the Author.

### 1.2.5 Fieldworks

To accomplish our objectives in this research in addition to other methodologies, fieldwork was also used as a resource, focused on a few main tasks, aiming to meet research interests. This step can be divided into three types, according to Frame 5. Figure 11 shows "Starship Robot", a delivery machine that runs on Milton Keynes, place where a field work was carried out.

[15] One interview followed more structured script, which are available in this document as Attachment 1.

**Frame 5 -** Fieldworks developed in the research

| Chapter | Objective | | Description |
|---|---|---|---|
| I | **Observe and Register** | Cardiff | This stage consists of visiting the field to observe and register shapes, processes or connections regarding the empiric case that may not be well described in the literature. This stage was applied in the comparative analyses mentioned. (Figure 11). |
| | **Observe, Register and Talk** | Milton Keynes | This stage consisted on a field developed aiming to discover and analyze elements of experiencing smart cities famous cases (transportation, cost of life, use of technological gadgets). In this opportunity I also had a conversation/interview in Dr. Miguel Valdez. (Figure 11). |
| III | **Observe and Register** | London | Due the impact of London's experience in developing GIS to "tackle" urban problems, mainly focusing on public transportation and Control rooms / boards. |
| IV | **Check, enhance or complement databases** | Campinas | This fieldwork aimed to check and complement information about the production of space in Campinas, mainly focused on discovering new connections among the analyzed structures. |

Source: Organized by the author.

**Figure 11 -** Fieldwork picture example


Source: Author's Collection. Obtained in field (2022/2023).

### 1.2.6 Cartography and geotechnologies: understanding and representing Campinas

Alongside other research techniques (described and discussed in this first topic) we consider cartography and geotechnologies key elements to produce contributory results, either theoretical or applied knowledge, framing them beyond their technical features, through a geographical praxis, covering the understanding of "totality" that implies on a specific and historical role of technology (Matias, 2003). Within the production of geographical knowledge, disputes over the concepts of Cartography and Geotechnologies are harsh, due to theoretical and methodological divergences as shown by Archela and Archela (2002) and Girardi (2014). In fact, different groups consider cartography according to its research and political interests: from more positivistic and linked with mathematic precision, more artistic and emotional approaches blurring the limits between producer and "user" (post-structuralist), also having approaches (like ours) that claims the concept of geographical cartography as understanding of an instrument of representation endowed with ideology, with specific objectives and consequences of its methodological choices[16].

As our methodological choice, this work contains two different approaches two cartography: *i)* within chapters one, two, three and four, we present maps following conventional *forms*, although understanding cartography through a non-positivistic approach, committed to a geographical praxis, based, on the one hand, on graphical semiology and critical cartography and on the other, on Communication and Social Theory (Matias, 1991). Further, as we understand geographic space as absolute, relative and relational, it is necessary to understand our cartographic results by thinking about cartographic space *beyond* absolute space (Fonseca, 2004). Nevertheless, in chapter five, we approach cartography by *ii)* chorematic, meaning a perspective focused on representing fewer details and focusing on geographical processes. More explanations about the potential and possibilities given by this approach are available on the next topic.

Geotechnologies, in turn, embrace: "digital cartography, Global Positioning System (GPS)[17], remote sensing and Geographic Information System (GIS)" (Matias, 2003, p. 30). In our case, the most used components of such definition were digital cartography and GIS, to

[16] This a quite controversial and complex discussion, that would need hundreds of pages to properly explain. A lot have been produced on this subject during the last eighth years. Mine and Matias (2021) presented recent contributions regarding Brazilian current scenario, but to properly understand this debate, the following literature can be checked: Harley and Woodward (1987), Crampton and Krygier (2006), Wood (2010), Koutsopoulos (2011), Brunn and Dodge (2017).

[17] Currently the most accurate term to refer is GNSS, but we kept the citation due to the great relevance of the paper.

produce, process and represent data and elements of urban space in Campinas. As well as cartography, concerns to the approach given to GIS have multiple social implications, following arguments presented by Pickles (1995, 2004). In this sense, GIS can deep socio-spatial inequalities as empower differently the agent's producers of space; can underpin surveillance system that can reproduce gender, race and ethnical violence, can produce and reveal sensitive information on subjects or social groups or give companies the power to control several infrastructures.

To visualize, edit and share data and information produced, we used two software: QGIS and ArcGIS Pro. Strict protocols and instructions were followed to prepare the cartographic material, as shown in Zeiler (1999), Harder and Brown (2017) and Corte et al (2020). All collected and produced data were stored in specific folders on the student's hard disk and counted on regular backups to the institutional drive provided by Unicamp. Our main sources to analyse Campinas were: the GeoGet database and the Campinas Municipal Power database (2014). The database, as shows Maguire *et al* (2005) and Miranda (2005) counts on layers in *shapefile* format with three types of geometry: points, lines and polygons, with each having its own topological properties, associated with geographical features in space. The shapefile also attaches other information to the features (its coordinates, table containing multiple information etc.). Frame 6 important layers used in the analyses and representations.

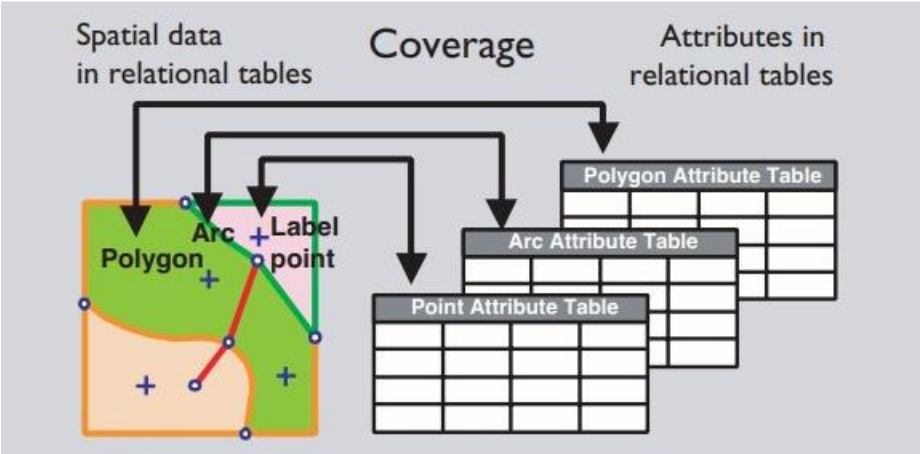
**Frame 6 -** Layers used in the research, its sources and specificities

| Layer | Source | Date | Specificities |
|---|---|---|---|
| Boundary | GeoGet | 2010 | Polygon, SIRGAS 2000, UTM 23S |
| Regional administrations | CMP | 2014 | Polygon, SIRGAS 2000, UTM 23S |
| Urbanized area | GeoGet | 2020 | Polygon, SIRGAS 2000, UTM 23S |
| Industrial area | GeoGet | 2018 | Polygon, SIRGAS 2000, UTM 23S |
| Optical Fibre infrastructure | CMP | 2021 | Polyline, SIRGAS 2000, UTM 23S |
| Public Buildings | CMP | 2018 | Points, SIRGAS 2000, UTM 23S |
| Open Wi-Fi spots | CMP | 2018 | Points, SIRGAS 2000, UTM 23S |
| Highways System | GeoGet | 2018 | Polyline, SIRGAS 2000, UTM 23S |
| Urban Road System | CMP | 2021 | Polyline, SIRGAS 2000, UTM 23S |
| Developing Hubs | CMP | 2018 | Points, SIRGAS 2000, UTM 23S |
| Urban Projects | CMP | 2018 | Points, SIRGAS 2000, UTM 23S |
| Potential Enterprise areas | CMP | 2018 | Points, SIRGAS 2000, UTM 23S |
| Census track | IBGE | 2010 | Polygons, SIRGAS 2000, UTM 23S3 |

Source: Organized by the author.

The collected and produced data were stored as a coverage data model, when each layer has its own specific related attribute table, as shows Figure 12.

**Figure 12 -** Coverage data model according to Zeiler (1999)



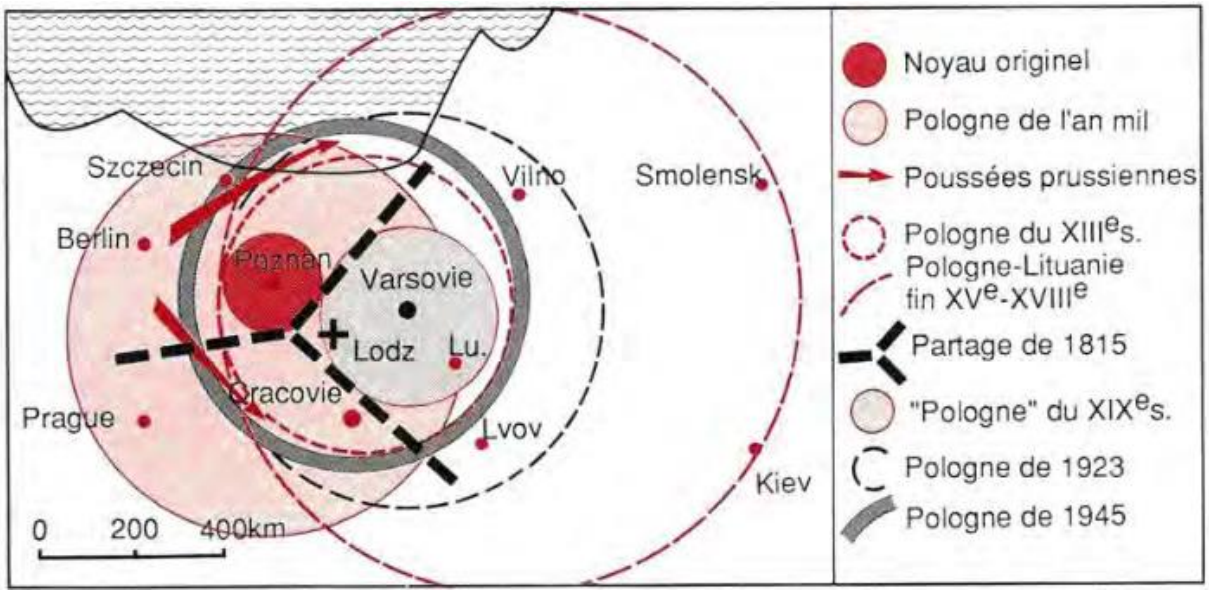

Source: Zeiler (1999).

### 1.3 Reading urban space through chorems: procedures and outcomes

One important assumption on method in this research is a critical scepticism on endless quantification as solutions to all urban questions, mainly when separated from concrete logic, as can be seen, scattered through smart projects. As proposed by Lefebvre (1975), quantity is transformed into quality as one of the laws of the dialectic method, underlining the importance of crises and transformations (Costa *et al,* 2014). Further, Lefebvre (1975) argues that to act over reality, its crisis points need to be found, as these moments represent the transformations into something else. This has as an outcome a socially-positioned cartographical production in this research. Committed to that conviction, beyond the methods pointed out in the previous topic, we also adopted chorematic, a framework proposed by Roger Brunet (1986; 2017).

The core reason for us to adopt chorems to understand and represent space in Campinas was its focus on structures and processes, with less emphasis on precise details, as a meandering municipal boundary or very detailed urban sprawl (Brunet, 1986; 2017). Brunet's work is also strongly connected to land planning policies and suffered the influence of French structuralism (Reis-Júnior, 2019). As examples of chorematic models, Figure 13 shows famous Brunet's proposition of Poland's territory over time. It is possible to observe how the national boundary changes over centuries and how Brunet simplified the "actual" features into a circle.

**Figure 13-** Choromatic Model of Poland

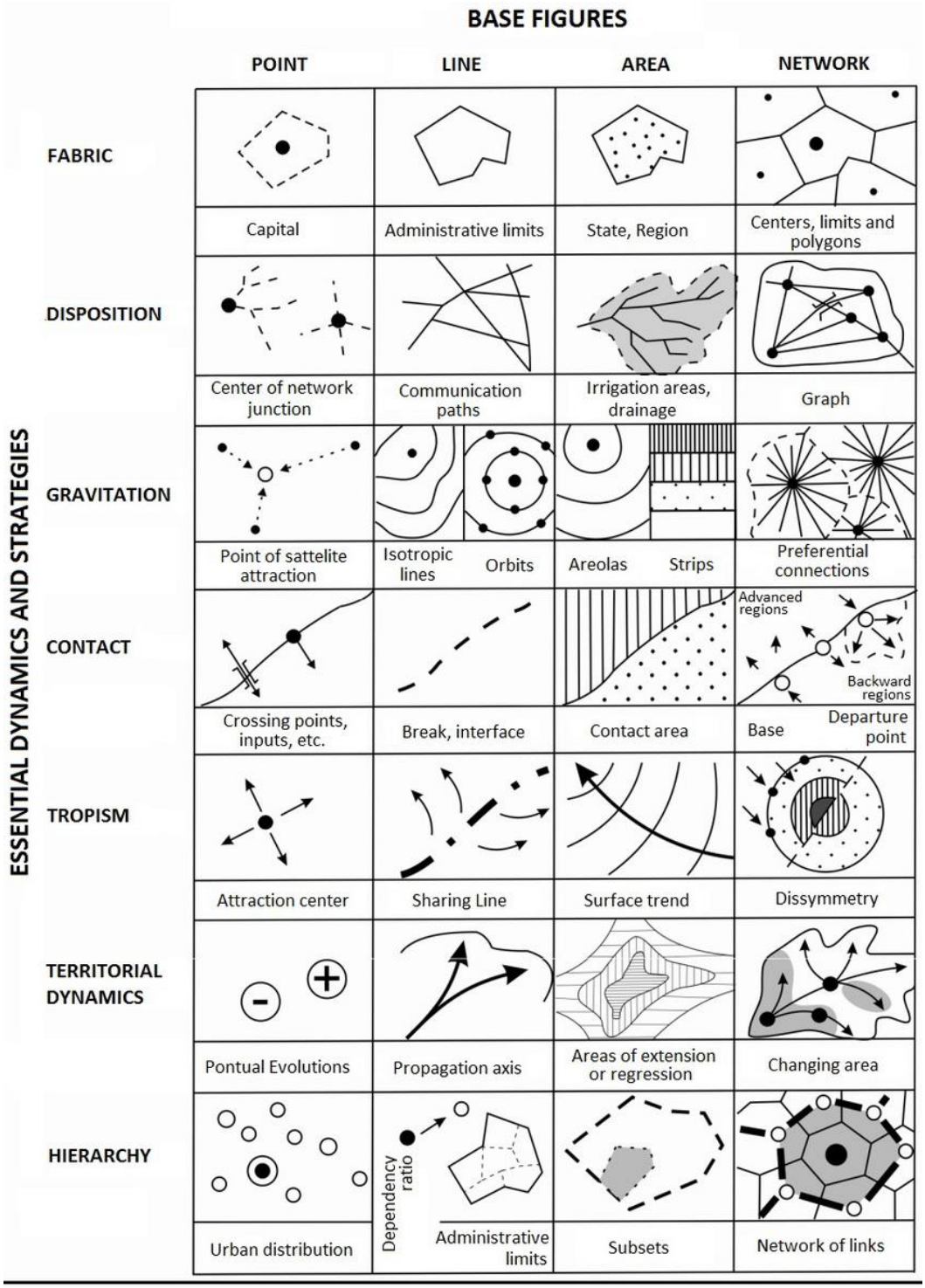



Source: Brunet (1986).

The process of producing chorematic models is based on testing and readjusting forms through confrontations with materiality, being elementary cartographic as its possibilities: points, lines, polygons and nets. To represent structures and processes in space, Brunet (1986) proposed 28 chorems, as being an elementary symbol (graphic model) endowed with meaning. They can be used as means to represent fabric, disposition, gravitation, contact, tropism, territorial dynamics and hierarchy. Figure 14 shows the chorems proposed by Brunet (1986).

The lines represent spatial dynamics while the columns represent topological structures, implying on multiple attributes of the features represented. For instance, if we put together gravitation and area, the result is a “polygon” that due to its spatial characteristics tend to attract other specific activities. In similar vein, combining propagation axis with line, the result is a axis (deprived of area) propagating a spatial feature (like agribusiness frontier in Brazil, for example). In chapter 4 we develop our representations with specific chorems from this list and their spatial characteristic will be more explored.

**Figure 14 -** Chorems proposed by Brunet (1986)

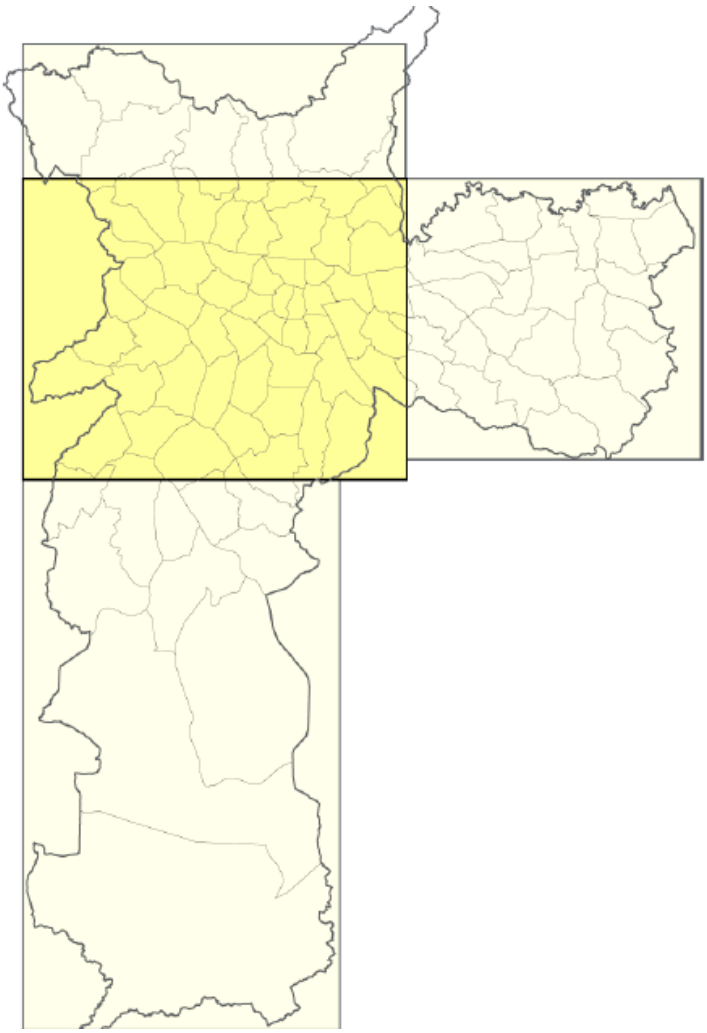



Source: Martinuci (2016).

To bring up other chorematic experiences in Brazil, aiming to connect the production to a closer context, we also based our methodology and procedures on the work of Thery (2012a, 2012b), Fagundes and Matias (2016) and Fagundes (2017), which developed

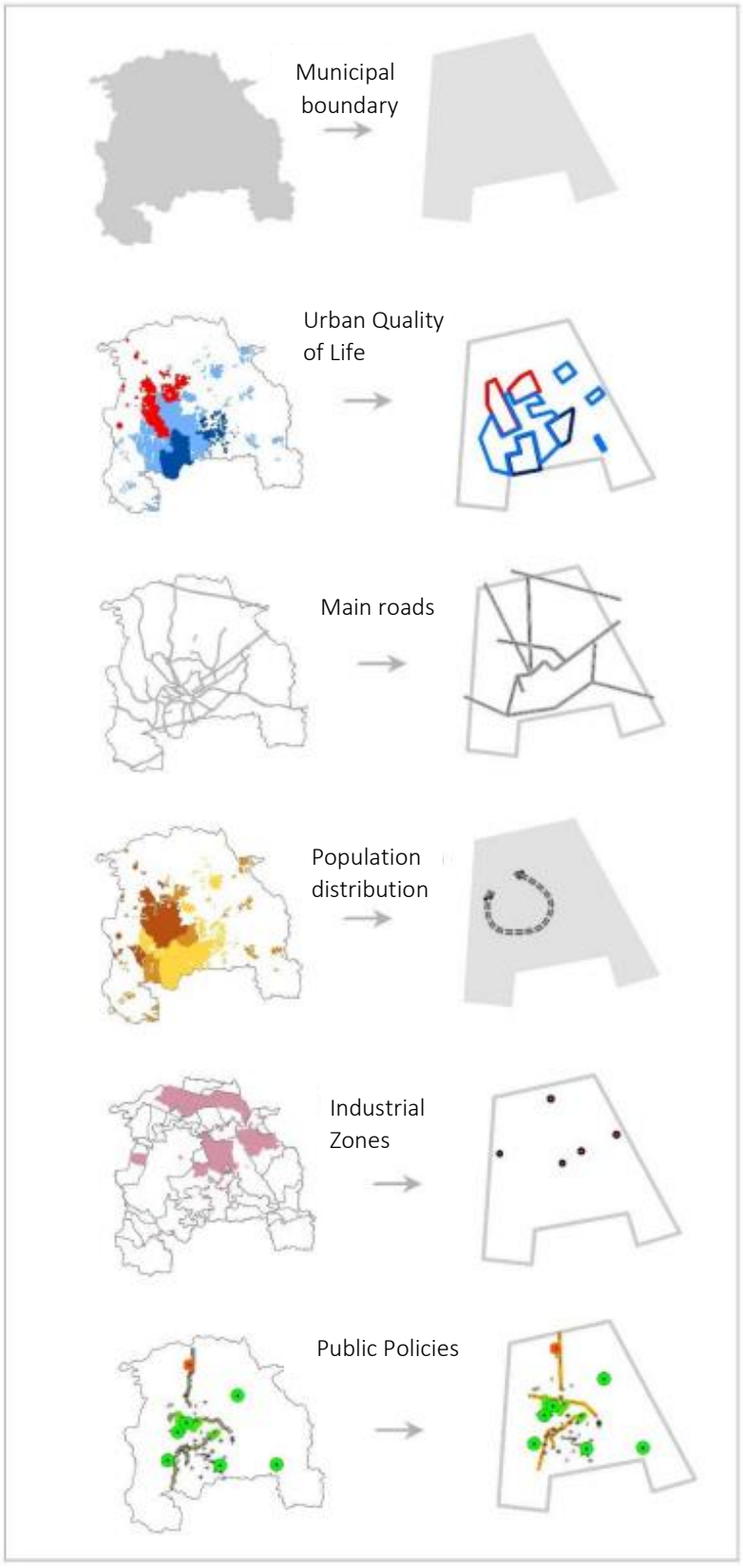
choremática approaches to the city and the state of São Paulo and Sorocaba, showing important and qualified outcomes. Figure 15 shows Thery's (2012a, 2012b) choremática boundary of São Paulo (SP) and Figure 16 shows Fagundes' (2017) chorems to Sorocaba (SP). Figure 17 shows an example applied to Campinas developed by Seixas (2022).

**Figure 15** - Choremática Boundary of São Paulo According to Thery



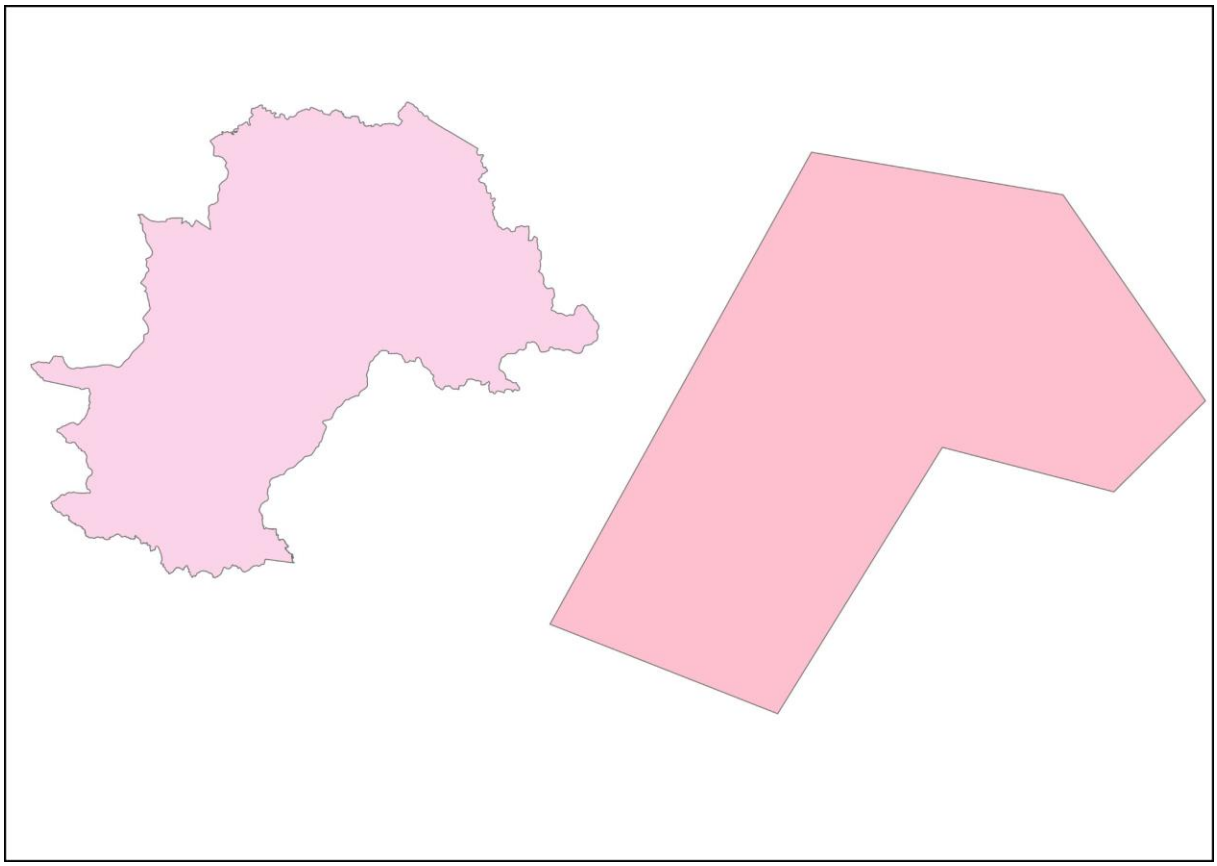
Source: Thery (2012a).

**Figure 16 -** Example of Choremático models to Sorocaba (SP) according to Fagundes (2017)




Source: Adapted from Fagundes (2017).

**Figure 17 -** Campinas Boundary chorematic model



Source: made by the author.

To produce the chorems used throughout the research, we used the software ArcGIS Pro as a methodological update from Fagundes and Matias (2016) which used ArcGIS 10.0. This step was adopted owing to the possibility of departing from the regular cartographic base, overlaying the chosen themes to apply procedures described by Del Fatto *et al* (2008) and Dhieb (2020). The main applied procedures were generalization, simplification, refining and geometrization (Fagundes, Matias, 2016).

# CHAPTER 2:

# THE IDEAL OF SMART CITY AND THE PRODUCTION OF SPACE: TOWARDS A GEOGRAPHICAL PERSPECTIVE

*Os ventos do norte não movem moinhos*[18].

**Secos e Molhados** (1973).

Internationally, there are tons of papers or scholarships regarding smart cities, smart urbanism, picturing, on the one hand, how to make cities "smarter" and secondly, critically concerning how this phenomenon shapes cities' development and what consequences are upcoming. Camero and Alba (2019) show that the interest in the topic fast increased in the last decade, with central countries such as the USA, western Europa countries on the first hand and China, on the second. Brazil doesn't have a core role in this international scenario. But despite the fact that it is not on the leading edge of this debate from any perspective, the smart city ideal is often used as a "solution" to create innovative, developed, and virtuous cases.

Notwithstanding, smart cities in Brazil are becoming very popular on account of multiple reasons. Despite the plural meanings the term or concept (depending on who is using the word) has, it is an agreement in all instances that *something* in this subject is *spatial*. Indeed, fields like Engineering, Architecture, Urbanism, Planning, etc. are concerned about this. In opposition, Geography is still beginning to interpret this process. The fact is that Geography, with a sturdy framework and approach to space, and more specifically, with urban space, can strongly contribute to this debate.

Having this scenario in mind, Chapter II aims to depict the concept's current form, origin and ideological influences, linking it to economic changes in the productive structure. Afterwards, we cross-check the concept and its assumptions to a critical approach to urban space and present the main agents performing core roles in the production of urban space related to smart urbanism.

[18] Free translation: "The winds from North don't make the mills move", part of the lyrics of "Sangue Latino", by Brazilian musical group Secos e Molhados.

## 2.1 The capitalist production of space in the 21th century: neoliberalism and urban space

Capitalism, while producing material conditions in Europe (primitive accumulation) to enable the bourgeois class domination, had shown, almost as a historical condition, its need for globalization compelling the production of space. Slavery and colonization served, through exploitation, as fuel to the capitalist mode of production to achieve new spaces. Meanwhile, those were placed in contradictory dynamics of production (Sheppard, 2016; Federici, 2004, Fraser, 2022).

One of the main reasons for this need to expand under capitalism is set on a spatial adjustment to the cyclical conditions of accumulation and crises: the spatial search for new markets, deposits and labour can at least in the short term and from a hegemonic perspective find solutions to immediate contradictions (Harvey, 2001). Lefebvre (2008), through a historical dialectical materialist approach, argues that social reality shifts according to productive activities and their shapes. Further, the author sets that the constant capitalist attempts to expand through space to handle its inherent contradictions are responsible for the dialectical production of things *in* space, which becomes the production *of* space.

Capitalist expansion and globalization are coordinated by uneven development, which creates and highlights socio-spatial inequalities, mainly because of the difference in investments, patents, innovations, and people (Sheppard, 2016). Smith (1990) explains that due to the need for continuous movements that capital has, the most advanced model of uneven development occurs on the urban scale, which is the one where capital has more mobility.

Geographic space, in these terms of capitalist production, overlaps its absolutes, relatives, and relational aspects in order to expose places and bodies to precarious conditions, while, in contrast, others to dynamics of accumulation, making it impossible to understand those processes disconnectedly (Harvey, 2006a). Therefore, those patterns may assume different characteristics: clustering, regional system productions, transport or communication infrastructure, or spatial divisions of labour (Brenner, Theodore, 2002). A challenge that capitalism tries to sneak in emerges from these conflicts and contradictions: the urban standard way of life in the centre is unsustainable in other socio-spatial contexts (because of environmental, social and economic costs), but the demand for labour and markets keeps expanding urban processes, contradictorily, to these spaces (Davis, 2006).

After 1970 the Fordist crises broke the link previously set between national mass production and national mass consumption, due to a new global competitiveness pattern. This

process triggered deindustrialization in the capitalist centre and caused the abandonment of the Bretton Woods currency agreement (Brenner; Theodore, 2002). In the final decades of the XX century and at the beginning of the XXI, capitalism, which had in the industrial Fordist production the centre of the accumulation process, shifts to a financialized reality (Fraser, 2018). Although the recent emergency on this theme, concerns in urban geography with credit and financial circuits in urban geography date back on the 1980's (Harvey, 1982; Sanfelici, Halbert, 2019). To explain this process, Sanfelici and Halbert (2019) turn "to the priority given to macro-economic goals over urban development priories" (p. 17), which gives asset managers a core role in the implementation of public policies.

Other major elements of the neoliberal phase of capitalism are its establishment as "a mix of classic fundamentalism, market regulation, economic redistribution favoring capital, moral authoritarianism and international negotiations with fewer customs fees (Moody, 1997). Harvey (2005; 2006b) explains neoliberalism as a political project that aims to reestablish conditions for capital accumulation, stressing class struggles in the context of Fordist regulation crises.

Economically and ideologically, in neoliberalism, denying class struggles through the understanding of society as a tangle of individuals becomes the hegemonic narrative and starts to underpin the mode of production. This ideological aspect also focuses on interpreting society through entrepreneurship, which breaks with the historical dialectical materialism understanding of class. In this neoliberal approach, any individual can identify, by their means, market opportunities and become an entrepreneur. Another eminent adjustment is a most subjective approach to economy, leading away from regulatory theories, as did classical liberalism. The new focus is to turn the responsibility to each individual for its success or failure without linking social and socio-spatial inequalities to capitalism (Dardot, Laval, 2017). This theory, by a majority, comes from the Austrian and Chicago scholarships.

The proliferation of neoliberal mechanisms has led to a convergence of (under)development agendas, that, in the periphery manifests itself mainly through regulatory experiments (managing governance through the market, strengthening public/private partnerships with big tech companies, such as Google, IBM, or Amazon (Peck *et al,* 2012; Nascimento, 2020.) A crucial characteristic of these regulatory agendas is the appeal to resilience and smartness in cities (Nascimento, 2021).

Considering on consequences of the process of financialization and deindustrialization from an urban perspective, Degen and Rose (2022) demonstrate a growing

trend of financial centres and mixed public/private spaces, setting multiple urban activities into a business approach, as shown in Figure 18.

**Figure 18 -** Example of a business centre in London (UK)

Source: Author's collection. Obtained in field (2023).

Figure 18 shows different shapes overlapping in the centre of London-UK. It is possible to observe in the landscape the concentration of tall mirrored and sharp buildings, diverging from other structures. These are "command centres" typically from financialized capitalism (Arantes, 2009). It is common to this type of craft to have specific technology patterns, to enable the offices and employees to very quick communicate, high standards on information security and energy resource efficient administration, to attach the companies' brand to current social needs (environmentalism). Companies owning these buildings aim to appear smart and efficient in their own structures to convince society that their governance and influence over planning and other economic decision would make the same effect in society (Alvarez, 2013).

These readjustments in the urban space focus on new functions that align with the contexts, needs, desires, and ideologies of their respective period. Under capitalism, the production of space becomes commodified, making trade value the most relevant feature. The shaping and functional transformation of refurbished spaces turn their utilization into a

productive moment, linking the act of accessing the city as a means of reproducing capital. This type of space is called a simulacrum (Harvey, 1989; Carlos, 2017). The tendency in this logic of urban space production is abstract and homogenizing, leading to the detachment of places from their local historical and geographic processes to project, again, a global agenda. The sum of class efforts to undertake, conquer, produce and maximize profits, creates, in this context, a union of distinguished and incohesive, which through dialectical struggles condition the reproduction of space (Lefebvre, 1991).

The urban landscapes are also affected by these shifts in capitalist and urban contexts. The cutting-edge architecture, with mirrored buildings, takes place instead of the old cement constructions to show transparency, flexibility, lightness and fluid perspective following the change in the centre of capital accumulation (Harvey, 1989; Arantes, 2009). Differently from what occurred with the modernist city (Paviani, 1989; 2010; Choay, 1996), this “flexible” production of urban space, underpinned by new productive structures promotes more selective remodeling, as the intention is not to create massive infrastructural interventions, but to create a fragmented space in terms of technology and general material conditions (Carlos, 2017). Arantes (2009) shows significant shift in the mass production of cities characterized by an entrepreneurial focus aimed at building "spectacular" monuments, thereby reinforcing the notion of a performative city.

As much literature on this specific field is available, we only could pass by some of the main elements and consequences throughout this topic, bearing in mind the emergency of neoliberalism in urban space. Numerous research studies have been and will continue to be conducted in order to comprehend these processes and transformations. In the current context, with this topic, we aimed to demonstrate that the “smart” ideal is a product of a specific period under a certain geographical context, showing that changes in how capital reproduces itself can affect multiple aspects of urban space.

After establishing these connections, it is necessary to go further into the origin and development of the link between smartness and cities. What are the epistemological roots? Where do they come from? Which were the key moments and factors to condition this ideal? What are the consequences to the urban space and different socio-spatial groups? These are some questions we try to answer on the following topic.

## 2.2 Smart Cities, a definition: the enlightened utopia and the future of cities

To approach the smart city ideal, we depart from historical dialectical materialism, which understands that the production of space is shaped by the capitalist mode of production. By definition, it is contradictory regarding multiple dialectic pairs, for instance, capital and labour, use value and trade value, bourgeois and working class (Marx, Engels, 2016 [1878]; 1965 [1932], Lefebvre, 1991; Harvey, 1980). Thereupon, we argue that urbanization has a connection with specific changes in society caused by industrialization (that has particularities in different contexts according to the historical, social, and territorial formation (Martins, 1986; Moraes, 2011; Lefebvre, 2008)).

Through this understanding, the production of an uneven urban space becomes a direct and unavoidable consequence of capitalist contradictions. Therefore, our approach to the ideal of smart city and its interventions in urban space as the solution to conflicts is sceptical, as we consider it part of the structure that continuously produces inequalities.

Indeed, proposals for reforms, readjustments, changes and many other denominations are quite common throughout the history of urban development (Jacobs, 1992 [1961]; Hall, 2014). Nevertheless, each period endows these discourses with its general conditions and ideologies (Degen, Rose, 2022), shaping and giving specific contents and processes to urban space at different times. Some elements, however, appear clearly in urban reform projects.

Berman (1982) produced extensive research and knowledge about the modern period and explains that the vigorous impetus to transform, expand and develop (bearing in mind the disputes over this meaning) is a central element in modern rationality. The energy spent to produce a rationalized through technic advancement space came to act as an even civilizing element, endowing certain societies with more value according to their relations with techniques. Geography and cartography even had a core role in this process, working as an instrument of power (Pickles, 2004).

An eminent historical milestone concerning the relationship between knowledge production and space production was the work of the English philosopher Francis Bacon (1561 – 1626). More specifically, Bacon abords the relationship between science and the construction of an urban infrastructure linking technical/technological progress with a utopian vision of life in the cities. Cugurullo (2021) argues that New Atlantis (1626) was the first formal register of an ideal based on the scientific and technic progress, framing reason (Eurocentric, white, masculine approach to reason (Carneiro, 2009; Davis, 2016)) as key to improvement of life.

State and Capital created alliances aiming to modify urban space towards a rational, scientific and enlightened image of progress, imposing an optimistic vision about capitalist reforms and restructuring (Lefebvre, 2002). Such urban models were based on control over urban forms to enable the complete and organized fulfillment of their functions (mobility, dwelling, economic activities). Some of the core theoretical examples of these processes that occurred during the XIX and XX centuries are Gardens Cities of Tomorrow, by Ebenezer Howard, Cittá Nuova, by Sant'Elias, as shown by Fagundes (2017), many times motivated by adjustments to industrial and fordist capitalism (Harvey, 1989).

The urban space, where the materialization of the tensions of capital reproduction concenters, in this context, also undergoes restructuring to fit the current processes of capital accumulation. Hegemonic economic agents in the process of production of space use masks to implement their urban projects: supposedly collective elements, such as sustainability or smart cities, are claimed as the centre of urban transformations in the period (Cugurullo, 2013).

Cugurrulo (2021) points to two specific moments when the investments in technology increased in urban space: *i)* during the second industrial revolution, when science, technology and industry started became more cohesive and *ii)* during the 1970's with the convergence of microelectronics, computing and telecommunications, which have led to quantitative and qualitative changes in the reproduction of space (Castells, 2008).

Castells (2008) also sets that in the "age of information" networks (understood as a set of interconnected nodes) became a new social morphology, capable of transforming productive processes. This occurs in a new paradigm, in which information becomes the material bases for expanding the accumulation process (and production of space too).

The concept of appropriating the characteristics of the network society (Castells, 2008) to build a new city model emerges and starts to evolve, as shown by Kitchin *et al* (2019), referring to "wired cities" (Dutton, 1987); "digital cities" (Ishida; Isbister, 2000) "cyber cities" (Graham, Marvin, 1999), "intelligent cities" (Konminos, 2002), "networked cities" (Hanley, 2004) e sentient cities (Sheppard, 2011). It is necessary to mention that this moment, mainly in the final period of the 1900s and at the beginning of the 2000s, represents a significative event: the urban projects now count on material data infrastructure and digital information, in opposition to analogic structures. Not that these are forgotten or underestimated, but there is a perception that there can be a qualitative change in urban space from an approach that combines digital elements.

Kitchin (2014) reveals that transformations in data production infrastructures (including georeferenced data) were central elements in transition planning and governance

models. During the 1980-decade structures capable of collecting and producing data, information and analysis already existed. Nevertheless, the periodicity and scale of data production did not allow for more in-depth analyses, connections, and conclusions that were more specific to the urban context.

In the first decade of 2000, articles about smart cities increased in number and significance. A few examples of relevant publications at this moment are Kanter and Litow (2009); Lombardi *et al* (2012); Nam e Pardo (2011), when core features of the “ideal of smart city” start to embody. Morozov and Bria (2019) argue that the term "smart" in the context of cities vaguely qualifies them, articulating a series of political and economic interests around a word that is commonly associated with essentially positive signs. However, regardless of the investments made in smart city research and advertising, whether in academia or in the market, the success in terms of uptake and investment that smart cities have achieved over the last decade is not explained by this factor alone (which does not exclude the importance of these elements either).

The influence of Smart Growth (planning and economic scholarship, created in the USA during the 1980 decade) and of the technology-based intelligent city can be interpreted as the *zeitgeist* of the ideal of a smart city (Hollands, 2008; Södeström, 2014; Vanolo, 2014). Meanwhile, the next step in the process consists of transforming this *zeitgeist* into minimal material and ideological bases structured in urban space. This step was taken by big enterprises, by creating specific programs and products.

IBM, Cisco, and Siemens were responsible for organizing elements and strengthening, through this agenda, the narrative that, based on technology and information would be possible to improve urban quality of life, using big data and big analyses (Townsend, 2013). Yet, IBM took ideological and practical arrangements to implement projects focused on smart cities as a way out of the accumulation crises. It created the Smarter Cities program, patented in 2011 and quickly attracted much interest and many investments so that even other companies started to join these initiatives (Google, HP, and Microsoft) (Paroutis *et al,* 2014).

Each one of these companies has its own strategies e contexts, but they share the intention of transferring retained technology in single products to city planning and management, picturing technology as the solution even without knowing exactly what to do with it. The approaches also shared the idea of an objective urban reality, quantifiable, measured, and solved (Townsend, 2013; Söderström, 2014).

Another criticism made by scholars to these pathways is the fact that they don’t show a historical character, leading different cities (produced by different socio-spatial

conditions) through the same political receipt (Greenfield, 2013), reinforcing Eurocentric development patterns (as occurred historically in Brazil (Servilha, 2017)). In determined contexts, mostly in the global north, this occurred attached to an imaginary of sustainability, surveillance (Scassa, 2018), smartness, and competitiveness (Sadowski, 2020; Hollands, 2008; 2015; Vanolo, 2014). Vanolo (2016) emphasizes that this approach considers citizens as silent and blind, and the smartness feature is given to the city, as a living entity.

Many cities in Brazil and Europe, North America, and Asia adopted this type of project. Vanolo (2014) points out cases in Milan (Italy) in partnership with Cisco and New York (USA), Chicago (USA), Madrid (Spain), and Genoa (Italy). This subject became the focus of big European and international projects (i.e., Smart Cities and Communities European Innovation Partnership[19]).

One significant consequence of these smart initiatives, made through public and private partnerships was adding an operational infrastructure of data production instruments (cams, sensors, GPS's) in conventional infrastructures (highways, public transportation; pavement) (Dodge, Kitchin, 2005; Graham, 2011; Straube, 2018) or security and surveillance infrastructure (Pickles, 2004; Sadowski, 2020;). From the global south perspective, cities were used as marketing challenges to the enterprises mentioned, such as Rio de Janeiro (RJ, Brazil) (Bernardes *et al*, 2017; Freitas, 2020). Also, in these opportunities, those companies took the opportunity to develop a global agenda of urban interests, regulating socio-spatial and administrative processes, rushing urban planning, and creating (un)predictable consequences (Bottura, 2014).

Cugurullo (2019) emphasizes that the concretization of a smart city ideology represents, in theoretical terms, the triumph of subjective reason as it articulates supposedly collective elements to acute individual interests or focused on hegemonic agents of capitalism. Such a constitution materialises on account of contradictions inherent in the capitalist mode of accumulation, based on private property and the patent model, which makes scientific development a catalyst of socio-spatial inequalities in different ways. Firstly, Cugurullo (2019) argues that the bourgeois class benefits, represented by some technology companies, which profit from the transfer of their commodities, used in the creation or reform of urban processes,

[19] "The European Innovation Partnership for Smart Cities and Communities is an initiative supported by the European Commission combining **Information and Communication Technologies** (ICT), **energy** management and **transport** management to come up with innovative solutions to the major environmental, societal and health challenges facing European cities today." Maschio, I. Available in: https://e3p.jrc.ec.europa.eu/articles/european-innovation-partnership-smart-cities-and-communities

often managed by the state or by public-private partnerships; and secondly, a slightly broader set of wage-earners who have access to income to use the resources created. At least in the most relevant definitions of smart city, we can see a strong relationship with technology, data, sustainability, efficiency, environment, and quality of life.

After these considerations, we move towards a definition of smart city onwards. To help in enquiry, we elaborated the Frame 7.

**Frame 7** - Important definitions of Smart City

| Author | Definition | Type of Agent |
|---|---|---|
| Kanter and Litow (2009) | A smarter city infuses information into its physical infrastructure to improve conveniences, facilitate mobility, add efficiencies, conserve energy, improve the quality of air and water, identify problems and fix them quickly, recover rapidly from disasters, collect data to make better decisions and deploy resources effectively, and share to enable collaboration across entities and domains. | Researcher |
| Angelidou (2014) | Smart cities represent a conceptual urban development model on the basis of the utilization of human, collective, and technological capital for the development of urban agglomerations. | Researcher |
| UNECE and ITU (2017) | A smart sustainable city is an innovative city that uses ICTs and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects. | International Organization |
| Smart City Index (IMD; SCO; SUTD) (2017) | Smart City is defined as an urban setting that applies technology to enhance the benefits and diminish the shortcomings of urbanization for its citizens. | Private |
| WenWen Li (2018) | A 'smart city' might be defined as a city that exploits digital technology in the interests of improving its operation and management, and addressing the problems that afflict the modern city. | Researcher |
| Rob Kitchin (2018) | A smart city is one that strategically uses networked infrastructure and associated big data analytics to produce a smart economy, smart government, smart mobility, smart environments, smart living, smart people. | Researcher |
| Los Angeles Smart City Strategic Plan (2020) | A Smart City is one that efficiently and ethically uses secure technologies, data, & resources to improve quality of life and sustainability for residents, businesses, and visitors. | Municipal Council |

Source: Organized by the author based on the mentioned authors.

Frame 7 brings important definitions of smart city. Although different approaches, all definitions share, generically "technology to improve quality of life". Figure 19 shows the most common words in Frame 7. The bigger the frequency, the bigger its size.

**Figure 19 -** Word cloud of Smart City Concept


Source: Organized by the author.

Based on the analyzed literature and considering the most prominent authors and stakeholders, it is possible to propose a definition: the ideal of smart city is a set of initiatives, projects and plans claimed by different agents to refer to an urban context where (geo)technology affects, shapes or condition multiple aspects of life, labour, planning and, in general terms, the production of space.

Taking into account arguments developed throughout the chapter, despite the utopic narrative and belief, the ideal of smart city centered on the state as the main agent and aiming to solve urban problems is not quite embodied and spread throughout cities, especially in the Brazilian case. Many risks were pointed by multiple researchers and social movements: Söderstrom *et al* (2014) showed how the smart city can be understood as a corporative storytelling, while Vanolo (2014) wonders on the role designated for citizens in smart cities projects and Datta (2019) shows the multiple obstacles of smart cities implementation in India. Nevertheless, these restricted partnerships between the State and capital enabled[20] one main

[20] By "enabling" we mean legally, physically, ideologically.

process, although to different extents in the capitalist centre and periphery: the embodiment of basic communication infrastructure in urban space. According to Barns (2020), this reality resulted on:

> The collective intelligence generated by billions of daily interactions with global digital platforms – whether Google Maps, Gmail, Uber, Aliplay, Airbnb, Didi, Amazon and so forth – means these companies are now equipped with vast, globally integrated data assets that are now used to shape myriad urban behaviours in fundamental ways (p.13).

If these companies are now equipped with massive data and advanced technology that to some extent fulfill smart urbanism promises, is it possible to define them as smart urbanism agents? And if so, who is now on the leading edge of such kind of urbanism? Is there any connection between this "platform" economy with smart cities? It is impossible to study smart cities further without considering this aspect. In the next topic, we expose some recent theoretical dialogues to explore these connections.

### 2.3 Platform capitalism, platform urbanism: technologies, risks and the future of smart cities

Due to the current central role played by information in the reproduction of space, the urban experience is influenced by companies that have the means to gather and analyze vast amounts of data (Molina, Barreto Jr, 2022). Within this reality, global platforms shifted from spaces for sharing and connecting social life to major infrastructures with power to produce urban life and space (Plantin *et al*, 2016; Barns, 2020).

The designation "platform" to such a specific type of company or economy, according to Srnicek (2017) and Woodcock and Graham (2020), has its roots in the fact that originally, a platform is used as "a raised surface on which people can stand" (p.47). Further, the authors argue that a platform, in terms of economic and administrative organization, has as its main feature the fact that they provide infrastructures aiming to mediate the offer and demand of labour or commodities. Through this argumentative mechanism, platforms run away from legal duties (workers' rights and protections).

This perspective meets the neoliberal idea of personal responsibility for success or failure, transferring to the subject the burden to analyse market possibilities and movements and use this capability to read social relations as a way to make profits, known as "entrepreneurship" (Peck, 2009; Dardot, Laval, 2017). To "intermediate" that, platforms work, as Woodcock and Graham (2020) state, "to create a digital context in which buyers of labour power can connect with sellers of labour power" (p.26). Based on this assumption, platforms

claim they are not employers, as they only provide digital infrastructure to connect two sides. However, as platforms "mediate" several relationships in real-time, they actively influence the production of space – specially assisted by big data, and big analyses, ran by complex algorithms that set out prices, values, availability and evaluations.

Furthermore, this manner of surveillance, beyond more elementary (although not straightforward) consequences to labour (low incomes, lack of guarantees, extensive working days, informality) (Antunes, 2019; Woodcock, Graham, 2020), have *urban* consequences. To explain this through an urban perspective, it is necessary first to focus on specific elements in their geographical effects. Frame 8 illustrates some key platforms that play a significant role in urban mediation (although many other sectors, categories, and applications exist, we focus on the most influential regarding smart urbanism).

**Frame 8 -** Main digital applications and companies mediating urban space production in Brazil

| | Urban Transport | Short stay renting/hosting | Mapping Application | Food Delivery |
|---|---|---|---|---|
| Companies | Uber, 99 Taxi | Airbnb | Google Maps and Earth, Waze, Citymapper | Ifood, Rappi |
| Service | "Connects workers (drivers) with passengers through an app-based service" (van Dijck *et al*, 2018) | Allows connections between tourists and people happening to have an under-utilized room/space/property | Connects users with dense and high-quality real-time maps, routes, services, and transportation on cities and highways | Connects restaurants, drivers, and clients through an online platform. |
| Mechanism | Datafied marketplace that doesn't have transportation infrastructure, but can directly interfere in urban mobility (van Dijck *et al,* 2018) | Accommodation provider that uses data-analytics to outsource real-state fixed capital (Srnicek, 2016). | Digital Atlas or online mapping applications feed actively or passively by users to develop or enhance marketing or advertisement location-based strategies (Caquard, 2019). | A digital platform that uses big data (spatial information) to, based on the gig economy, monitor food delivery demand. |

| | | | | |
|---|---|---|---|---|
| Consequences | • Blured division between public and private transportation<br>• Entanglement of multiple new actors in urban transportation<br>• Datification and surveillance on transports.<br>• Labour rights and security losts<br>• Loss of "public values" on transportation | • Blurring boundaries between housing and tourism accommodation (Hotels, Hostels) (Stabrowski, 2017)<br>• Effect on local sense of place<br>• Retail structure modified<br>• Plataformisation of home-stay<br>• Increasing cost of life<br>• Buy-to-let investments (Söderstrom; Mermet, 2020) | • Producing space to prioritise economic interactions<br>• Mediatization of urban space<br>• Packing of local knowledge by offshore experts for general consumption<br>• Spatial neo-coloniality (Luque-ayala; Neves Maia (2019) AND Mcquire (2019) | • Generating bigdata on food demand in urban contexts which can work as competitive edge<br>• Decrease in payment to employees<br>• Impacting in traffic accidents (Rodrigues, 2021) |

Source: Organized by the author based on Srnicek (2016); van Dijck *et al* (2018); Stabrowski (2017), Caquard (2019) and Söderström and Mermet (2020), Luque-Ayala, Neves Maia (2019) Mcquire (2019) and Rodrigues (2021).

Woodcock and Graham (2020) show four categories of working under this new platformed economy which have different relationships with time and space, due to its specific and highlighted high demand for local mobility during the work period. The authors consider three main elements to develop their analysis and propose four categories. Temporality is related to the possibility or suggestion for the employment's term duration. The category "Traditional Waged Employment" refers to the most common during the last decades type of employment contract. The place where the employee develops the labour is very important, but with very low mobility: most part of the times, the employee stays at an office. "Cloudwork"[21] is a new type of relationship, when the employee does not come to the company's office and can work from home (but staying at the same place during the worked hours) – being this the main difference.

With "Micro Cloudwork", the work can be done from home as well, but the contracts are very short and related to a specific task that can be done in a short period of time, with no obligation from the company to continue with the employee after this first initial task.

[21] In Brazil, this term was translated as "Home Office". Despite the anglicism, the translation is not literal.

Finally, with Geographic-tethered work, the term is ideally short (like a gig to develop during a transition between traditional employments, for instance) and the work must be done out of the office as well. However, *where* the work is done becomes the central core of the work. A uber driver *must* be at a specific address at a specific time *multiple times* during a working day, for instance. An Ifood driver have to reach multiple restaurants and deliver the parcel to specific addresses as well. From a geographical standpoint, it represents a great difference, as *where in space* is the worker changes in real time. In terms of data production, for instance, multiple databases regarding consumption patterns can be produced and sold or used to create new business, for instance.

Just like the traditional waged employment, the "Geographic Stickiness" (obligation to be physically at a specific place during work) is high in the geographic-tethered work. The big difference is the local mobility during work. In this case, the most disruptive regarding the ideal of smart city is the category "Geographic-tethered platform work", as shows Frame 9.

**Frame 9 -** Employment categorization under platforms

| Category | Temporality | Geographic Stickiness | Local mobility during work period necessity |
|---|---|---|---|
| Traditional Waged Employment | Long term possibility | High | Low |
| Cloudwork | Long term possibility | Low | Low |
| Micro Cloudwork | Short term | Low | Low |
| Geographic-tethered platform work | Short term (supposed) | High | High |

Source: Adapted by the author from Woodcock and Graham (2020).

More specifically, the argument developed in Frame 9 explains that due to the massive changes in Fordist economy (as single task work and State regulation (Harvey, 2010)), based on mass connectivity and cheap technology (Woodcock, Graham, 2020) Capital created new forms of working (cloudwork, micro cloudwork etc.), mostly based on the gig economy. Our argument is that one of these forms, geographic tethered platform work, has much to do with the ideal of smart cities (although all of them have, anyhow).

Based on the definition presented on the last topic: "the ideal of smart city is a set of initiatives, projects and plans claimed by different agents to refer to an urban context where

(geo)technology affects, shapes or conditions multiple aspects of life, labour, planning and, in general terms, the production of space", we argue that accessing a service by opening a smartphone application that works with a sturdy database to find someone who sells its labour power to meet the initial demand (mobility, for instance) is indeed a manifestation of the smart city concept being realized.

What the authors call "Geographic-tethered platform work" has much to do with the ideal of smart city materialized and fully operating. We underpin this affirmative on the fact that this specific category of work is based on live geographic bigdata and big analysis, controlled by algorithms. On the one hand, urban space presents its dynamics and needs as a result of struggles among space producers. In this case, users, sharing their data with platforms end up giving them the exact demand of any service or product in a specific region or daytime (delivery service, a "ride" service or a need for a room in a particular neighbourhood).

Prosumers engage with this new model of accessing tasks (shopping, grocery store) or basic needs (health, mobility, chatting) by the zero-price-advertisement business model, in which they don't pay[22] to access, but the counterpart comes when they are asked to transfer personal data that will ensure sophisticated market cleavage to advertisement (Molina, Barreto Jr, 2022).

Sadowski (2020) shows another facet of this connection between infrastructure and technology companies while shows Amazon's effort to make their tracking behaviour system more "urban". The company developed a surveillance strategy to its online clients and is capable of high precision predictions on consumptions patterns, so they can offer specific products during specific periods of the year, month, week or day, for instance. However, this database was geographic limited, as Amazon didn't have access to client's spatial routine. To understand how people behave in physical stores, they bought the groceries chain Whole Foods, that have hundreds of stores across the United States. By tracking the costumer's shopping, company build giant databases and create profiles that understands *physically* shopping patterns. In this case, even thinking in the urban context, only big tech companies have such capability, while the State loses its role in practicing smart policies or initiatives.

In this sense, Barns (2020) based on Sadowski (2019) and Kitchin (2017), understands the urban space towards a platformed condition, which means a certain number of protocols typical of platforms structure and way of understanding society and space. Barns (2020) considers platform urbanism a relational process, focusing on co-constitutive natures of

[22] It is becoming common for these services to limit users' possibilities in the zero-cost version.

multiple urban space producers (institutions, actors, State). Söderström and Mermet (2020) define Platform Urbanism as "the ways in which digital platforms – and in particular enterprises like Facebook, Uber or Airbnb – reshape economies policies infrastructures and social lives of cities" (p. 2).

Despite the elementary fact that platform urbanism focuses on the particular role of these agents, while smart cities focus on more centralized (*i.e.,* urban dashboards, surveillance systems), the boundary between them is fuzzy (Söderström, Mermet, 2020). Leszczynski (2020) and Caprotti and Liu (2020) consider platform urbanism extension, reconfiguration or intensification of the ideal smart city, while Söderström and Mermet (2020) consider it "actually existing smart urbanism", as they argue that "smart cities promise remain mostly in the ether of utopian narrative and imagery" (p.3).

While in the last topic, we showed the origins and a few moments of "smart cities" trajectory, we see that its concrete present and future lay on its connections with platform urbanism, considering the inexorable, unrelenting and ceaseless advances this type of "urbanism" could perform during last decade. Therefore, the utopian reality of smart cities ended up materializing itself as this very contradictory and incongruous reality. The next topic regards on reflections on matters exposed throughout this chapter.

## 2.4 Approaching Smart cities through a geographical perspective: challenges and possibilities

The development of the smart city ideal is intricately connected with the production of urban space and it is related to multiple other processes concerning urban geography. In this sense, we analyzed the development of these initiatives under geography's framework. This approach helped to uncover inherent contradictions within the discourse surrounding the "future of cities".

We've shown through the literature *i*) a qualitative shift, with the advance of neoliberalism, city marketing, globalization, competitiveness, and the "global urban agenda" and *ii*) a quantitative transformation (building technological infrastructures in urban space to produce data). These processes were coordinated by companies linked with the technology market, being one of the most common strategies was to start partnerships with municipal councils around the world, both in the global north (as models) and south (as challenges). This scenario represents the embodiment of the ideal of a smart city, which is typified by the investment in strategic plans in municipal councils, tech companies (hardware and software)

leading marketing campaigns, technological thickening in urban space (mainly on transportation and surveillance), “smart civil infrastructures” (as buildings, for instance) and sustainability and energetic transition discourse.

Socio-spatial shifts, after this framework, took the “smart” ideal to new momentum. The main change is that the state, in multiple of its scales and institutions, in a way, becomes “stagnant” in some specific mediations, linked, in the center of capitalism, to transportation and surveillance. In the capitalist periphery, or the Global South, not even transport systems, in most cases, have been "equipped" with (geo)technologies capable of producing and storing data and feeding analyses. Some contexts have installed surveillance infrastructures, such as the case of Rio de Janeiro.

It has been observed that hegemonic agents of global capitalism tend to raise assumptions that technology is able to solve the urban problems accumulated over centuries of (re)production of space. More than that, they conspire that only a system of political and economic organization based on the alliance between State (in multiple scales with multiple functions) and capital, promote a great densification of technology fed by big data (most of the times created and powered involuntarily by the citizens themselves) can create a healthy and sustainable environment, in which cities compete globally for investments and that this is the only recipe for, generically, the increase of life quality.

Nevertheless, tech-mediated urban life was not particularly strong in this context. In a sense, multiple agents could empower technology to many uses (military, profits, logistics) but not from the perspective that the smart city ideal promised. From this context, arose a new type of smart city: the mediation of the city by service applications (transportation, food, accommodation, shopping). Despite a few differences, in many terms, the called “Platform Urbanism” can be understood as actually existing smart urbanism. The manners (geo)technologies that were applied to turn cities into “smart” became decentralized. The original concept of an organized, planned, and citizen-mediated urban environment, characterized by a harmonious alignment between its form and functions, has undergone a transformation into a fragmented, incongruous, decentralized, technocratic, and fetishized city. This transformation is driven by the utilization of extensive data and comprehensive analyses to facilitate urban services.

In this sense, even in an unpredicted way, cities are now smarter. It doesn’t mean they are fairer, safer, diverse. It is possible to predict routes, paths, duration and costs of individual transportation in a city, as the smart promise prophesied. Drivers have less guarantees, longer journeys and companies have fewer costs though.

# CHAPTER 3:

# GEOGRAPHY AND SMART CITIES: GIS, URBAN MODELS AND SOCIO-SPATIAL CONTRADICTIONS

*Spaces are always being - and can be again - reconfigured by neo geo-graphs and carto-graphs, new writing, new lines of inscriptions and new lines of demarcation.*

**John Pickles** - A History of Spaces, 2004 (p.41).

Framing Geography, geotechnologies, and urban development together and trying to understand how these elements interacted historically is not an easy task. However, connecting their trajectories can bring a few runways in favour of achieving the goals of this research. Starting from the current ideal of a smart city, we observe its connections with a neopositivist approach to urban development, which has its geographical roots in the GIS and geotechnologies epistemological debate.

If nowadays the "smart city" must be spatially enabled by geotechnologies, linked with surveillance and control over space, in the past, geographic knowledge, mainly represented by maps, underpinned many geopolitical (coordinated action over territory) inquiries (Lacoste, 2005; Graham, 2011). Although this historical relationship is deeply entangled and full of controversies, the focus here is to demonstrate that the power to produce space is related to the control over geographical knowledge, mostly represented by maps (Wood, 1992) and geotechnologies (Goodchild; Janelle, 2010; Goodchild, 2015). To explore this argument, it is necessary to understand the recent debate on the geotechnologies field, because, in some ways, the differences in the approach to geotechnologies are similar to the different concerns in the smartness debate.

To start this association, we refer to the process that happened during the 20$^{th}$ century, when modernism brought well-defined characteristics to urban planning, organizing cities in a technocratic-centralized-authoritarian model (Vainer, 2000), which had a systemic rationality, with the state responsible for comprehensive urban form planning, organizing, and producing the entire city, within the context of a Fordist capitalism that stimulated mass production and consumption. This city model was a product of the Enlightenment logic of progress through scientific knowledge and control, imposing an optimistic view of urban transformations promoted by capitalism (Lefebvre, 2002).

This conjuncture also displayed a highly Cartesian view of urban space, bound to abstractions associated with masculinism, control, science, and universalism. This subjective way of relating to urban space imposed specific articulations, producing urban space according to conceptions, interests, and representations of hegemonic groups, strengthening surveillance and control (Rose, 1995; Pickles, 2004), revealing a process of fetishism of urban space, as socio-spatial relations are concealed from planning, which now works from an absolute view of space and position, omitting the relative and relational nature of geographical space.

Maps (and with technological advancement, geotechnologies did as well) played a pivotal role in conferring legitimacy upon a multitude of abstractions conceived to meet the specific cultural demands that emerged within the Eurocentric capitalist context, such as boundaries, states, empires, and private property (Pickles, 2004). Within urban settings, maps and geotechnologies, assumed the mantle of authority for spatial regulation, wielding the ability to enforce constraints, zoning designations, and facilitating levies and transactions (Monmonier, 2018), thereby exhibiting a mathematically oriented perspective of urban space.

In the post-World War II era, the development of satellite-based positioning and imaging technologies was predominantly centered within the government agencies of the United States and the Soviet Union. Significant progress in satellite imaging production was realized through the LANDSAT project, commencing in 1972, along with satellite positioning systems like the Global Positioning System (GPS) in the United States and the Global Navigation System (GLONASS) in the Soviet Union (Lago *et al*., 2002; Brown; Harder 2016). During this period, particularly in North America, cartographic studies began to institutionalize themselves with greater autonomy.

Scientific production during this era was focused on transforming the map into a mirror of reality, aiming to enhance the precision and accuracy of models. The underlying premise was that a map could serve as a faithful and enlightened representation of reality (Monmonier, 2015). In a context marked by the increasing application of technology to mapping techniques and the digitization of Geographic Information Systems (GIS), hegemonic actors leverage geotechnologies to expand control over territory and progress towards what Lefebvre (1991; 1995) called a more extensive *appropriation* of space.

With geotechnologies and maps rising their power over society and helping to "measure" the cities, alongside with the technological disruptive innovations like internet, processors, debates began in academic spaces, mainly in Geography. But before we start presenting this debate, we show our understanding on GIS.

Within this research, we understand GIS as technology closely tied to demands (ideological and concrete) of certain groups, due to its capability of changing social relations in the market, producing new demands, and defining, framing, and mapping space and nature (Pickles, 1995). Keeping this argument in mind and giving attention to the specificities that GIS has in comparison with other technologies, we also understand GIS according to the definition organised by Ricker (2015), based on Goodchild (1997) and Longley *et al* (2015):

> GIS is a broad term that describes a suite of tools, often desktop software but also enterprise systems and processes, including hardware, software, spatial data, procedures, analysis, and outputs (maps) that work together to organise, inventory, display, query and analyse geographic and spatial information (p.48).

Although these different pathways are based on different methods and ideological perspectives, it seems to have one comprehensive agreement in this discussion: the fact that geotechnologies primarily provide the materiality needed in "smart" urban experiences. The way these infrastructures interact with agents and space can be seen from different standpoints, but their importance is undeniable.

In this research, we aim to explore the role geography played in smart city development in the last decades. We divided the paper into *i)* GIS and Space: a dialectical relationship. Then, we turn attention to one of the approaches to smart cities in topic *ii)* GIS and the smart city: big data, real-time, and the positivistic approach. Finally, we show our arguments and conclusions about the subject.

### 3.1 GIS and space: framing the debate

GIS, a term coined by Tomlinson in the 1960s to refer to Geographic Information Systems, has strongly influenced the epistemological or methodological debates in Geography, bringing up again some arguments from the early debate in the 1950s (Coppock, Rhind, 1991; Wright, 1997). Since its development in Canada, during the 1960s (Foresman, 1998; Harley, 2001), geographers and other scientists restlessly debated on ontological and epistemological aspects of geotechnology and its influences (Matias, 2004; Bolfe *et al,* 2008; Buzai, 2011; Elwood, Mitchell, 2013; Kitchin, 2014). Some went through a more positivistic pathway and argued that only GIS could "fix" geography and give it the necessary scientific base, contrasting with the developing "critical" perspective on geography (Openshaw, 1991; 1992; 1997).

Others were concerned with social implications and the changes in spatial power structures that GIS could bring, while they understood that it would have social implications (Pickles, 1995; Eubanks, 2017). But the fact is that throughout the last three decades, the

development of GIS was attached to a specific historical moment when technology got a high development rate and was strongly applied to space (Pickles, 1995), as part of the formation of the network society (Castells, 2008) - which has its geographical features well defined by Harvey (1989) and Lefebvre (1991). This scenario leaded to divisions on geographical knowledge production, as different approaches and understands emerged (Pickles, 1999).

Although GIS originated as an organized concept in the 1960s, the debate got stronger in the 1990s with the emergence of ideas as proposed by Taylor (1990), Openshaw (1991), Pickles (1991; 1994), and Goodchild (1994). Peter Taylor, a geographer at University of Newcastle, develops his arguments defending that GIS emergence was derived from a strategy that put together the critics on empiricist geography (Santos, 1978; Harvey, 1980) while reproduces the optimistic approach to progressive modernism, calling it "the very worst sort of positivism, a most naïve empiricism (Taylor, 1990, p.211-212). On the other hand, at this moment, the most part of GIS practitioners started defending a "almost evangelical" solution given by GIS to save geography from its marginal and weak position in universities (Pickles, 1999).

The most important example is Stan Openshaw, an academic at University of Leeds, where he ran the Centre for Computational Geography (Longley *et al*, 2022). Openshaw (1991) departs from a quite radical perspective to geography and its "fashions" (new waves of methodological and critical approaches that appear and disappear in Geography). However, the author points out that GIS would play a different role and could act as a glue to put the pieces of geography together, with the scientific base to underpin its knowledge. A famous paper written by Openshaw argues that GIS would work like a glue to put "Humpty Dumpty[23]" together again – a metaphor, indicating that GIS could be responsible for "uniting" Geography again. The reason for this understanding is the rigor, technique and multiple applications that GIS would have (Openshaw, 1991). Pickles (1999) argues that this approach reflects an objectivist and pragmatic approach that refuses broad theoretical implications and debates.

In response to these assumptions, John Pickles, geographer at University of North Carolina at Chapel Hill developed very critical arguments (1991; 1995; 2004) focused on the epistemological and practical implications of GIS in multiple aspects of society. According to Sheppard (2005), other authors argued that such a claim (as made by Openshaw) reinforces the "*status quo*" by giving legitimacy to an empiricist epistemology, giving space a geometric feature that makes it unable to represent other conceptions of relationship with nature, society,

[23] Humpty Dumpty is a famous children's character in the UK, similar to an egg with limbs. In the lullaby, the egg falls and no one can put it together again.

and rationality. Pickles (1991), Smith (1992), and Lake (1993), as shown by Sheppard (2005), argue that GIS facilitates practices that reinforce class, gender, and race socio-spatial inequalities.

According to Pickles (2004), GIS constitute the "heart" of the new cultural and economic arrangement, with implications present both in daily life in major cities and in warfare with weapons guided by coordinate systems. Therefore, continuing with Pickles' argument (2004), the more robust geotechnological apparatus of some capitalist actors, such as in the partnership between the State and Capital, is capable of deepening class conflicts, as well as reinforcing structural racism and patriarchy, as it equips these actors with techniques and social control organizations.

Pickles (1994; 2004) also argues that GIS, the in hands of hegemonic agents[24], could strongly impact the production of space. By being applied, for instance, local police could create a predictive model of surveillance, aiming to identify “potentially dangerous” neighbourhoods or citizens. However, this type of approach is significantly problematic as it can create racist, classist, and xenophobic patterns of acting. Graham and Marvin (2001) and Graham (2011) reinforce the impact that this technology can have in conflicts as a way to control territory or even relate GIS to the industrial-military complex.

In this debate, the term Geographic Information Science (GIScience) also became relevant – initiating a new debate on science, though. This conception comes from an approach that tried to avoid the shallow non-philosophical idea of GIS (positivistic) but also ran away from concerns shown by critical thinkers (Wright, 1997; Sheppard, 2005). Goodchild (1994) for instance, sees in the development of GIS epistemology a multiplicity of philosophical approaches, from positivism to postmodernism.

Despite this massive debate, the focus of the current session is to argue that the relationship between GIS and space is dialectical, as argues Sheppard (2004). The author shows that, on the one hand, society shapes GIS, as results from a specific socio-spatial context, counting on the participation of key individuals, techniques, and social barriers. Further, Sheppard (2004) argues that the local adaptations made by users due to technological or social differences also contribute to shaping GIS. On the second hand, Matias (2001) argues that GIS finds possibilities to influence socio-spatial dynamics whether reinforcing hegemonic agents or enabling a transformative praxis, depending on the agent that appropriates its capabilities.

[24] At the time, in the 1990s, the main conflicts would come from the state in its multiple scales of acting (local governments or military actions overseas). However, currently, private companies have taken control of GIS technologies and apply them to produce space according to their interests.

Based on these statements, we aim to further explore the way geography (strongly sustained by GIS) has participated in the building of a specific model of Smart City and list some of the biggest consequences to urban space in the last decades.

### 3.2 GIS and the smart city: big data, real-time, and the positivist approach

This section focus is to explore the ideas and perspectives of more positivistic authors on Smart Cities - and this fact is also a consequence of their positivist approach to GIS. This connection comes from the role played by geotechnologies during urban planning and urban space transformations in the last decades. Geotechnology and its applications to the urban space have grown in many aspects since the beginning of this debate – accompanied by new ways of leveraging these resources for the acquisition and retention of substantial data infrastructures capable of shifting important markets (Sadowski, 2020). Subsequent to this processes, significant efforts were also focused on understanding how geotechnologies could impact cities and make them "smarter". Theoretical, practical, and digital models were created and many consequences can be measured. Of course, much scientific literature was produced about the means of application and the possible consequences to urban space, as this topic will present

In the 1990s, theoretical, technical, and technological development of GIS and urban planning was well developed, due to the significant scientific effort at the time to create literature on the subject. Birkin *et al* (1996) state that the literature about the specific intersection of GIS and basic local authorities' responsibilities was very comprehensive.

In this scenario, the late 1990's shared the perception that computers and software (GIS software) were not only a way of better understanding the world and the urban space but producing[25] it, in general, starts to appear more clearly in the literature. Two of the main researchers that pointed out this argument were Michael Batty and Paul Longley, with important scientific work published: Batty and Longley (1994) and Batty (1997). At the time, they didn't refer to "smart" ideas yet, although, in the United States, Smart Growth, which afterward influenced the conception of the "smart city" term, dates from the 1980s.

During the decade of 2000, on the first hand, technology kept quickly developing and started being applied to cities, underpinning the ideal of smart cities from a material

[25] The word "produce", in this context, makes reference to our own understanding of how space differentiates, within critical geography perspectives. The authors we refer to at the moment, do not share this understanding. In this case, "producing" refers to the current paper's perspectives. Batty (1997) and Batty and Longley (1994) state that GIS is capable of interfering with or changing space.

perspective. By material perspective, we refer to the approach made by Straube (2016, 2018) that moves towards the technical details and infrastructures to affect the supposed chances in urban space, linking them to the hard materiality of bitwise operations, optical cables, and other "computational processes, languages, protocols, formats, and standards involved" (Straube, 2016).

The most complex and complete proposal for a smart city model from a geographical perspective, counting on GIS as a key tool, is stated by Batty *et al* (2012). The author (alongside a research network in several universities in different countries) tries to compose multiple layers, as they understand the city as an entanglement of systems. Through this composition, Batty *et al* (2012) aim to point out that smart cities can be a new way of understanding and tackling urban problems, almost like a roadmap for the future of urban development, boosting planning and public policies.

Batty *et al* (2012) underpin their model with a few important understandings:

- The citizens: the authors argue that citizens can play an active role in basic operations and designing policies. The suggestion is citizens get access to information, always using ICTs to participate. The proposal employed the idea of citizen science to build the "ideal type" of mentality for smart city dwellers.
- Urban technologies: the structure responsible for understanding, planning, and changing the other relations and behaviours in smart cities. The model implies that citizens have undisclosed behaviours that only can be understood through big data and big analyses. To enable such things, it is necessary first to build material infrastructure (sensors, GPS, imagery). Furthermore, citizens need to use smartphones to produce data and feed the systems.
- Governance and administration: while the business sector can provide hardware and software experience, the public sector can engage the community, focusing on the quality of life.
- Laboratory to innovation: As ICTs are receiving increasing investments that can turn into services, the smart city should evolve these functions enabling monitoring and design. Further, they argue that digital models of the city should be simulations of possible futures.

Michael Batty, in a different paper (Batty, 2013), while presenting the theoretical basis for his perspective of smart cities, points out some significant definitions. According to Batty (2013): "Smart cities can also be synonymous with intelligent cities, virtual cities, amongst

many other nomenclatures, but here our usage pertains rather narrowly to data and theory that brings more immediacy to our urban understanding" (p.277). Further, the author states that *"*Smart cities belie a shift in this emphasis to a deeper understanding of how urban systems function in the short term*"* (p.277). Based on these affirmatives, we observe that the focus of the urban understanding to the author is underpinned by the theoretical assumption that sees the urban space as a "complex system", in which people interact with each other and with infrastructure services in a way that can be even predictable with big data.

In fact, data (and its most recent dressing up, big data) is closely related to the intelligent city model and perspective. To comprehensively address the subject, it is imperative to delve into technical, ethical, political, and economic aspects associated with it, whereas each would have its own criteria for data (Kitchin, 2014). From the technical perspective, during the production of data, generalizations, approximations, and abstractions can be made, causing uncertainty, which generates doubt about their use in representations (Goodchild, 2009; Kitchin, 2014). The precision and accuracy of data hold paramount importance in this context.

To enable many real-time systems to work the distinction between small data and big data became necessary. Shortly defining, small data usually is composed of samples, with coarse resolution and hardly relational. Big data (a term first referred to by John Mashey, while Chief Scientist at Silicon Graphics in the middle of the 1990s (Diebold,2012)) refers to a massive volume of data that can rapidly connect, exhaustive in scope, fine-grained in resolution, relational in nature, flexible and diverse in variety and often temporally and spatially referenced that only became a common and major concept in the 2010s (Dodge, Kitchin, 2005; Zikopoulos *et al*, 2012; Mayer-Schonberger, Cuckier, 2013; Kitchin, 2014). Frame 10 shows the enablers of big data, according to Kitchin (2014).

**Frame 10 -** Enablers of Big Data

| Enabler | Importance/role |
|---|---|
| Computation | Enabling people and organisations to process wide-scale data. |
| Networking | Linking computational devices to enable communication and data production and flow. |
| Pervasive and ubiquitous computing | Enables devices to use an ability to make autonomous and automatic decisions from a suite of defined choices (which can be called smartness in some cases). |
| Indexical and machine-readable identification | Digitally enabling identification of identity and spatially (coordinates or postcodes). Further, devices with GPS receivers can share or record position/location. |
| Data storage | Shifting the capability of storing with hard disks, and mobile storage. |

Source: Organized by the author based on Kitchin (2014).

More enthusiastic authors about smart cities and technology argue that big data can massively contribute to urban development. Data on cities "have been generated in audits, interviews, questionnaires, cartographic surveys, observations, photography, and remote sensing" (Kitchin, 2016, Kitchin, Mcardle, 2016). This relationship is historically worldwide and applied during different historical moments, but this described period has unfolded a new concept: data-driven urbanism (Kitchin, 2016). According to Kitchin *et al* (2015), cities can be understood and controlled in new ways that answer to data systems.

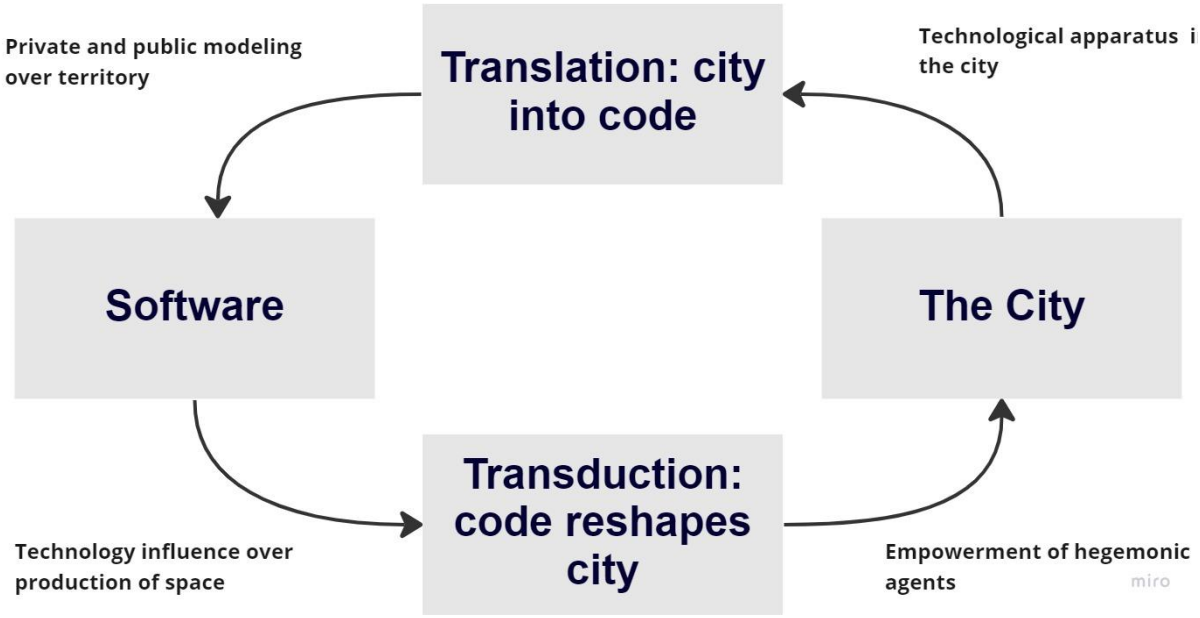
The most significant shift was in the data collection systems: before the 2000s cities have been applying spatial data in multiple sectors of public administration and even private enterprises, but the temporal resolution didn't allow them to control and drive private and public policies. In fact, the material shift that enabled this new reality was the technological incorporation of traditional urban infrastructure: transportation (buses, roads, vehicles) and energy, water, and light supply. Now, all these systems, in cases of data-driven or smart projects, are equipped with sensors, actuators, scanners, transponders, cameras, metres, and GPS receivers (Kitchin, 2016).

The data produced by these systems and devices are continuous and controlled by urban dashboards. Batty (1997) mentions and explains how software can produce the city by

enabling the creation of a real-time database or dashboard (counting on georeferenced data) and shows examples related to traffic and census. A milestone regarding this subject is the adoption of an "urban dashboard" in Baltimore (Maryland, USA) in 1999, called CitiStat and the project inspired others, like DCStat (2005) and NYCStat (2008) (Tauberer, 2014). Dashboards represent the embodiment of the multi-systems understanding of the urban space, as it combines, *i.e.*, satellite images of weather and traffic maps, housing information alongside cycleways (Mattern, 2015).

Although software can play a key role in urban planning or development, this process requires some translations from the materiality to code and then from codes to any mediation or regulation made by it (Kitchin, 2011). The way this approach deals with urban features and processes forwards the understanding of this logic through a model, according to Kitchin (2011), that turns the city into data and then, after procedures in software, the data reshapes the city, as shown in Figure 20.

**Figure 20 -** Translations in Software and Cities relationship




Source: author adapted from Kitchin (2011).

Regarding public participation in smart projects, Goodchild (2007) argues that citizens can act like sensors by using systems such as VGIs or crowdsourcing. To precisely define the terms, according to Goodchild (2007, p. 212), prosumers:

> Are largely untrained and their actions are almost always voluntary, and the results may or may not be accurate. But collectively, they represent a dramatic innovation that will certainly have profound impacts on geographic information systems (GIS) and more

> generally on the discipline of geography and its relationship to the general public. I term this volunteered geographic information (VGI).

Goodchild (2007) cites a few initiatives in which citizens act like sensors, producing data and even analyses, contributing to different sectors: *i.e.,* ornithology or atmospheric observation applied to teaching. This activity is mainly based on georeferenced information, GPS, Remote Sensing, and mapping software. Batty (2015) warns that as databases get more complex, new methods of data mining are needed to identify deep patterns and structures, which forwards the models (like those developed in OpenStreetMap) to a need for adaptation. Even with these known limitations, Batty (2012) argues that citizens can create smart communities and play more active roles in smart cities due to access to communication. Although the authors don't formally propose an agenda for citizens to participate in the smart city, they give some ideas of how they picture the scenario: information, self-organization, and innovation.

The author then presents a series of software and initiatives that aim to unite and represent geographic information: Flicker, Open Street Map, and Wikimapia. Despite the potential of these platforms (Feldmeyer *et al,* 2020; Page, 2020), some authors also point out limitations: mainly gaps between the maps and the need in streets (Carvalho, José, 2022).

### 3.3 The spatially enabled smart city: challenges and limitations

Roche (2014) argues that "a smart city is first and foremost, a spatially enabled city" (p. 704). By "spatially-enabled" the author means a scenario where spatial concepts (location, place, or coordinates) are available to different social groups (or, as we prefer to refer, urban space production agents) to organise or produce their activities (Williamson *et al,* 2010). Nevertheless, the author states that the geographic and geospatial references, knowledge, and procedures have less importance whether in the public or private sector actions than they could, being the researchers the main group that often correlate geotechnologies and "smartness".

It would be impossible and beyond this chapter's objective to extensively describe and articulate all these elements. Nevertheless, we will list and provide short explanations of the main applications of geotechnologies with smart cities. Roche (2014) points out four fundamental dimensions of uses of Geotechnologies. Frame 11 lists these dimensions and exposes our standpoint on them. After Frame 11 we show some reflective arguments on core dimensions shown by Roche (2014).

**Frame 11 -** Dimensions of GIS in Smart Cities according to Roche (2014)

| Dimensions | Other important references | How they impact | Critics |
|---|---|---|---|
| Crowdsourcing and Volunteered Geographic Information (VGI) | Ratti and Haw, 2012; Vaccari et al., 2010 | Citizen Science; Improve application interfaces; improve spatial thinking | Although Citizen Science and spatial thinking can be important and bring benefits, the way the authors set it is either scale limited or detached from materiality. |
| Digital City | Goodchild *et al* (2012) and Roche, Rajabifard (2012) | Urban informational infrastructure, Serial Digital Interface (SDI) and Big Data | Place of dispute among producers of space due to potential to shape multiple features of reality. |
| Open city and open democracy | Batty *et al* (2012) and Tao (2012) | Cooperation, participation and transparency (technological mechanisms and infrastructures for data and analyses). | Although important concepts, there is lack of political and ideological explanations over the concepts (i.e., Democracy). |
| Geodesign | (NCGIA, 2008) Flaxman, (2010), Goodchild (2010) Steinitz (2012); | "provides innovative, creative, deliberative, uncertain, multi actor, multi-scale and multi-thematic methods and tools to design smart cities" (Goodchild, 2010). | Geodesign is a complex methodology that would need several pages to be discussed. However, we are sceptical about how much related to the smart debate it is, as the foreseen interventions are not particular to smart city debate, as it is also common to multiple urban interventions during the last century. |

Source: Author based on Roche (2014).

In this scenario, public participation is closely related to a specific link between personal access to technological devices and personal motivation and interest in contributing to databases. Working on databases requires a series of technical procedures and demands time and multiple resources to be applied on an urban scale. Furthermore, the availability of time and material conditions represent serious obstacles to crowdsourcing or VGI being consistently used in peripheral contexts. This element shows that mainstream propositions represent limited spatial, urban, and cultural perspectives.

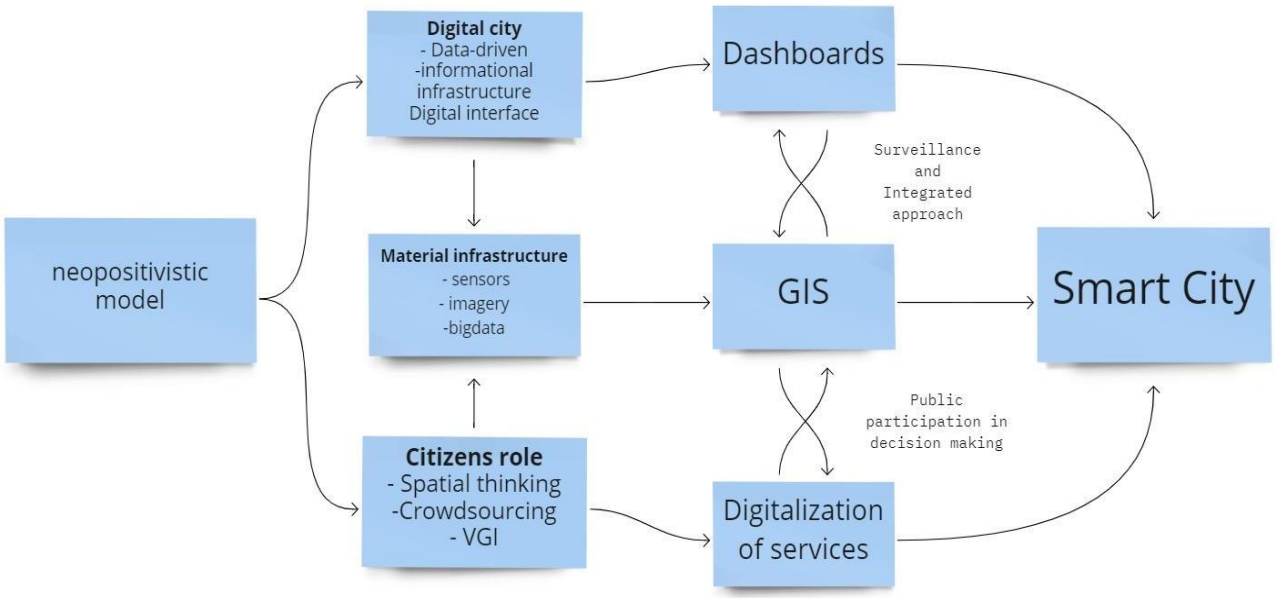
In reference to "digital cities", we argue that this is a scenario of the biggest struggle among producers of urban space, due to the dialectical relationship between GIS and space. Nevertheless, most of the analysed literature only shows a shallow understanding of public

services and again always linked with personal access to technological devices. In this case, GIS has been used to better control urban space and to give more economic and financial precision to empower private action in urban space, either by the direct action of companies or by regulations ma de by the state.

Based on the discussion presented within the paper, we elaborated a flowchart to explain this model of smart city (Figure 21). We argue that the current concept of smart cities was influenced by the work of geographers, most of them from the central context of capitalist globalisation. The model is based on three main pillars: *i)* the material infrastructure to underpin other structures; *ii*) the digitalization of services through data-driven urbanism, enabling qualitative and quantitative shifts in planning and *iii)* a specific role to be played by citizens, participating through a depoliticized and detached from materiality approach.

Figure 21 summarizes the understanding developed during the current research on how the most positivistic approaches think the operation of smart cities. The material infrastructure works like a connection between the digitalization that citizens can access and on the other hand, enable their participation. The tendency is that a "digital city" project delivers a type of urban dashboards, either for promoting safety or to citizens to access services etc. This is only possible when the city has a sturdy GIS, getting feed by big data. According to this approach (which whom we don't agree), the material infrastructure guaranties more democratic urban living, as enable citizens to participate on decision-making.

**Figure 21** - Flowchart of neopositivist approach to smart cities




Source: organized by the author.

This interaction between material infrastructure, planning, and citizen participation forwards the smart city model to some risks: on one hand, GIS can interact with public or private infrastructures to empower features that give hegemonic agents more control over the production of space. It can happen through creating a sturdy model of surveillance that punish marginalised populations, and strengthens a consumer and vendor relationship to citizenship.

Analysing epistemological debates on GIS and how the arguments were applied to urban models during the last decades brought us a few outcomes. First, we argue that the most significant approach to smart cities in the geographical scientific literature is based on technology as a key to solving multiple urban problems. Further, we understand that the debate on GIS during the 1990s has influenced an approach to smart cities, as both share the understanding that data can clarify undisclosed patterns and work as a binding element, either giving geography a scientific background or giving planning and the future of cities a brand new and virtuous perspective - neglecting a dialectical production of urban space.

Additionally, we argue that the proposal for a smart city discussed within the paper has limited contributions to enhance life in cities. Aside from the fact that few contexts have material conditions to apply what the authors argue to be a general solution to cities, the proposed solutions lead the production of space towards acceleration of fluxes as ways to improve “quality of life”. This model has different implications in different geographical contexts, but generally, it contributes to extending working journeys, amplifying work exploitation, and reinforcing material inequalities in urban space, as it gives hegemonic agents a better understanding and control over space. Beyond this spatial limitation, the analysed approach to smart cities has contradictions in another fundamental dimension: time. Most of the propositions were written during the last decade, mainly between 2010 - 2016, a period in which more optimistic visions of technology become popular. However, on the other hand, we question whether this approach is capable of radically changing urban reality. Up to the present, this approach could not convince that it can be applied in different contexts and contribute to revealing mechanisms that reproduce socio-spatial inequalities, to reduce gender violence or police violence. Likewise, the approach seems to hardly dialog with different relationships with space, nature, and society - only connecting with a hegemonic model of reproduction of space.

# CHAPTER 4:

# FROM NORTH TO NORTH: PLANNING AND OPERATING THE SMART CITY IN CAMPINAS

*Any theory of uneven geographical development must be simple enough to aid comprehension and complex enough to embrace the nuances and particularities that call for interpretation.*

**David Harvey** (2004, p.58).

Throughout Chapters I, II, and III we discussed our methodological and theoretical approaches, investigated the origins of the ideal of smart cities, how it developed and lead the world-system to the current moment, having technology as an idealist solution to urban conflicts. We also noted that the State and Capital were the two main agents promoting these practices, but during the process, big digital platforms were more efficient to put in practice the spacialities of smart cities, although sometimes they don't fully claim this archetype.

Now we start to explain how Campinas connects with this debate: one first important matter to investigate is the idea of scale and geographical development. As we saw, the ideal of smart cities comes from central contexts in globalization, being thought and practiced on these cases. In our perspective, in Campinas, it is possible to find many layers of centre and periphery, one overlapping the other. Then we present the constraints that brought Campinas to the current momentum and show areas that concentrate structures part of the ideal of smart cities – despite the fact that these structures are part of a decentralized and plural conception of the relationship between technology, governance, society and urban space.

This chapter focus on demonstrating specific socio-spatial relations in Campinas concerning technological development and the way these elements historically developed in the city in how it impacts different social groups. We understand that despite a few restricted connections to typical central capitalist practices (California, London, Frankfurt), Campinas presents and favours highlighted socio-spatial inequalities, due to severe contradictions, as typical capitalist periphery. More than that, technical and technological contents, working through hegemonic capitalist ways will coexist will other forms of producing value and the supposed positive effects can stay more constrained.

By highlighting on the first hand that we expected Campinas to present differences from cases like mentioned on the last paragraph, we refer to a centre-periphery structure on globalized capitalism based on a hierarchy between different "regions". Multiple authors

proposed arguments and approaches to such process, like Prebisch (1949), Singer (1950) in CEPAL the early economic context. Later, Fajnzyber (1990) showed other arguments to reinforce a Centre-Periphery approach to development[26]. One of the focus on this approach is to break the "Stages of Economic Growth", proposed by Rostow (1959) or Samuelson's (1949), based on relative comparative trade advantages (liberal-idealist approaches), arguing that in long term, the peripheric countries, specialized in low value commodities, will face deterioration of trade terms.

Further, Amin (1978) proposes that centre and periphery of capitalism have different specialization capabilities and the periphery is characterized by a heterogeneous materialization of capitalist mode of production, mainly in countries with colonization and slave labour as violence and exploitation marks. In these cases, other non-capitalist or pre-capitalist modes of production can coexist and become subordinated to the dominant capitalism, departing from contradiction of capitalism itself (Mesquita, Fernandes, 2021). Wallernstein[27] (1980, 2011a; 2011b; 2011c) also develops a great series of explanations on the formation of what the author calls "the Modern World-System Theory", in which he analyses, among many other processes, the formation and integration of a "global economy", having Europe as centre of this development and the biggest benefited from it taking advantage from its relationships with Semi-peripheric and Peripheric countries (Latin America and Caribe, Africa, Asian South-East etc.).

Quijano[28] (2005) also represents an important voice on this debate, focusing on going further in understanding colonial process, giving attention to how the production of knowledge is related to power and control, which had core role in the formation of this "Modern World-System". The artificial production of a racialized "world" was one of the main bases to enable the "economy" to work globally. In this case, the author proposes the concept of "Modern-Colonial World-System", to reinforce this characteristic of exploitation from a white centre controlling labour force by race and gender patterns globally.

[26] This debate goes further and further, full of complex economic discussions and publications. So much that would be beyond our scope and capability to fully develop in this topic. Many references can be checked to better understand this: Taylor (2008); Rist (2019); Nassif (2021) and Svampa (2018).

[27] He published a series of books called "The Modern World-System", going from I to IV, where the author develops analyses from the formation of conditions in Europe to produce the "globalized" world and goes through mercantilism, colonization and "stops" in the formation of "liberal states".

[28] Once more, it is important to reinforce that the "decolonial studies", approach in which Quijano takes part is an immense academic and social debate, composed by many important authors, as Walter Mignolo, Laura Candau, Maristella Svampa, Porto-Gonçalves etc. In Brazilian Geography, studies on this subject have been increasing but are still not dominant, even in "Critical Geography".

Finally, to be able to understand Campinas through this sturdy methodological approach, we turn to Neil Smith (1990) and Harvey (2004) writings on uneven geographical development. According to Harvey (2004) "uneven geographical developments reflect the different ways in which different social groups have materially embedded their modes of sociality into web of life, understood as an evolving socio-ecological system" (p.60). One of the core ideas behind the ideal of smart cities is what Harvey (2004) calls "speed-up and the annihilation of space through time", as ICTs are results of pressures for reduction of frictions of distance by innovation. Departing from Moraes's (2011) approach to territorial formation, we aim to argue on the main factors that contributed to the current stage of, on the one hand, high-quality labour offer linked with technological development and on the second hand, small wages and lack of basic infrastructures in Campinas.

By understanding reality through a dialectic method (Sposito, 2003) and, further, by a historical and materialist dialectal approach (Marx, 1974; McLellan, 1983), we claim that the current perspective on smart cities in Campinas comes from earlier structures that took on new forms. Baldoni (2019) recently studied the case and argues towards the existence of a local system of innovation in Campinas, mostly focused in Barão Geraldo district and builds multiple arguments to underpin such affirmative. Nascimento (2013) while studying Campinas' Metropolitan Region[29] through a social inclusion/exclusion perspective shows that the district of Barão Geraldo, during the period of 1990 to 2010 had an outstanding improvement of its social indicators, while the general trend in the region was the increasing the population with lowest wages, particularly in south Campinas.

We understand that this difference is, in some aspects, linked to the way the ideal of smart cities (together with other matters) shapes the production of space and to previous contexts that shaped development in Campinas. But to get closer to explain this particular territorial formation, that forwards the urban space to the current features, we need to better explain a few urban aspects of Campinas, departing from the formation of its industrial strength, passing through the transformation during the 1970's that linked Campinas with technology development and that resulted on, among other processes, the ideal of smart city in Campinas.

[29] Nascimento (2013) analysis works on a different scale than ours, as it focuses on a regional approach. However, the cartographic material produced in the research makes it possible to observe the specific case of Barão Geraldo or any other district/neighbourhood.

### 4.1. Making a city smarter? PECTI, PECCI and the state as urban space producer in Campinas

Before actually analysing how the late urban planning in Campinas is connected to the ideal of smart cities and how these processes are shaping the production of space, we first quickly analyse the territorial formation process in Campinas, from where the current context departs. As this is an extensive subject, we couldn't give it the necessary amount of explanation to build a sturdy understanding in this final text. However, the literature on this subject in also extensive and can be consulted.[30]

The early stages of Campinas' urban development dates from the late 19th century, and are marked by the most uneven, brutal and violent context possible: capital accumulation based on enslaved people on coffee plantations[31], processes that was responsible for creating a "*paulista*"[32] urban complex (Cano, 2007, Lencioni, 2008). In this moment, the capital accumulated by coffee producers was invested in the industry of non-durable consumer goods as shows Andreotti (2015), forming an initial industrial-urban context.

During the 20th century, the decades of 1930 to 1960 had focus on the rationalist, enlightened and modernist approach to planning (Villaça, 2010), known in Campinas as Prestes Maia Plan, as shows Rodrigues (2012), moment when a series of urban reforms were made, aiming to adapt the city to more advanced capitalist forms (wide avenues, productive specialization, intense spatial division of labour) – during this process, the working population were removed from its historical sites to the periphery with lack of basic infrastructures.

This model of non-durable goods industry was stable until the decades of 1960-1970, when new processes impacted the economic activities in the state of São Paulo (Silva, 2020). The decade of 1960's marks the beginning of a series of infrastructures coming to Campinas, as Baldoni (2019) shows: ITAL (1963), CATI (1967) and Unicamp (1965-66). In the following decades, this type of investment continues to be held in Campinas and it becomes significative part of the city's economic profile. In the 1970's, as competently shown by Selingardi-Sampaio (2009), São Paulo and its Metropolitan Region suffered a deconcentrating process, in which Campinas was one of the most benefited cities – being the focus of industrial activity increase. It is important to reinforce that this moment was part of a greater context of "flexible" economy (and Fordist crises), in a global scenario where communication and

[30] The following references can be consulted if necessary: Cano and Brandão (2002); Badaró (1996); Nascimento (2013).

[31] About this process, multiple authors produced strong and critical arguments and explanations: Reis (2012), Reis and Silva (2016), Nogueira *et al* (2022).

[32] This word is the gentile to something from the state of São Paulo.

information technology allowed companies to have the economical decision centre far from its factors (Harvey, 2015).

Despite the fact that Campinas had a big economic increase linked with this industrial development, at least in this moment, the city didn't attract the decision-making centres: the majority of offices and headquarters stayed in São Paulo or RMSP (Selingardi-Sampaio, 2009). An important deployment of this context was the responsibility division between different government spheres: the state government focused on coordinating actions to materialize infrastructures to produce in the countryside (Silva, 2020), while the local sphere focused on developing its own strategy to manage the intended approach to development. Together with this transportation and accessibility infrastructure (roads, airports), Campinas starts receiving research and development institutes, centres and headquarters.

According to Silva (2010) and Gomes (1995), it was during this period that Campinas was, for the first time, compared to the Silicon Valley experience, by the Unicamp's professor and CODETEC's president physicist Cerqueira Leite – his influence surrounded Campinas' policy during the next decade (1980s) and the context of multiple investments in R&D institutions. On the other hand, according to Silva (2010) and Badaró (1996), this period showed high increase of precarious housing[33] on the city.

As shows Baldoni (2019), during the 1980's the Federal Government in Brazil brings to Campinas ITC Renato Archer (1982) and in 1987, the construction of the LNLS began, achieving a new standard of technology intensity at the region, as LNLS leads physics, biology and multiple scientific fields technology at Latin American Level – During the following decades, investments continued and increased, transforming LNLS in a bigger complex, CNPEM, which puts together multiple other laboratories and centres, being the most important one SIRIUS, a fourth generation particle accelerator, as shows Figure 22.

[33] *Favelas,* in Portuguese.

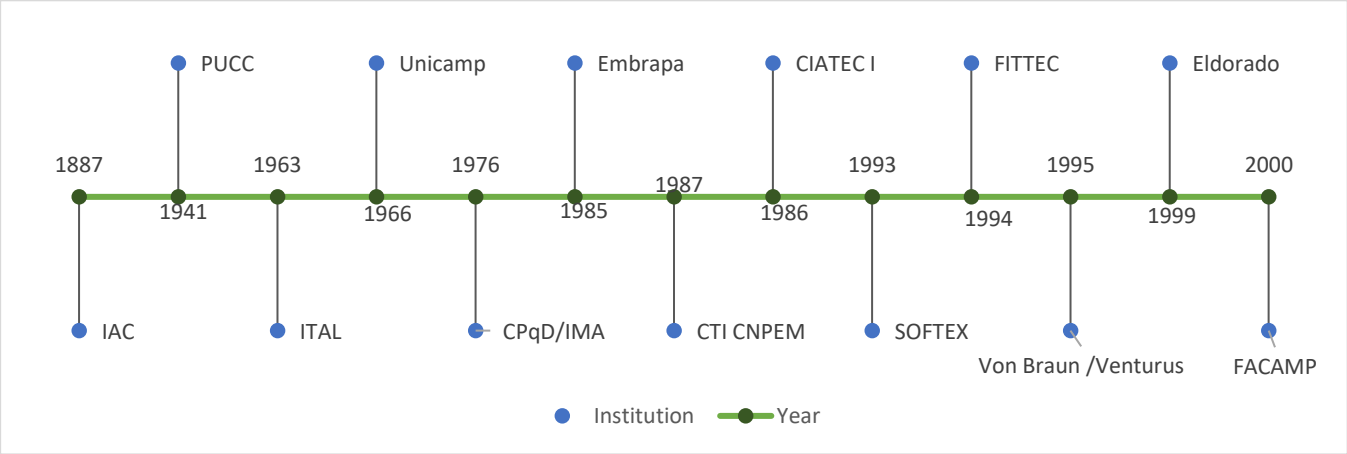
**Figure 22** - CNPEM totem showing laboratories


Source: Author's collection. Obtained in Field (2023).

In 1986, show Baldoni (2015) and Silva (2010), an area of 682,000 m² were allocated for the construction of technology-based companies and this area received the name

of CIATEC. In the next decade, the 1990's Campinas received more investments linked with science, technology and innovation: SOFTEX (software) (1993), FITec (innovation centre) (1994) and Venturus (also innovation centre) (1995), Von Braun Centre for Advanced Research (1995) and Eldorado Institute (software and hardware development) (1999). Figure 23 shows a timeline of this process.

**Figure 23 -** Timeline of institutions




Source: Organized by the author based on multiple references.

Explaining this context helps to understand the origin of Campinas constraints that converged to the adoption of strategic planning focused on smart cities. Before starting further debating it, it is important to clarify that in Brazil, there is a regulatory reference for a city to become a "smart city". NBR ISO 37120 37122 e 37123[34] (sustainability in smart urban communities), which defines a series of criteria and quantitative indexes to attest smartness in cities. Our impression is that Campinas have been trying to fit the requirements stated by ISOs, although few public information regarding this case is available. However, our analyses focus on broad meaning of "smart cities" and doesn't follow NBR ISO as its single criteria.

Beyond these more "formal" standards and rules, private companies also produce their own rankings to evaluate "smart city cases". Connected Smart Cities (2021), for instance, gained repercussion in Brazil recently ad presents Campinas as the 5th "smarter" city, for instance. In previous years, Campinas even won the first place. Multiple critical appointments were developed to smart cities' rankings: Cunha (2019) shows that a lack of transparency regarding the criteria, samples, and sources can jeopardize the trustworthiness of such rankings. We add as our worries the completely corporative interests contained in these rankings, working

[34] In this case, the only city in Brazil meeting the standards is São José dos Campos – SP (SJC, 2022).

as propaganda to cities to attract investments. Frame 12 shows the top 10 smarter cities in Brazil, according to Connected Smart Cities (2021).

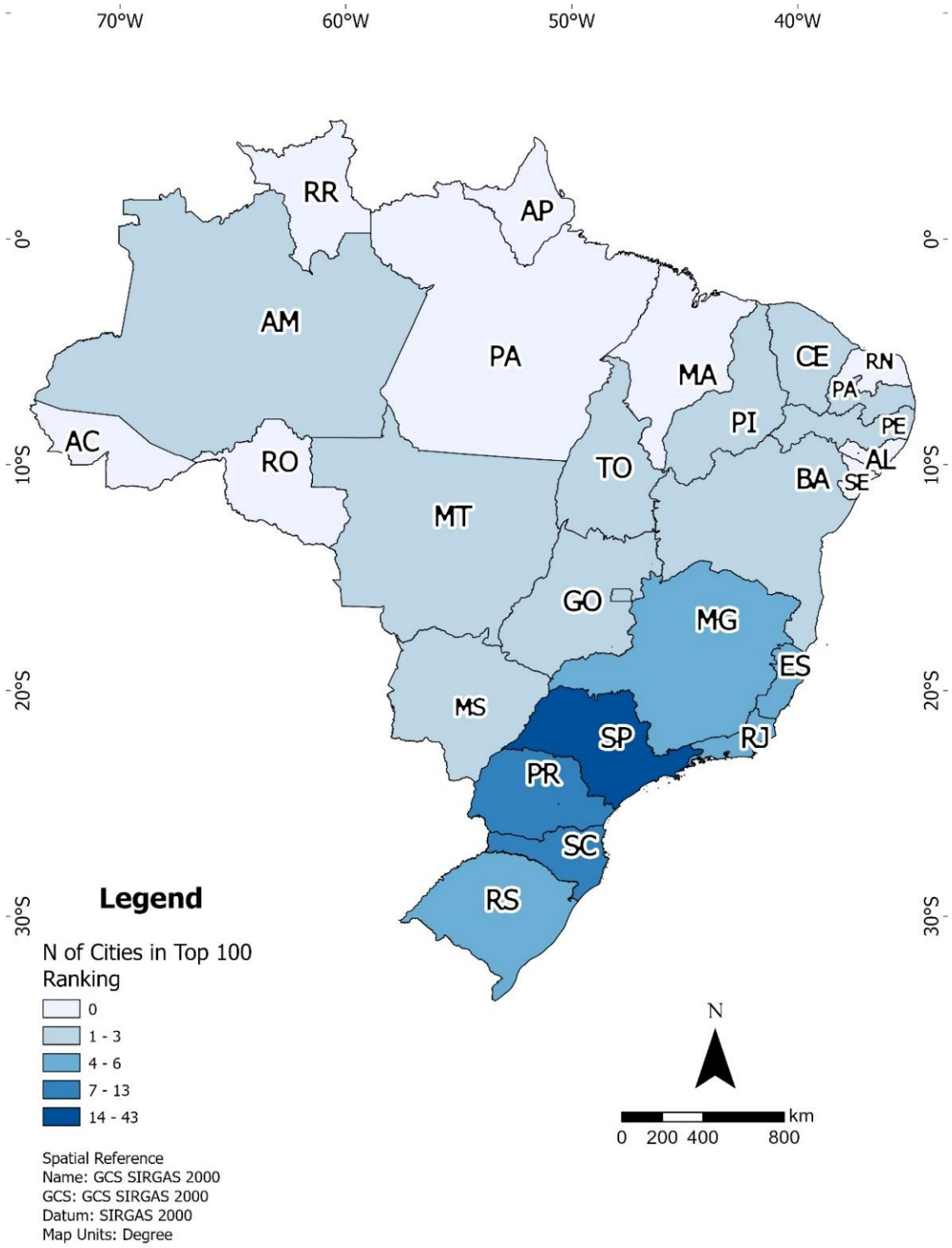
**Frame 12 -** Top 10 Smarter Cities in Brazil according to Connected Smart Cities in 2021

| Position | City | State |
|---|---|---|
| 1st | Curitiba | Paraná |
| 2nd | Florianopolis | Santa Catarina |
| 3rd | São Paulo | São Paulo |
| 4th | São Caetano do Sul | São Paulo |
| 5th | Campinas | São Paulo |
| 6th | Brasília | Distrito Federal |
| 7th | Vitória | Espírito Santo |
| 8th | Niterói | Rio de Janeiro |
| 9th | Salvador | Bahia |
| 10th | Rio de Janeiro | Rio de Janeiro |

Source: Connected Smart Cities, 2021.

As analyzed by Santos (2021), in Brazilian territory, the "smartness" in cities according to Connected Smart Cities (2021) follows the structural reproduction of inequalities, as the majority of the top 100 cities in the ranking in located in Southeast or South Brazil, the region that concentrates high-value economic activities throughout Brazilian socio-spatial formation. Figure 24 shows in which state are located cities on the ranking (Santos, Silveira, 2013).

**Figure 24 -** Number of cities among top 100 ranking (Connected Smart Cities) (2021)




Source: Connected Smart Cities (2021) and IBGE (2023).

As Figure 24 makes clear, in Brazil, the corporative perception of "smartness" on cities is linked with traditional development patterns, concentrated on South East (mainly in the state of São Paulo) and South. More vulnerable and less structured states like Maranhão or Pará

don't present *any* city between the 100 smartest. Another important aspect linked to the development of smart cities in current Brazilian reality is what both Santos (2021) and Pasti and Cracco (2022) call attention for, analysing the survey made by Distrito (another consulting company): the high number of start-ups linked with a supposed "ecosystem" of smart cities, as shown Figure 25.

**Figure 25** - Start-ups connected to the ideal of smart cities in Brazil according to Distrito (2022)


Source: Adapted from Smart Cities Distrito Report (2020).

Despite the fact that Campinas have been for decades involved in the process of trying to become a city connected to technology development, it is necessary to find a milestone to connect this wide context into "smart policies", reproducing the ideal of smart cities. In this case, we point to the creation, in 2013, of the Municipal Council to Science, Technology and Innovation by Municipal Act number 14.739/2013 (Campinas, 2013), that preceded the release of two core documents: Strategic Plan for Science, Technology, and Innovation (2015) and Strategic Plan for Campinas Smart City (2019). When observing the cover page of both strategic plans, it is possible to note elements proposed by Cugurullo (2019; 2021) underpinning approach, linking "smartness" with strategy, rationalist, technocratic and utopic perspectives. It is also possible to find multiple similarities with the presented case of Cardiff Smart City

Roadmap (Figure 8). Figure 26[35] shows both plan's cover page which brings a brain, representing rationalist planning, made of electric devices and a lamp made of electronic connections.

**Figure 26 -** PECTI (2015) and PECCI (2019) cover pages


Source: PECTI (2015) and PECCI (2019).

Following a chronologic order, we first bring our reading on PECTI (2015), then PECCI (2019). PECTI (2015) has as its main objective "to build the Municipal Science, Technology, and Innovation Policy between 2015 and 2025, defining the achievement of goals by the municipal government and civil society" (p.7). The main responsible for achieving the stablished goals are Municipal Office of Economic, Social, and Tourism Development (this Office actually changed its name, as we tell next), identified in the plan as a "facilitator" to connect the local power to "the entrepreneurs", working as "the front door for them (entrepreneurs) connect with the Municipal Authority and with municipality of Campinas" (p.13).

The strategic plan mentions a few Municipal Council for Science, Technology and Innovation meetings, counting on the participation of 15 people, representing the local government and "science, technology and innovation institutions" that elected 52 participants to take part in the methodological steps that followed. It is not clear if these meetings were public, but the documents suggests that civil representants were not invited and did not take

[35] The figure shows the original cover pages of the two plans. Translating to English the titles: Strategic Plan to Science, Technoly and Innovation (2015-2025) and Strategic Plan Campinas Smart City (2019-2029).

direct part. The 52 elected members came from companies, foundations, universities and similar institutions, as shown in Frame 13.

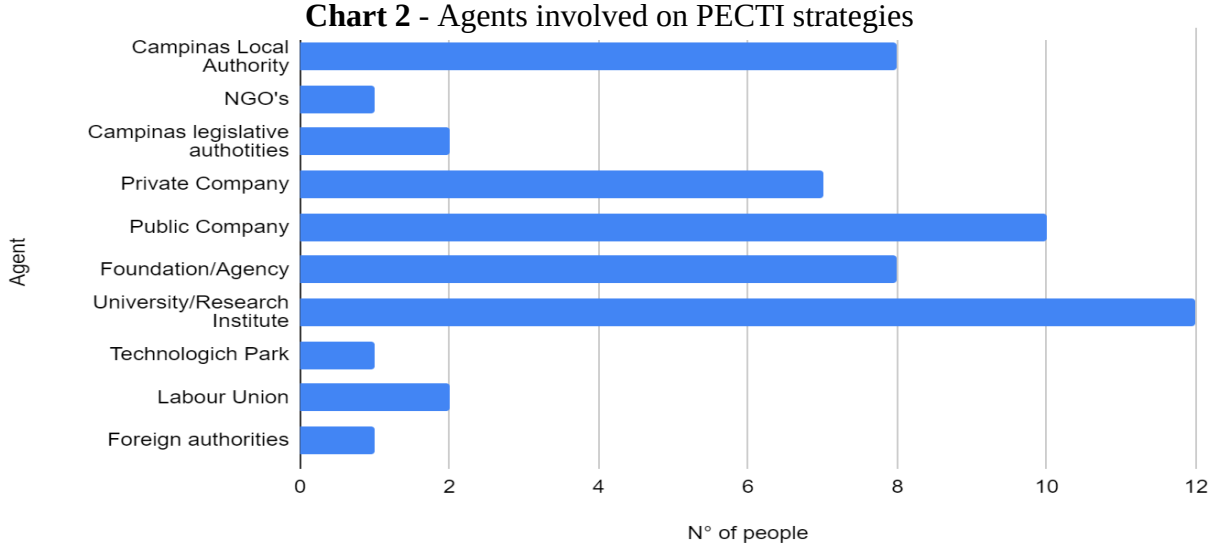
**Frame 13 -** Agents that took part on PECTI (2015)

| Agent | Examples |
|---|---|
| Municipal City Hall | Municipal Office of Economic, Social, and Tourism Development |
| Universities and research institutes | Unicamp, PUCCAMP, Mackenzie, IAC, ITAL, CTI, CPqD |
| Enterprises | Samsung, SAVIS, Baita |
| Municipal Council | Councillor |
| Public Enterprises | CIATEC, SP Negócios, IMA, Inova Unicamp, NIT Mantiqueira, Softex, SANASA |
| Foundation | Forum Campinas Foundation, CPqD Foundation |
| Technology Park | Techno Park |
| Associations | Campinas Start-ups |
| Other City halls | Timon |
| Syndicates | SIPCT |
| Private Associations | ADESG |

Source: Organized by the author based PECTI (2015).

In quantitative terms, Chart 2 shows the type of agent who took part in mapping out the strategies.

**Chart 2** - Agents involved on PECTI strategies




Source: Organized by the author based on PECTI (2015).

These frames shows that multiple institutions that were created during the last decades still take part in this fresh appearance of planning, adapting to new aesthetics and contents in globalizing neoliberal capitalism, who approaches cities by "strategic planning". To define the strategies to be developed during the validity of the plan, the agents used a methodology called "SWOT"[36]: this strategy consists on identifying "Strengths", "Weaknesses", "Opportunities" and "Threads" to the referred project, being quite common in business management, revealing the corporative character of the approach developed in Campinas. The following frame (Frame 14) shows what resulted from the approach, contained in PECTI (2015).

**Frame 14 -** Critical comments on PECTI reading on Campinas

| Type | Items | Critics |
|---|---|---|
| Strengths | Good communication between agents, technology parks, well developed commerce, R&D institutions, Universities, Municipal Council on Science, Technology and Innovation, accessibility, regional influence, urban infrastructure, qualified labour, important industrial complex. | The plan highlights a few structures in Campinas that allow the annihilation of space by time in generic terms, without even mentioning the socio-spatial inequalities to access them. |
| Weaknesses | Expensive labour, lack of municipal belonging feeling, lack of entrepreneurship culture, low innovation taxes, lack of risky investments culture, land use regulation, criminality, lack of marketing, limited spaces to develop technology endeavours. | These listed items show the radical neoliberal approach developed by PECTI (2015). They suggest a cultural need to amplify the entrepreneurship and risky investment, criticize spatial regulations that aim to secure basic rights to citizens and basic environmental laws. |
| Opportunities | Resources up taking, developed knowledge intense activities, enforcing entrepreneurship culture, transportation projects, airport expansion, location. | Enforces competition between regions/municipalities and public-private partnerships. |
| Threads | Cost of life, public insecurity, competition with other municipalities, "Brazil Cost", bureaucracy, complex legislation, limited hydric resources. | Narrow and common-sense based vision on processes, aiming to protect private property and reduce costs to hegemonic agents. |

Source: Organized by the author based on PECTI (2015).

The assumptions resulted from the applied methodology show great contradictions and reflect ideological aspects of the groups involved in its elaboration. The plan focuses on

[36] More on this approach can be found at Evans and Wright (2009) and Gürel and Tat (2017).

promoting a neoliberal agenda, having as central element the omission of socio-spatial inequalities in Campinas. Basic environmental regulation is seen as limitation to economic growth and development and any commitment with social infrastructures counts as “risks” for the developed approach. Citizens, in the background according to PECTI (2015), should support the strategic ideology and obey the established measures, going in the opposite direction of any democratic proposal to smart cities – even though understood by the current research as quite limited and depoliticized, a few approaches to smart cities consider more horizontal governance and citizen sovereignty, like Vanolo (2014), for instance.

In this case, it starts to get clear that the project focuses on specific social groups and excludes the peripherical part of the city. Science and technology have been seen as potential to concentrate capital and not a way to reduce inequalities. From these conclusions on Campinas’ economic scenario, PECTI (2015) comes up with a few “axes” and assign to “key subjects” the responsibility to achieve them. The plan counts on dozens of measures to indicate progress, although the criteria are rather broad and subjective, like “reach developed countries education level”. It would be hard to state if this was or was not achieved due to the lack of specificity. “Developed countries”, in terms of education, communicates few information. Would the goal be to get similar to Finland? Or Germany? Or USA? This makes great difference, as each country has its own approach and priorities regarding education. The text contains a lot of similar cases.

To have a few reasonable measures, we created our own categories based on the political-ideological nature of the indicated “axes” (key-subjects) describing its objectives and measures in the documents and assessed the current status of the foreseen initiatives (Frame 15). It is important to highlight that PECTI (2015) was published in 2015 counting on the perspective of planning the next 10 years. In this case, in the final month of 2023, 80% of the period is covered, making possible for us to develop a few assessments (available on column “status”).

It is also important to make it clear that the information shown in Frame 15 comes from official information published on Official Gazette or in other public official documents, as PECCI (2019) or other official websites, like Foundation Forum Campinas (2023), InvestSP (2023) or Campinas Masterplan (2018).

**Frame 15 -** PECTI Objectives and initiatives status

| Key-Subject | Objectives | Initiatives | Status |
|---|---|---|---|
| Market and society | Branding Campinas and attracting investments in technology sector | Create new science museum in Campinas | Not Implemented |
| | | Collaborative business and innovation forum | Adapted implementation |
| | | Development Agency | Adapted implementation |
| Entrepreneurship and "social innovation" | Build credibility with citizens based on transparency | Big data infrastructure to work as "transparency website" | Partially implemented |
| | | People's lab/living lab to develop and spread access to technology | Partially implemented |
| | | New Municipal Technical School | Not Implemented |
| | | Integrated georeferenced public database | Partially implemented |
| | | Strength technological parks policies in Campinas | Implemented |
| | | Change urban legislation to enable investments in new areas | Implemented |
| | | Promote start-ups and co-workings investments | Implemented |
| Transform energetic sources | Mitigate climate change effects | Develop research on the subject | Adapted implementation |
| | | Car sharing schemes | Not implemented |

Source: Organized by the author based on PECTI (2015).

One first interpretation to get from this analysis in the fact that the goals linked to promote the corporative and hegemonic initiatives, like create new areas to real state/strategic investments, tax incentive or of institutions/agencies/forums to help hegemonic development had way better implementation rates that the more direct "returns" to society, like museums, schools and technology dissemination, which were not implemented. The current status of the planned initiatives gives another argument to state that the focus of Campinas' "smart transition" is to accelerate capital accumulation, being the outcomes to workers/citizens as restricted as possible.

Second, we argue towards a changing role of the municipal authority, which in PECTI (2015) had foreseen to itself a central role in implementing the measures. In practice, other agents had bigger participation, highlighting the role played by Unicamp, by digital platforms, and other private companies or sectors, like real estate. The local authority had two main roles: administrative reforms to insert at least in the offices' names/objectives the link with technology and smart cities and created regulation to promote technology and innovation development.

As we couldn't find the creation of a "development agency" in Campinas, we argue that during the transformations part of the ideal of smart cities being implemented in Campinas, other structures had their objectives and responsibilities altered to attach to the "development" debate. Regarding the first mentioned role, two cases should be highlighted: the changes in the former Development Office to Development, Technology and Innovation Office in 2021 (Campinas, 2023a) and Emdec (former transportation company), that became Strategic Subjects and Smart Cities Office in 2020. In the case of Strategic Subjects and Smart Cities Office, we obtained information about the structure and the processes there by interviewing an employee, that shared with us non sensible information. As mentioned before, the questions are available as Attachment 1.

One first interesting debate targets the staff profile in the Office. As informed during the interview, there were not new admissions to build the team to work on this field – what happened was the transference of employees from IT and enterprises sectors. The expertise of the team becomes less linked with planning or public administration and concentrates in technology development and application. The Office's focus changed from transportation to urban "redevelopment" in areas in Campinas like Campos Salles Avenue and Railway yard (historical sight) (both places are in city centre, as can be observed in Figure 2. More Specifically, both are also located inside the "darkest" red circle in next map, Figure 27) and to the development of applications and websites like "Campinas in the palm of your hand[37]" or "Panic Button[38]". These initiatives answer to the fields "big data infrastructure to work as a transparency website" and "Integrated georeferenced public database", which are stated as "partially implemented" in Frame 15.

Regarding the importance of GIS in the Strategic Subjects and Smart Cities infrastructure, as we discussed throughout Chapter 3, the information revealed to us does not

[37] This is a platform that unifies multiple urban services digitally, like information on public education, water supply or sewage.

[38] This is an application that calls the municipal guard in case of harassment in public transportation.

meet with the discussed models, although the plans and narratives focus on the importance of big data and integrative platforms to share geoinformation. The reality of the Office is that the georeferenced bases are scarce and they have a massive problem with storage, mainly due to old servers almost full and the local power is risking to lose all the information on parking charges: there is a private company developing the service and at the end of the term's validity, the public infrastructure can't absorb the data. Another matter pointed during the interview linked with the application of geotechnologies is lack of "knowhow", as the biggest part of the employees don't have much knowledge on the field.

The conclusions of this conversation indicate that the urban operations promoted by the board do not possess peculiarities that reference smart city models; instead, they replicate typical structures of capitalist public sectors from the last 40 years. There may be a few technological embellishments in the process, but they amount to nothing more than fragmented (and fragmenting) actions. The department lacks a database to support transportation, housing, and other services, let alone the ability to generate its own data. In other words, even within the already problematic framework of the smart city model to which Campinas alludes, there is no established infrastructure for data management and city monitoring.

Resuming the actions took by the local authority, we now dissert on regulation measures to promote the ideal of smart cities in Campinas. The first important change is the signature of "Innovation Act", known by Act n°16.165, in 2021 (Campinas, 2021), based on Federal Act 182/2021 (Brasil, 2021). This act, among other broad measures,

- Gives the city power promote product and services development in start-ups by supporting scholarships or specific parcels to be developed;
- Creates the Municipal Innovation Fund;
- Gives start-ups the legal right to test its products in public administration.

Through this Act, the local authority starts and adapts (in sense that the implementation does not occur in the exact terms as it appears in PECTI (2015)) many initiatives shown in Frame 15, answering to fields stated as "People's lab/living lab to develop and spread access to technology"; "Promote start-ups and co-workings investments"; "Develop Research on the subject". The point here is that local authority is willing to give its demand to be supplied by "innovative" companies based in Campinas. Through this mechanism, the public services and social rights are open to risks (malfunctions, fragilities) in order to give investors and corporations more security. Further, Act 16.165 (Campinas, 2021) allows the local authority to fund scholarships in companies based in Campinas to innovate, being an adaptation of the initial plan, which stated that Campinas would "develop research" on the subject.

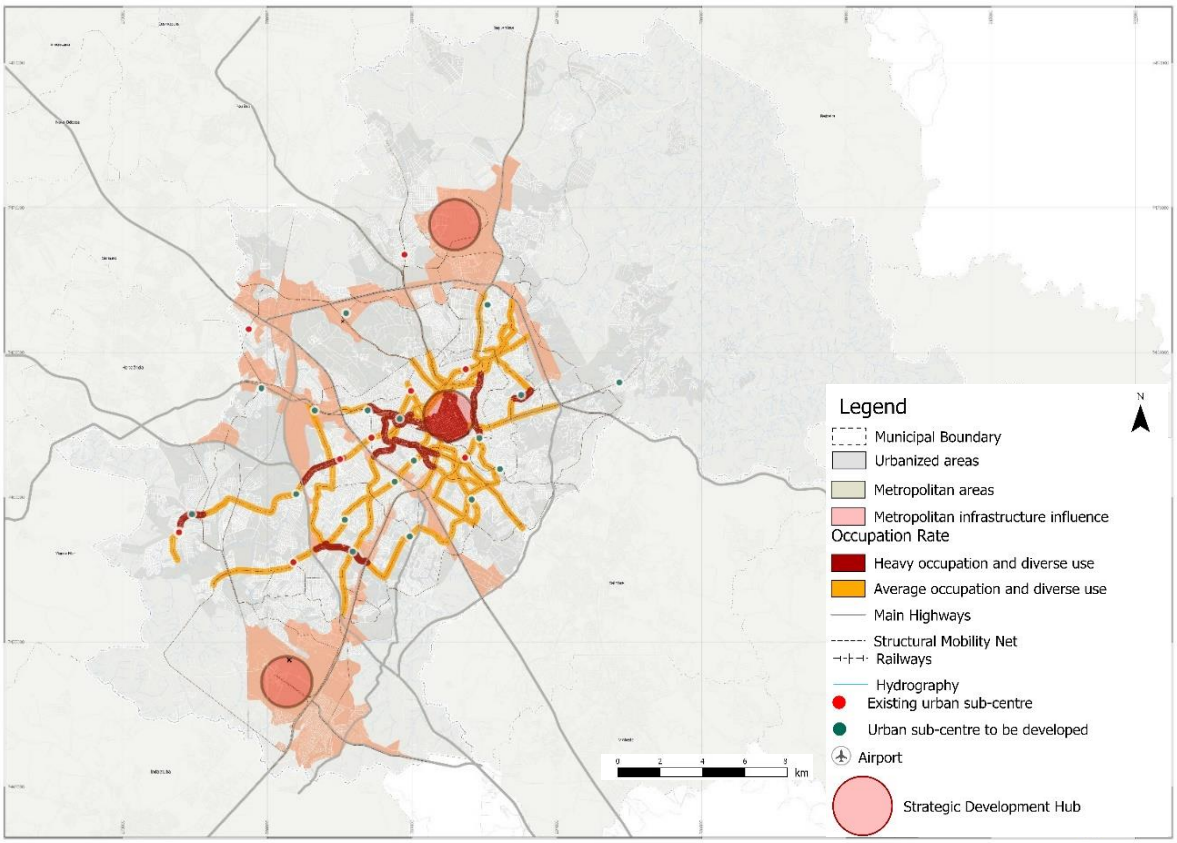
This context strength the public-private partnerships, keeping hegemonic agents in the lead of development. Once more, it starts to get clear the answer to "who is the smart city for?" By analysing the initiatives implemented by the local authority in PECTI (2015) context, the focus is to create and accelerate capital's accumulation. The interest in science, technology and innovation is due to its capability of creating value to be exploited, as very few outcomes have impact in public services or guaranteeing fundamental rights in areas/groups lacking infrastructure or accessing daily needs.

The other important regulatory change promoted during PECTI's (2015) validity is linked with another important document: 2018 masterplan. It is necessary to state that analysing this document deserves more attention than the given by this research, as a lot of effort is needed to better understand its contexts, its implications, its outcomes etc. However, due to the multiple nature resources, here in this dissertation we focus only in a few aspects strictly linked to "smart city" processes.

Despite a general continuity regarding the focus of development in the masterplans since the 1990s (with three main focus being the area of Barão Geraldo, the city centre and the south near Viracopos Airport), the most recent masterplan, in 2018 (which started to be debated in 2014) changes a few regulations, mostly in Barão Geraldo, as we aim to focus on next subchapter. Figure 27 shows a map produced by 2018 Masterplan showing the focus of "big enterprises development areas" in Campinas.

The most transformative element in the context of the "new" masterplan, related to the ideal of smart cities and strategic planning is the acquisition of Argentina Farm by Unicamp (adjoined area), giving a whole new perspective to the surrounding area. At this moment, it is important to clarify that Unicamp started to exert influence as urban space producer, to the point of provoke a more intense debate on the regulatory statements in 2018 masterplan. As we mentioned, since the 1990s, the municipality have a special interest in Barão Geraldo area, but at the time, the masterplan defined it as "Establishment of an urban centre with residential, commercial, and service functions, aimed at supporting activities stemming from Unicamp and the healthcare sector, in alignment with the industrial utilization of the area as a high-tech hub" (Campinas, 1996).

**Figure 27 -** Areas of "big enterprises development" in Campinas 2018 Masterplan




Source: Campinas (2018b).

According to Unicamp (2021) after struggles with Barão Geraldo population, the new masterplan determines to the area a specific strategic use by Municipal Act n°208 (Campinas, 2018). According to the Act, this area consists on "Zone of strategic interest for the development of economic activities, intended for non-residential uses with low, medium, and high impact". This area, Barão Geraldo, will reunite great part of the "smartness" investments in Campinas, linking the promotion of technologic parks, start-ups investments, focus on technology development, creating qualified labour – dynamic that created new uses and transformed socio-spatial relationships, as we discuss in the next topic.

Regarding the "creation of a collaborative business and innovative forum", what this research found was only a modification in Forum Campinas Foundation (founded in 2002) members that happened in 2015, when members of the local authority and enterprises based in Campinas entered the council. According to Forum Campinas Foundation, their actions aim "to promote S, T&I and the articulation of all the main players in this innovation and entrepreneurship ecosystem" (Forum Campinas Foundation, 2023). It seems to us that this modification is linked with the new perspective given by PECTI in 2015, or at least is connected to the "heating" on smartness market in that moment. Last, in reference to "Strength

technological parks policies in Campinas", the focus became the area known as CIATEC II, inaugurated in 2014, near Barão Geraldo and also linked with HIDS process that gives tax incentives and unite companies technology-focused, encouraging cooperation, partnerships and knowledge sharing.

After taking this close look at PECTI (2015) and developing a few arguments and building our analyses, we now repeat the exercise with PECCI (2019) The document starts giving attention to one important news: the inclusion of UN's (UN, 2023) 2030 Development Agenda and the 17 objectives for Sustainable Development[39]. We start this analysis stating that PECCI (2019) is an outcome of PECTI (2015), as it was developed and approved by Science, Technology and Innovation Council, counting with selected members of the Council to elaborate it, with about more 100 collaborators from multiple specializations, focusing on finding people with ICT expertise. The text is divided in 10 chapters, counting on introduction and final considerations plus the references. Its methodologies, objectives and outcomes were defined in meeting with the council members and other collaborators. Similar to PECTI (2015), PECCI (2019), which's validity goes from 2019 to 2029, was developed based on a SWOT methodology, mainly focusing on the hindrances to "digital transformation".

Right in the beginning of the document there is a core concept to our analysis: a definition of what the document understands as "smart city". According to PECCI, (p.14):

> A smart city is innovative, resilient, and sustainable, placing people at the forefront of development. It harnesses information and communication technologies as a means to enhance urban management, quality of life, and the efficiency of urban services, while respecting economic, social, and environmental aspects through collaborative planning and citizen participation.

Within Chapter 2, we showed a list of the most relevant definitions of smart cities, by different types of character, being a few made by researchers, other proposed by international institutions, other by highlighted municipalities in the context, like Los Angeles, for instance. In this case, the one that matchet the most with what Campinas proposes for smart cities was UNECE (2017) available in their website:

> A smart sustainable city is an innovative city that uses ICTs and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects.

[39] We mention that this is an important chance due to the symbolic meaning of this inclusion. However, we don't resume this subject within the text because the plan itself is very confusing about this matter. They mention it as a core guideline but don't show at all how the city plans to incorporate the objectives in its smart city approach.

They both focus on the connection between smart cities, innovation, and sustainability, also giving importance, at least discursively, to "economic, social and environmental" aspects. Including "innovation" is something to highlight in Campinas' case, as among the presented definitions in Frame 7, it only appears in one (exactly UNECE and ITU, 2017). It makes sense while connected to the focus on innovation activities in Campinas, as we demonstrated within this chapter. The approach given to smart cities by Campinas/PECCI (2019) is linked to what Golubchikov and Thornbush (2020) calls "hard approach", focusing on technology development and application.

Needless to say, the project also reproduces the neoliberal approach to planning, appealing to the need for less bureaucracy and more efficiency to solve urban problems. Again, this perception is linked to the origins of the ideal of smart city and is part of the current post-modern fragmented reproduction of urban space, when the changes made by the state focuses on diffuse, complex and almost imperceptible to naïve eyes projects, as digitalization might be – in opposite to the quite hard and gross way of thinking the cities in modernist approach.

Despite this link with digitalization, material infrastructure is also necessary to implement this perspective, as we also discussed in Chapter 3. Moreover, GIS play an important role in operating the smart projects due to its features that includes, among other elements, software, hardware, data and operators. In this case, PECCI (2019) affirms that GIS "enable (…) modeling of large amounts of data related to spatial reference. This facilitates the incorporation of sociocultural, economic, and environmental aspects, contributing to more assertive and effective decision-making." (p. 15). Within the plan, PECCI (2019) shows a few initiatives to develop this approach to the city, although we consider could be more advanced, but the discussion on the plan that follows will make it clearer.

The application of SWOT methodology produced a very similar result to PECTI (2015), but we show some differences and peculiarities in Frame 16. When the affirmative is not included in PECTI (2015), only in PECCI (2019), it appears bold.

**Frame 16 -** Critical comments on PECCI reading on Campinas

| Type | Items |
|---|---|
| Strengths | Good agent's communication, well developed commerce, R&D institutions, Universities, Municipal Council on Science, Technology and Innovation, accessibility, urban infrastructure, qualified labour, important industrial complex, existing ICT infrastructure. |
| Weaknesses | Lack of unitary citizen registration, small data integration, poor communication between authority and citizens, social vulnerability, no defined instance authorising the contracting of ICT solutions for smart cities, |
| Opportunities | Developed knowledge intense activities, enforcing entrepreneurship culture, transportation projects, airport expansion, location, existing ICT infrastructure, strong institutional partnerships (*i.e.,* IDB). |
| Threads | Public insecurity, "Brazil Cost", bureaucracy, complex legislation, incomplete regulatory environment, lack of sustainability culture, lack of human resources, limited budget, data security and privacy. |

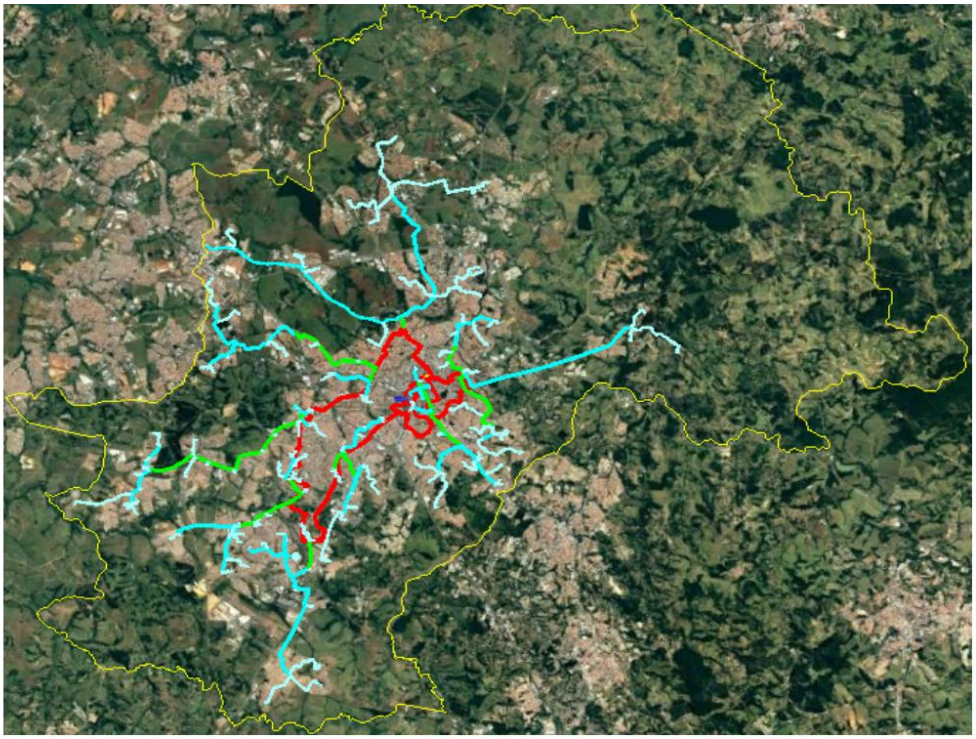
Source: Organized by the author based on PECCI (2019).

As it is possible to observe, the biggest differences are identified in the weakness and threads, while the "good qualities" are quite the same in both plans. It occurs because of this most "hard" approach on PECCI (2019), focusing on very technical elements, while PECTI (2015) doesn't goes deep in this type of information. After presenting these arguments, the plan brings important information for our analysis: it details a few infrastructures that Campinas developed, understood by the plan as its "digitalization process". The first case explored is the optical fibre structure. PECCI (2019) states that in 2019 Campinas had 120km of optical fibre structure to certify good internet connection between public buildings, aiming to provide good internet connection to public facilities. The projection is to reach 200km by the end of PECCI (2019) validity.

PECCI (2019) even divides this infrastructure in three parts: backbone (core part of the structure and capable of dealing with massive amount of data, red in Figure 28), backhaul (responsible for the distribution of data among different regions in the city, green in Figure 28) and the area of service (blue/white in Figure 28). It is a massive contradiction for a plan like PECCI (2019), that emphasizes the importance of GIS to planning to present a cartogram with such low quality, as Figure 28 shows.

If the plan states that Campinas' have some qualified ICT infrastructures and recognize that GIS is contributes to "create smart cities", a strategic plan should have a much more well elaborated map and database on its optical fibre infrastructure. This even raises suspicion on the reasons why the figure is so low qualified. Does the local authority have conditions to present it in better quality?

**Figure 28 -** Cartogram of Optical Fibre available in PECTI

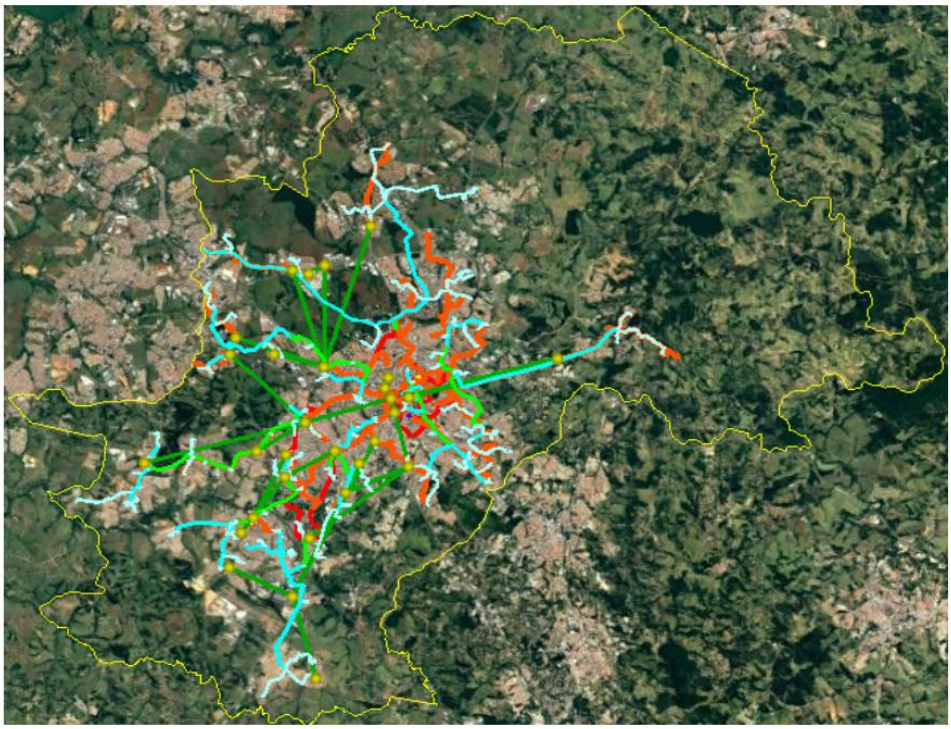


Source: PECCI (2019).

Trying to draw some analyses, even with the low-quality cartogram presented, what first calls attention is location of the backbone, that creates a ring in the city centre, the oldest urbanized area and place for important public facilities, including the city hall. A second interesting unfolding of this cartogram is when we take a look at what happens in north Campinas. The blue lines towards Sousas shows the importance of internet supply to that region and the size of the white lines in Barão Geraldo appears much bigger than in other regions, what that the speediness of connection in this area or its capability to process data is lower than other parts of the city. PECCI (2019) does not include any information on any implication to answer raised question (does the length of service wires interfere with internet quality?), despite being very attached to technical details in other parts of the text. might mean

Besides this, it is only possible to state that the supply basically follows the urbanized areas, with more capability in the centre, what is not different from expectation. However, besides this consolidated structure, the plan also shows that there is an expectation to amplify the coverage, as Figure 29 shows.

**Figure 29 -** Planned expansion of the optical fibre infrastructure

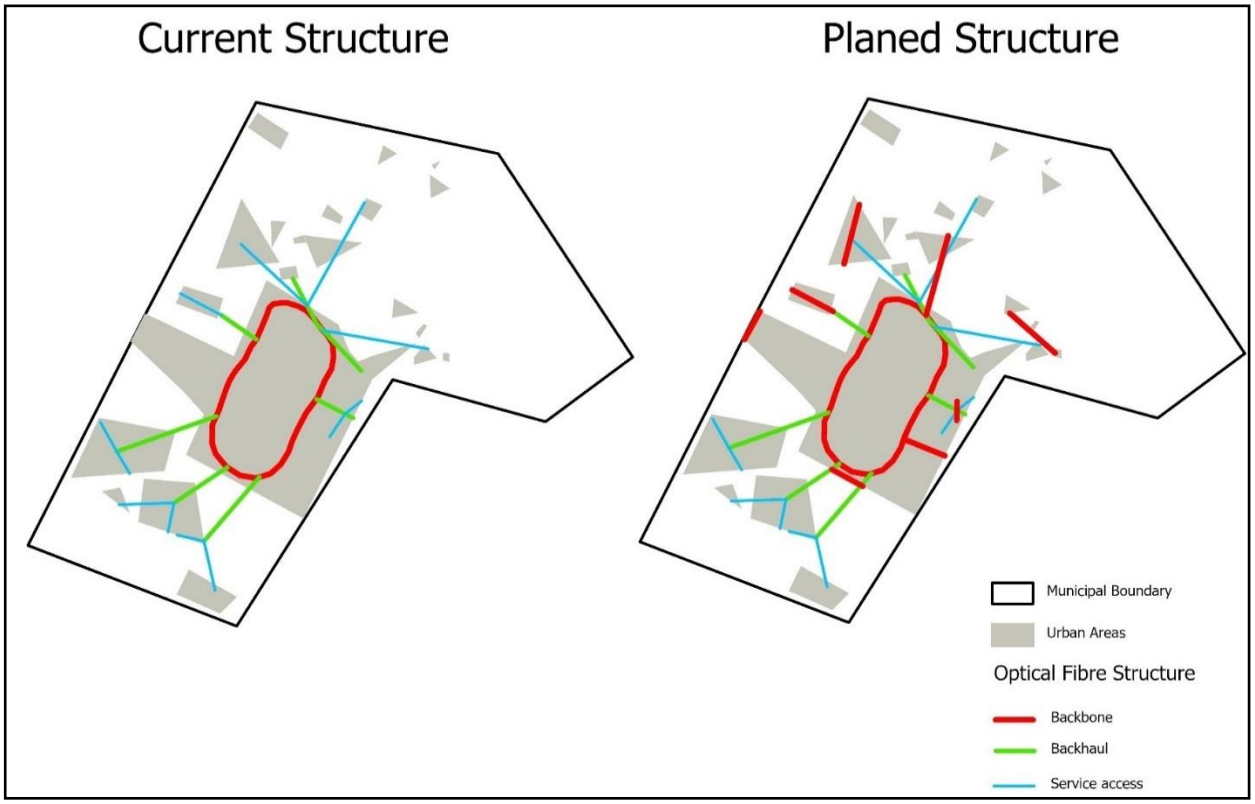


Source: PECCI (2019).

Again, the quality of the cartogram makes it hard to get much from it and the lack of a proper legend jeopardize the understanding. However, with this second cartogram, it is possible to observe how the plans focus on north Campinas. It is possible to observe a lot of new backbone structures in the north, while the south has few new investments. This fits the corporative perspective common during the plan, and indicates an intention to concentrate modern and high demanding internet/energy infrastructures in north Campinas, fitting other processes shown and upcoming in this document.

To enable a comparison, Figure 30 shows the chorem of current and the planned structures side by side. However, it is important to mention that it is the first chorem presented in this text. The details are simplified to present the process. This first one is relatively simple, but as the analyses goes further, the models get more complex. When we deem it necessary, we present a frame to explain better the elements in the chorem.

**Figure 30 -** Existing and planned optical fibre structure in Campinas

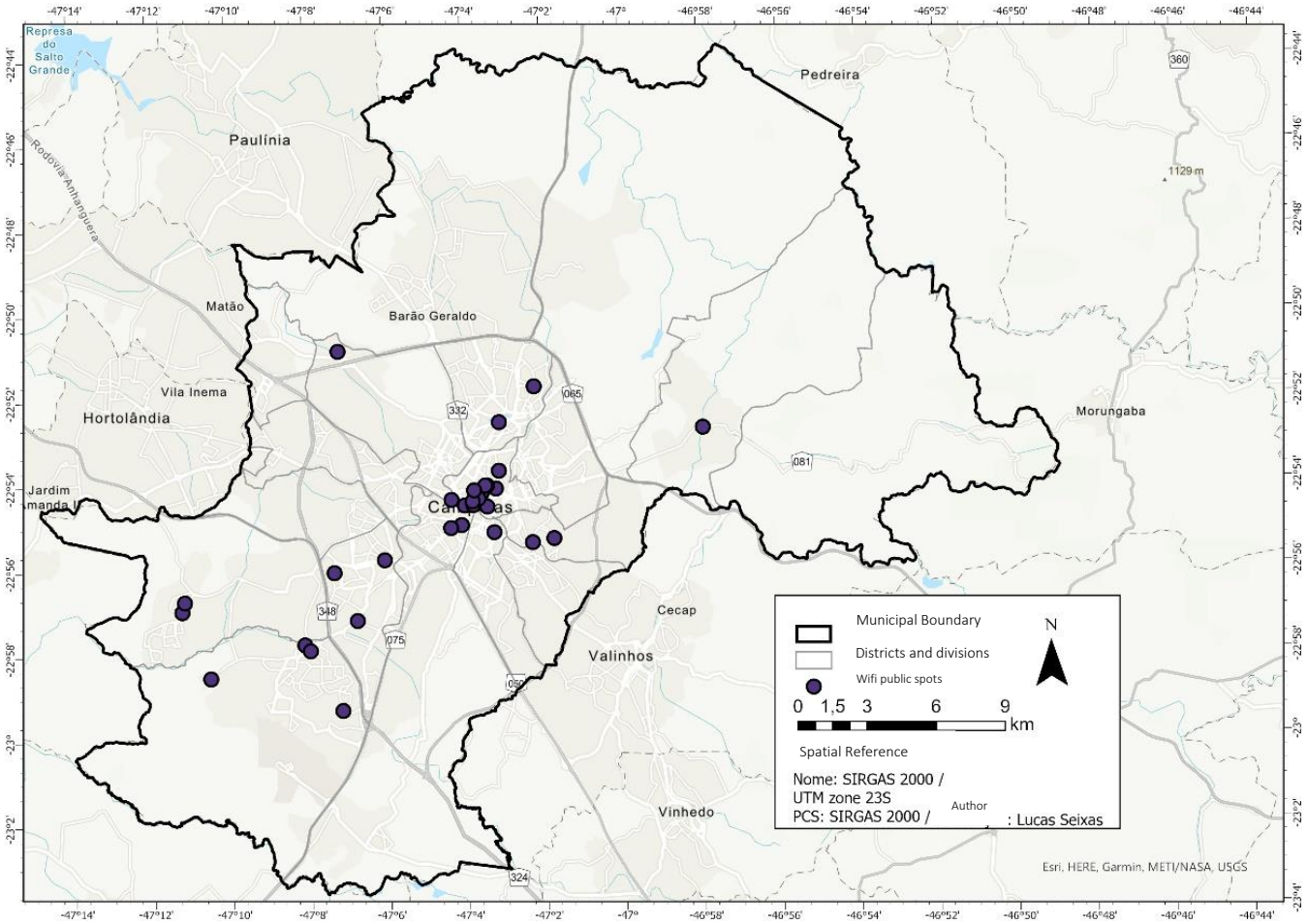



Source: PECCI (2019). Organized by the author.

As this comparison makes clear, the technology development according to the local authority became more focused on north areas, that concentrate a lot of institutions related to knowledge, data and information production, as well as important economic decision-making centres. The new backbone structures planned in north Campinas, them, aims to meet this demand forwards the region as a new centrality linked with hegemonic development.

PECCI (2019) then reveals more information regarding internet connection, but now focused on people's access. The text asserts that Campinas have 100% of coverage, considering private offer, Wi-fi and mobile connections (3G, 4G, 5G etc). At the first moment, we think that this data needs to be further investigated and deservers research effort, to analyse the quality of connection and the access within different areas in the city, the cost of connection relatively to the incomes and other similar issues. In terms of public free Wi-Fi connection, Campinas states to have now 48 free points where citizens can connect. Based on the addresses provided by IMA (mixed capital company that provides services to Campinas), we produced Figure 31.

**Figure 31 -** Open access Wi-Fi spots in Campinas (PECTI) (2019**)**




Source: PECCI (2019) and GeoGet (2023). Made by the author.

The most part of the "free access" Wi-Fi spots are hospitals, public offices, squares or bus terminals or stops and located in the city centre, with a few others more spread through the city. According to the local authority (Campinas, 2023b), it is possible to stay connected for 40 minutes after filling an enrolment. Despite might have interesting benefits for citizens, the democratization of Internet in Campinas is still far of being achieved. According to the local authority, in 2018, 60% of the houses had fix internet connections (Campinas, 2018a). To compare, according to TIC *Domicílios* (2022), in South-East region in Brazil, 70% of houses have access to Internet.

However, there is a matter that is beyond this dichotomy between access *versus* lack of access. As we discussed within this research, it is fact that internet shapes in multiple ways the production of space. We presented multiple references that convinced us that technology can bring risks to democratic relationships and produce and reinforce inequalities. This happens through multiple processes: spread of misinformation, privacy violation (even

when legally "agreed" through terms of use), algorithmic choice of content access based on political interests of the entrepreneurs, new forms of exploitation through digital platform labour[40], concentration of power to control various debates, behaviour surveillance, deepening of gender, race and age inequalities through algorithmic violence and other structural dangerous processes (Zuboff, 2019; Sadowski, 2020)

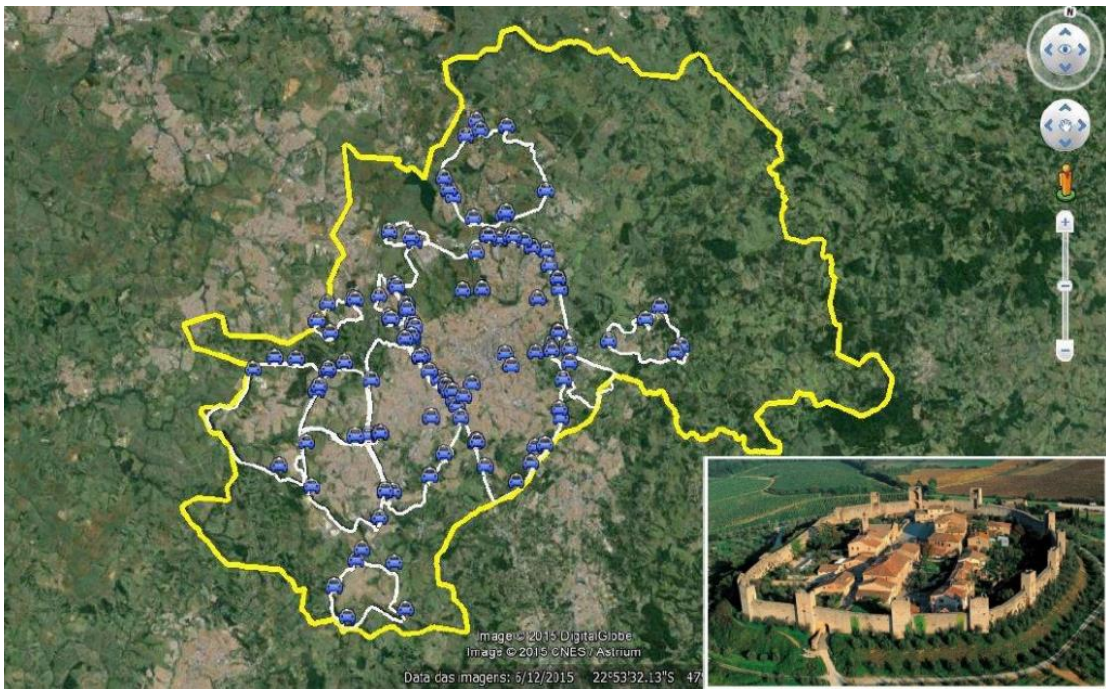
The debate is moving from "universalize access to internet" to "how to make sure that the relationship with Internet will not erode horizontal socio-spatial relationships in multiple communities?". Israel (2022) developed an interesting bibliographical review regarding the connections between territory and internet, reinforcing the importance of a geographical perspective that denies the disconnection between digitalization and materialization. The "digitalization" process is not a simple transformation from something "dumb" and traditional to something new and smart. The whole business changes, the agents change and the ways to produce space chance as well. In this case, the debate about internet connection in Campinas continues to reproduce a hegemonic approach.

Similarly, other classic smart city features are (being) developed in Campinas, and likewise, reproducing hegemonic answers to public subjects. The next reported case is the "security room", or "control room" or "urban dashboard". Although this structure exists in Campinas since 2006 (PECCI, 2019), in 2018 a new approach was implemented: a "living lab" for Huawei[41] (Campinas, 2018c). The new technology, according to the local power, can promote facial identification on "suspects" and the focus will be to monitor the centre. This new partnership added 30 new cameras to the system, totalling 639 cameras (in 2019). Composing this system called "Safe Campinas", the local authority also has "Smart Vehicle Monitoring System", aiming to recovery stolen cars or find vehicles used in crimes. PECCI (2019) brigs another cartogram to demonstrate the structure (Figure 32).

[40] There is a very late published book, organized by Ricardo Antunes, one of the biggest references in the subject in the world that have potential to be disruptive regarding the understanding of platform work, called *Icebergs à deriva*, or "Floating Icebergs", in our own translation. Due to its quite recent release, we couldn't give a lot of space in our debate, but this reference shows multiple ways of exploitation enable by platforms and technology.

[41] Big Chinese company linked with ICT globally.

**Figure 32 -** Representation of “Safe Campinas” surveillance scheme




Source: PECCI (2019).

This approach to “reduce criminality”, based on surveillance is focused on protecting private property of people with economic resources to use cars – similarly to what happens with private security and surveillance at fortified enclaves, that have been increasing in north Campinas, connected to the ideal of smart cities, as we aim to demonstrate in the next subchapter. Based on the information provided by PECCI (2019) we produced Figure 33, advancing in showing Campinas’ “digital” infrastructure. Smart Vehicle Monitoring System divided the city in 12 regions of surveillance, and the control room can identify which vehicles enters or leaves each region.

**Figure 33 -** Optical Fibre and Surveillance structure in Campinas


Source: Made by the author.

The third and last focus of the "digitalization" process mentioned in PECCI (2019) is the adoption of what they call Technology Platform, that according to the strategic plan is responsible for integrating the digital environments. They present a technical definition of smart city, stating that it must have five levels of operation: *i)* physical infrastructure, *ii*) sensors level, *iii)* network level, *iv)* data support level and *v)* Application level – this structure would be administrated by a "governance committee" inside the administrative structure. To integrate these levels, it is necessary a platform, commonly developed by big companies like IBM, CISCO, Microsoft and Huawei. The plan mentions that there is a company based in Campinas, Konker, that have "free access", and even has a partnership with Unicamp, linked to data management.

PECCI (2019) admits that to reach a working platform like described is still a challenge to the case of Campinas. Further than that, the research continuously developed about Campinas (Nascimento, 2013; Brasco, 2022) shows that the socio-spatial inequalities in the municipality are massive and regions like north-west[42] have massive lack of basic infrastructure, let alone smart infrastructure. Further, as argues Brasco (2022), the few and restricted infrastructure that the periphery has in Campinas is resulting from social movements, fight for land, fight for housing. It was not built or given by the local authority or any "smart" agent. The perspective of building this smart infrastructure becomes more and more boxed from the material needs of Campinas' working population and connected to utopian and Eurocentric hegemonic perspectives.

Before we conclude this analysis, it is necessary to mention that the focus of the plan, after discussing the "digitalization strategy" turns to points less directly linked with our goals in the current research, as explaining broad Brazilian strategies to digitalization, Brazilian strategies to develop Internet of Things, or National Board to 4.0 Industry (despite important to understand Campinas and smart cities, this scale is beyond our analytical possibilities at the moment).

The PECCI's (2019) topic aims to show a few potential developments from its planned objectives, focusing on the following subjects: urban mobility, energy and sanitation, health, public safety, public administration, education and other applications (environment, tourism, governance, finances, development, rural space). To each one, the document mentions a lot of possible applications, making it hard to develop consideration on each. Trying to solve

[42] We've been referring to "north Campinas" as a region with more developed infrastructures and place for high income housing and services. However, specifically the administration region "North-West", that in absolute terms in not even in "north" part of Campinas, is one of the most vulnerable regions in the city,

this question, we decided to elaborate a Frame 17 and develop a general consideration, finding similarities or differences in the mentioned initiatives.

**Frame 17** - Subjects and "smart" possibilities proposed by PECCI

| Subject | Possibilities proposed by PECCI |
|---|---|
| Urban Mobility | "Accessible pavement", cycleways, public transportation, autonomous vehicles, smart parking and charging, real time surveillance of traffic, smart management of traffic lights, smart charging to electric vehicles, private offer of transportation. |
| Energy and sanitation | Renewable energy development, efficiency, integrative management of solid waste, smart rubbish bins, air quality control, smart energy systems. |
| Health | Telemedicine, telehealth, telecare, health databases. |
| Public Safety | Predictable analyses, surveillance, social network surveillance, predicting environmental disasters. |
| Public Administration | Data production to underpin decisions, smart buildings, virtual assistance, application development, |
| Education | Improve performance, comparative analysis between schools, application to new students, gamification, improve mobility, virtual library administration, smart management. |
| Other subjects | Better tourism infrastructure, information centre. |

Source: Organized by the author based on PECCI (2019).

After observing what PECCI (2019) brings as possible developments of the digitalization process, it is necessary to present three main impressions:

The weak connection between multiple presented possibilities with the perspective on "smartness" developed during the rest of the document. The sudden inclusion of tourism, the contradictory mention of cycleways, for instance, have almost none connection with digital smart platform counting on multiple levels of operation. The intention might be to connect, somehow, the project with sustainable initiatives, but the way it is done shows that these ideas are poorly connected in Campinas' approach to Smart City – even if we don't develop much critic on this concept.

At the very least, the is a huge miscommunication with other specialist, like educators, public health specialists, for example. The presented ideas for education show an ideologic position linked with corporative approach, aiming to transform public education in a new marketing frontier in Brazil, as for instance, Catini and Branco (2022) have been

discussing. The theoretical understanding of public education and health, in this case, are quite restricted and the vision presented by the plan takes side with capitalist hegemonic interests.

Finally, third, the complete process of, on the one hand, precarization of public services and on the other, the space opened to private sector to monetize. The most striking case is transportation, in which the plan includes to offer a considerable part to be exploited by digital platforms as "alternatives". This type of policy can forward processes of misplacing incomes, belonging and strongly affect local business, as concentrate low cost and low-quality service offer in transnational companies that have few connections with the city, as can happen with digitalization of education, health, transportation and touristic accommodations.

Within this subchapter, the objective was to develop analyses over the process of digitalization in Campinas, also focusing on how its science, technology and innovation strategic plans are connected to the ideal of smart cities. We demonstrated the perspective Campinas has regarding smart cities, the agents mostly involved in this process, the current infrastructures linked with "smart" practices. Further, we presented a few maps that indicate that this set of actions may have as one of its main consequences the deepening of socio-spatial inequalities in Campinas.

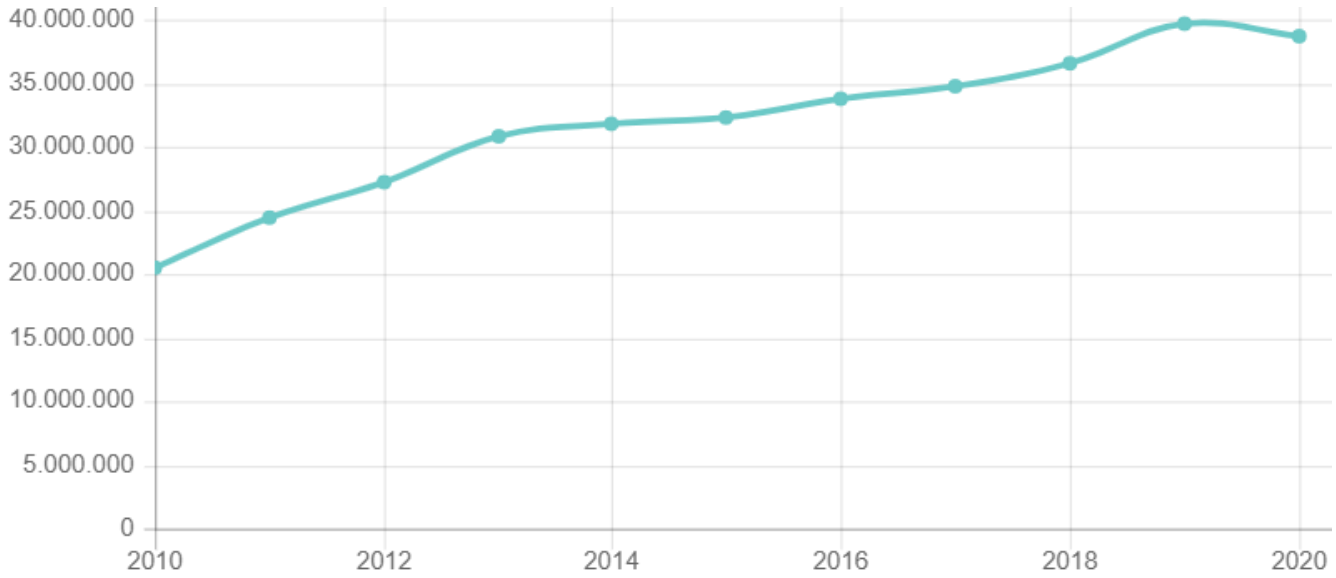
While the public and private agents have focused on the possibilities of hegemonic development in the north districts of Campinas to create a "smart" infrastructure and picture the smart city, the other parts of the city and mainly the periphery became even more segregated. Basic infrastructures are still scarce and the described initiatives doesn't aim to answer to these problems. If one of the ways that cartography plies power is deciding what goes in and what stays out of the map, the ideal of smart city does the same. Capital choses where to find it and which areas should stay out of the focus. Next subtopic goes further in investigating the dynamics and contradictions linked with the ideal of smart cities in north districts in Campinas, knowingly Barão Geraldo, Sousas and Joaquim Egídio.

### 4.2 Brazilian Silicon Valley? Campinas' territorial formations under uneven development

After focusing on the role played by the local power in Campinas and presenting the strategic plans that worked as guidelines to the development of the ideal of smart cities in Campinas, we now present the unfolding process of the mentioned context. In the beginning of this debate, the text brings a few data to better understand employment patterns in Campinas and a chorem to summarize the more "traditional" urban industrial structure. After that, we start including new elements in the analysis. The objective here is also to approach the subject by a urban perspective, putting together multiple aspects of urban space reproduction and observing the connections among them.

In late scenario, Campinas have been concentrating its economic activities in providing services, as the industry shows a very small growth rates and the city is even losing jobs in this sector to other municipalities in the metropolitan region (Miranda, Porto, 2022). On the other hand, added value in services sector have been increasing, as shows Chart 3. Figure 34 shows a chorem about the urban, industrial and transportation basic structures and dynamics, while Frame 18 gives more detail on the elements presents on the map.

**Chart 3** - Added value on Services in Campinas between 2010 and 2020 (R$ × 1000)




Source*: IBGE Cidades* (2023).

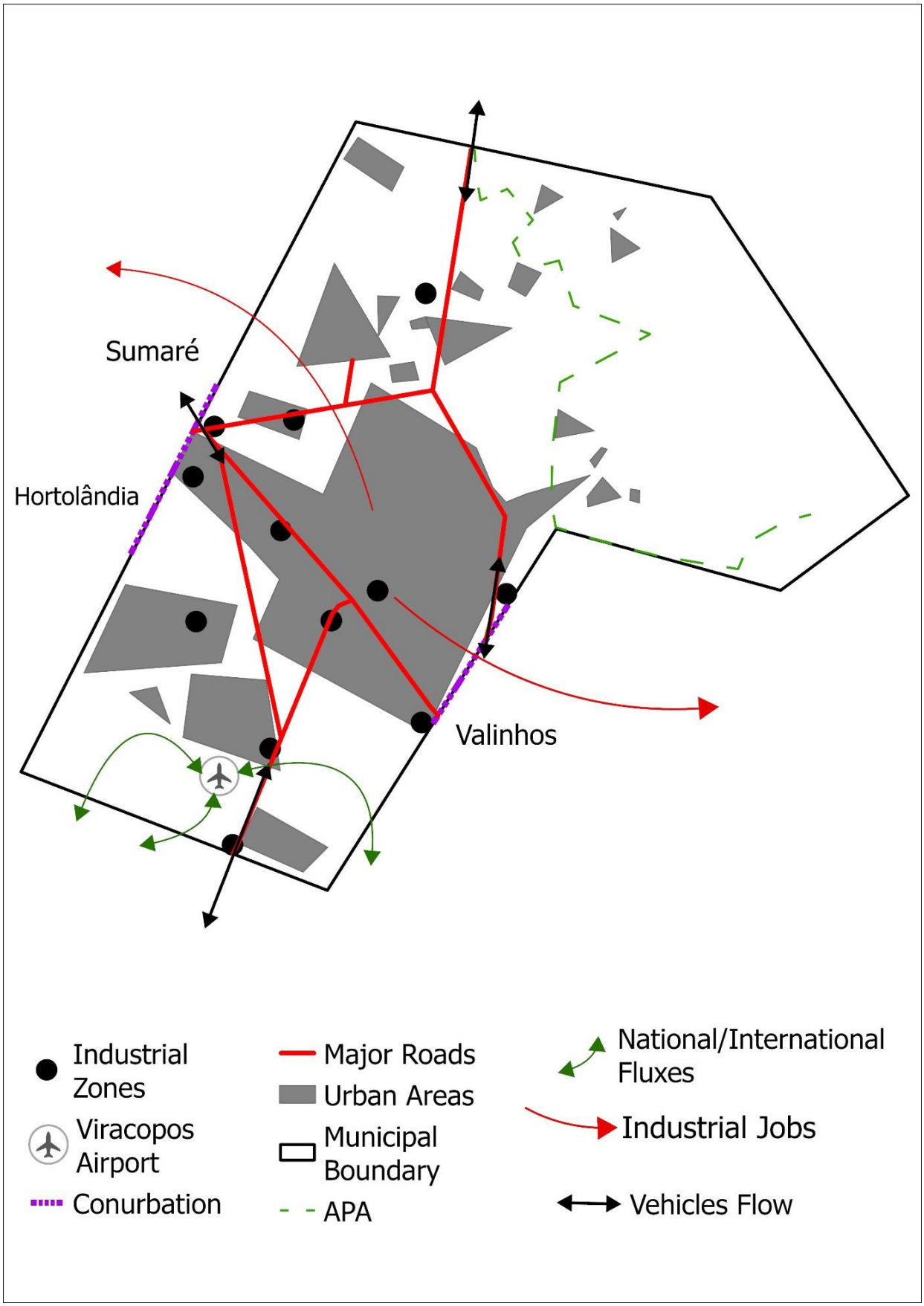
Like previously advised, now that the choremtic models are becoming more complex, frames were created to explain then chorems. The first column (Frame 18) shows what the chorem represents, the second informs to what elements in Figure 14 (Brunet's chorems) the structure in Figure 34 refers, the third one reveals which geographical fluxes depart or arrive from that chorem and the last one informs the source to the presented data.

**Frame 18 -** Representations and Sources to Figure 34

| Included Chorems | Representations | Fluxes | Source |
|---|---|---|---|
| Municipal Boundary | Fabric/Polygon | Industrial jobs Economic Values | Made by the author based on PMC (2014) and GeoGet (2020) |
| Highways | Line/Disposition | Cargo Vehicles Passengers Vehicles | Made by the author based on DER (SP) (2022) |
| Vehicle's flow | Line/Territorial dynamics | Vehicles | DER (2022) |
| Viracopos Airport | Point/Gravitation | National and International Cargo National and International Passengers | Made by the author based on Viracopos (2022) |
| Industrial Units | Point/Disposition | Value-added Commodities | GeoGet (2020) |
| Industrial jobs | Network/territorial dynamics | Industrial jobs | FIESP (2019) |
| Urbanized Areas | Area/Territorial Dynamics | - | Made by the author based on previous research available at GeoGet (2020) |
| EPA | Line/Contact | - | PMC (2014) |
| Conurbations | Area/Contact | Commuter flows | Geoget (2023) |

Source: Made by the author.

**Figure 34 -** Urban, industrial and transportation structures in Campinas – SP




Source: Organized by the author.

The model shows a lot about Campinas' urban-industrial structure and creates a good research scenario for us to depart the rest of the analysis. The urbanized areas show the big concentration on the centre but also reveal the fragmented urban space in Campinas. Further, it reveals that Campinas have conurbation with two other municipalities that are part of RMC, Valinhos and Sumaré. The only structure that seems to be barring the urban spread is EPA, but it is possible to observe that the barrier has its openings and the urbanized areas started entering. The roads are very strictly linked with the industrial localization, process that can by understood by the concept of development axis (Sposito, 2007). However, due to the focus on qualified labour in services, the centre of Campinas economy is not anymore in the industrial capital. Slowly, less technology intense sectors are migrating to the periphery of RMC. Finally, the chorems show Viracopos Airport as one important point of importing and exporting products and also working to enable national and international people's flux.

To explain this concentration in specific economic activities we turn to analyses on knowledge base theory[43] in peripherical capitalism made by Mesquita and Fernandes (2021), that, using data produced by FIRJAN (2021), shows that regarding analytical knowledge (specific type of knowledge linked with scientific development, deductive models, by cooperation with research units, codified and absolute knowledge), RMC was the third position in the national employment ranking, with 11.319 employees, behind São Paulo (SP) (61.680) and Rio de Janeiro (RJ) (19.923). The analyses on growth rate also shows Campinas between the highest in the country, with 8,2% (2003-2019), but this time behind Florianópolis (13,7%), Itajaí Valley (10,3%) and Centre-North Paraná (9,8%).

Besides this, Mesquita and Fernandes (2021) based on an approach developed by Martin (2012), calculated a Locational Quotient, in which values above 1 (one) means that the region has a superior analytical knowledge participation than the reference economy (in case, Brazil). Values bellow one means that the participation of analytical knowledge is lower than the reference economy. In this case, Campinas represents the *most concentrated* mesoregion in the country. Table 2 shows the top positions in Brazil.

[43] This theory aims to overcome dichotomies between codified and tacit or High-Low technology when referring to local innovation systems, say Mesquita and Fernandes (2021). This theory comes from overseas and central countries, so its applications in Brazilian reality must be carefully thought. The main authors and references on this subject are Laestadius (1998); Asheim and Coenen (2005); Asheim (2007); Asheim *et al*, 2017.

**Table 2 -** Top 10 most concentrated Locational Quotient regions in Brazil (2019)

| Position | Region | Value (LQ) |
|---|---|---|
| 1 | Campinas | 1,9 |
| 2 | Florianopolis | 1,8 |
| 3 | São Paulo | 1,7 |
| 4 | North Santa Catarina | 1,7 |
| 5 | Porto Alegre | 1,4 |
| 6 | Federal District | 1,4 |
| 7 | Rio de Janeiro | 1,4 |
| 8 | Marília | 1,3 |
| 9 | Itajaí | 1,2 |
| 10 | Paraíba Valley | 1,2 |

Source: Mesquita and Fernandes (2021). Organized by the author.

This very knowledge-intense production is related to a great infrastructure that now is becoming part of the "smartness" perspective, selecting activities and agents that can survive in the more competitive environment. Frame 19, contains the infrastructure of R&D institutions in Campinas. The "objects" that we make reference to in the first column are the ones we mention in the timeline in topic 4.1. The second column shows the date it was installed in Campinas' territory. The third column reveals the owner, to give the perspective of this multiple scale process. We tried to identify the type of flux that comes into these objects and the fluxes that come out of them, understanding, then, their relationship with the urban space. This initiative aims to underpin our corematic models we present on the following pages.

**Frame 19 -** Research, Development and Services Technology objects in Campinas

| Object | Date | Ownership | Fluxes (in) | Fluxes (out) |
|---|---|---|---|---|
| IAC | 1887 | SP Government | Public Resources and qualified labour | Technology on agriculture; Ultra-qualified workers |
| PUCC | 1941 | Diocese | Private Resources; Public Resources; Students, Qualified labour | Qualified workers |
| ITAL | 1963 | SP Government | Public Resources and Qualified labour Labou | Food technology and innovation |
| Unicamp | 1966 | SP Government | Public Resources; Private Resources; qualified labour; Students | (Ultra)Qualified workers; Healthcare; Patents Innovation; Scientific Advancements |
| CPqD | 1976 | Private | Private resources Qualified labor | Economic fluxes Innovations Qualified products |
| IMA Campinas | 1976 | Public/Private | Public Resources; Private Resources Qualified labour | Infrastructure and services linked to Smart Cities Digital consulting to municipalities |
| EMBRAPA Digital | 1985 | Federal Government | Public Resources; Qualified labour | Agriculture Technology; Qualified workers |
| EMBRAPA Territorial | 1985 | Federal Government | Public Resources; Qualified labour | Agriculture Technology; Qualified workers |
| CTI Renato Archer | 1987 | Federal Government | Public Resources; Qualified labour | Information Technology; Entrepreneurship Support |
| CNPEM | 1987 | Federal Government | Public Resources; ultra -qualified labour | Worldwide Scientific cooperation; Scientific publications and results; Ultraqualified workers; Cooperation with companies; Patents |

| | | | | |
|---|---|---|---|---|
| CIATEC I | 1986 | Municipal Government | Public and private resources | Cooperation between companies |
| SOFTEX | 1993 | Unicamp, Local authority and private | Public and private resources<br>Qualified labour | Software industry assistance<br>Funds to develop other companies<br>Consulting to tech industries and companies |
| FITTEC | 1994 | Private | Public and private resources | Consulting to tech industries and companies |
| FACAMP | 2000 | Private | Private resources<br>Qualified labour | Qualified workers |

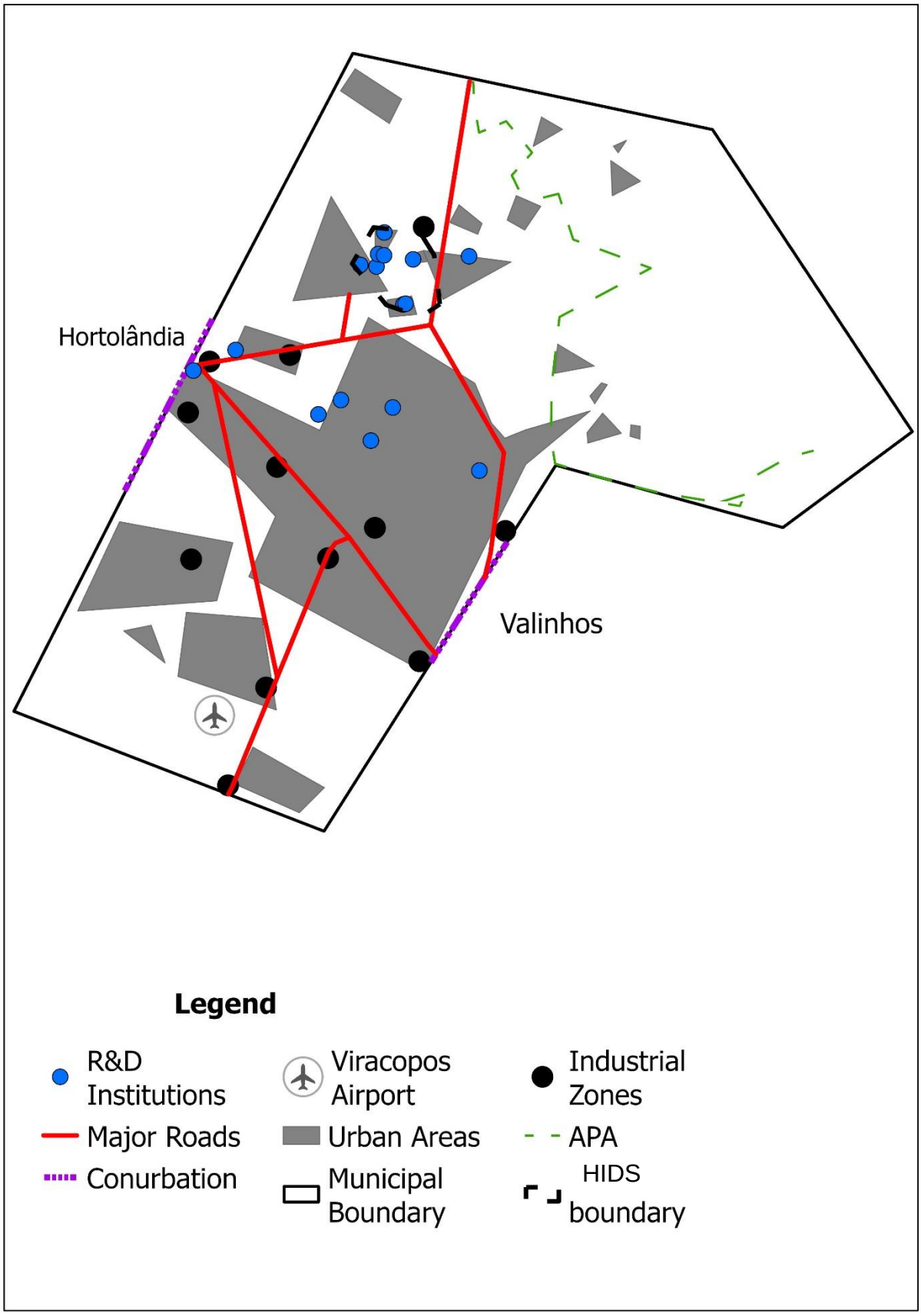
Source: Organized by the author based on information obtained in websites and documents of each mentioned organization and Baldoni (2019).

The institutions contained in Frame 19 together compose a system that produce knowledge that have the potential to become innovation. However, due to contradictory and uneven development that produced the urban space in Campinas, when we look to *where* these institutions take place, an important pattern stands out: the big concentration north from Dom Pedro Highway and in Barão Geraldo[44]. To better understand and discuss it, we present Figure 35, chorem showing the location of these institutions.

It is important to note on the chorem a small area located in Barão Geraldo, HIDS. This area concentrates some of the most important institutions focused on technology development and play an important role on creating conditionings to the strength the ideal of smart cities in Campinas. It is also interesting to observe on how different productive structures relates to space: while the industrial zones locate in south Campinas and strictly linked to highways and closer to the Viracopos Airport, creating the biggest vehicles flux in the region, and close to low-income working-class housing regions, the companies linked to producing technology concentrate near to each other and in north Campinas.

[44] Please note that we briefly presented the most important municipal divisions in Campinas in topic 1.1 – Campinas as Keyword.

**Figure 35** – R&D institutions in Campinas




Source: Made by the author.

We argue that the elements shown in Frame 19 are the core part of the infrastructure that creates conditions to parts of the city of Campinas to be associated to "Smart City". As this frame makes clear, this infrastructures have, in general, a tendency to transform *capital* into services or knowledge to underpin multiple aspects of space and technology integration: *i)* by training workers with analytic, synthetic and symbolic knowledge (industry, laboratories, public sector); *ii)* creating technology to enhance productivity and enable new industrial and agricultural activities[45]; *iii)* attracting activities with high aggregated value to this area, mostly services, and *iv)* incorporating urban space in Campinas with technological apparatus to produce data.

The three universities located in Barão Geraldo (PUC-Campinas, Unicamp and Facamp) are strongly connected to forming workers with analytical, synthetic and symbolic knowledge to act in specific activities. It is possible to create initial associations among the sectors we proposed on Frame 20 and the types of knowledge proposed by Asheim (2007), considering the contextualization made by Mesquita and Fernandes (2021), mainly when regarding the association between engineering and synthetic knowledge. However, associating the other fields to the types of knowledge can be tricky – that's why we decided to not do it on Frame 20.

[45] One way to better underpin this affirmative would be presenting patents registered derived from the mentioned institutions. However, due to resources (time, labour, etc), we didn't organize this material for all cases. But just to have an idea, according to Inova Unicamp (2022), in 2021, Unicamp registered 129 patents – a record to the University.

**Frame 20 -** Universities, fields and courses in Barão Geraldo/Campinas

| | Field | Faculties and Institutes | Number of Undergraduation courses/ Total Number of Vacancies |
|---|---|---|---|
| Unicamp | Human sciences | Education, Arts, Economics, Languages, Philosophy and Human Sciences, Geosciences. | 20/728 |
| | Natural and health sciences | Medical Sciences; Nursing; Biology; Chemistry; Physics; Pharmaceutical sciences, Physical education and Geosciences. | 15/735 |
| | Engineering | Agricultural, Civil, Food, Mechanic, Chemistry, Electric and computational. | 12/745 |
| | Mathematics, Computational and other technological sciences | Mathematics, Statistics and scientifical computation, Computation | 5/190 |
| | Total | - | 52/2.398 |
| Pucc | Human sciences | Architecture, Arts and Design, Human, Social Sciences and Law, Economics and Business, Languages and Communication | 30[46] |
| | Natural and health sciences | Biosciences | 15 |
| | Engineering | Polytechnic | 15 |
| | Mathematics, Computational and other technological sciences | Polytechnic | 3 |
| | Total | - | 63 |
| Facamp | Human and business | Business, Law, Economics, Marketing, International Relationships | 9/897[47] |
| | Engineering | Computation, Industrial, Mechanical | |
| | Total | - | 124/3.295 |

Source: Unicamp; Comvest; PUC-Campinas; Facamp. Organized by the author.

[46] Due to possible variation according to multiple aspects, the university didn't make the exact number of vacancies public.

[47] Similar to footnote 23, in this case, the university only published the total number of vacancies.

The frame shows that one of the main activities developing in Barão Geraldo, Campinas, is to create qualified workforce, to work on the companies and organizations that the municipality have been enquiring to attract. Through geographic perspective, then, it is possible to argue that the infrastructure present in Barão Geraldo consist in capital materialized in space in moments of great accumulation as temporal and spatial adjustment, as argues Harvey (2005) aiming to create qualified labour to produce more value.

These dynamics create transformations in urban space, being one of them a different connection with other territorial structures. In the case of industry, as we saw, the location of units tends to relate with highways and massive transportation structures (Sposito, 2007). Now, these activities tend to be closer to R&D centers, Universities, other similar companies etc. The main manifestation of this phenomenon in Campinas is the HIDS initiative. To further develop on HIDS, it is important to start explaining that according to FIPE-FAPESP (2020) and Fernandes (2022), it began to be thought when Unicamp acquired a new area known as "*Fazenda Argentina*" (1,4 km²) to expand its campus and the central administration entrusted DEPI to develop a masterplan.

Part of that supposed consensual urban development, debated previously on this document, Unicamp decided to bring the sustainable development approach to this campus expansion and invested in partnerships to attract funds and materialize the intended measures in the area. This resulted on the creation of a Founding Advisory Board[48] , in which 14 entities take part: São Paulo State Government (Economic Development Department), Municipal Council, Unicamp, PUCCamp, Facamp, Embrapa, CNPEM, CPqD, TRB Pharma (private company), Cargill (private company), Global Tech (private company), Eldorado Institute, CPFL (private company) e SANASA – these institutions were elected members of the Board due to its location inside the area of interest. Figure 36 represents this area and the institutions that compose it (HIDS, 2020).

[48] Our translation to "Conselho Consultivo Fundador".

**Figure 36** - HIDS main institutions and land use

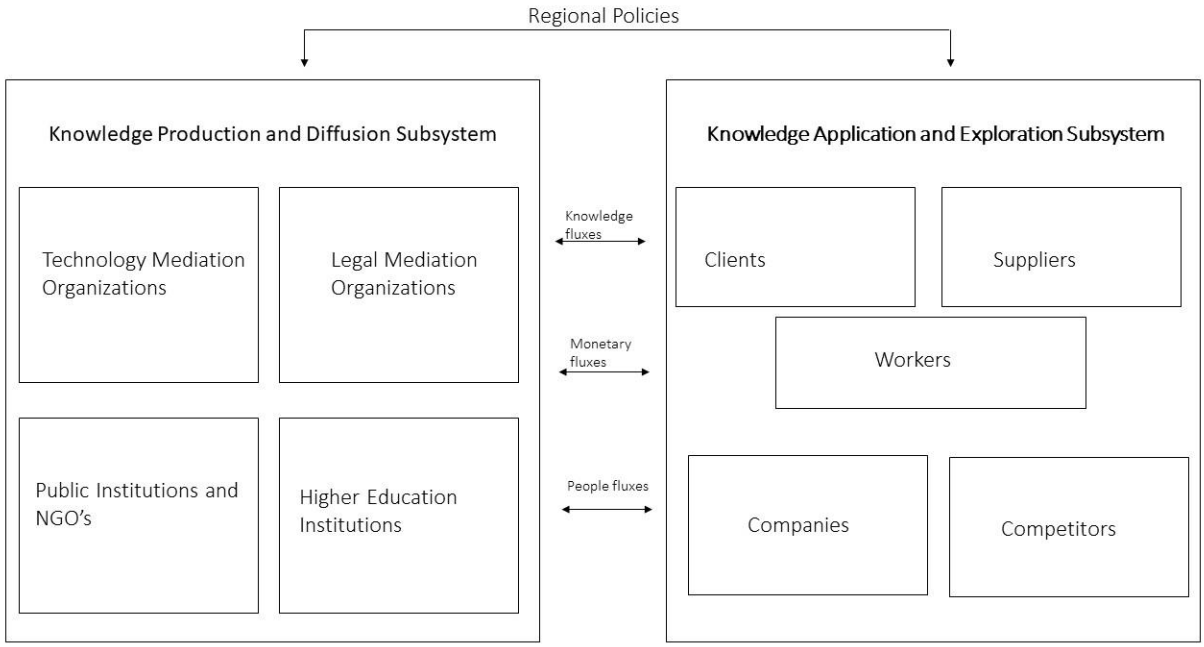
**Figure 37 -** Cargill Office (HIDS, Barão Geraldo, Campinas)


Source: Author's Collection. Obtained in Field (2023).

Developing a slightly different approach, mainly due to the scale (regional *versus* local), Beneli *et al* (2022) proposes a concept to Regional Inovative System, where they differ a Knowledge Production and Diffusion Subsystem and Knowledge Application and Exploration Subsystem. In this case, they interact sharing resources (people, knowledge and money) and they are both mediated by regional[49] policies. Figure 38 is one adapted version of the design produced by Beneli *et al* (2022).

[49] The approach developed by the authors are complex and full of details, connections and concepts. As it is not strictly linked to Smart Cities, the research could not fully develop/apply it. More on this debate can be found at Autio (1998) and Todtling and Trippl (2005), among others.

**Figure 38** - Regional Innovation System Adapted from Beneli et al (2022)




Source: Beneli *et al* (2022). Adapted by the author.

Our objective is not focus on specific attributes of this model, though. This exposure helps the research on conceptualizing and understanding how "Knowledge application and Exploitation" institutions interact with space. We presented and briefly discussed the educational and research-focused structure in Campinas. In this case, we understand that the context of investments in R&D created possibilities and structures to other institutions linked with services with high qualified labour, high technological infrastructure, sophisticated services offer and expensive housing in condominiums with ecological appeal.

We argue that this context leads the north area of Campinas to a specific dynamic that represent its own characteristics and contradictions, having HIDS area as the centre and expanding. By using our cartographical approach, with choremathics, it is possible to state that this focused area is expanding towards EPA Campinas, having Dom Pedro I road as porous boundary. Despite the mentioned institutions part of the R&D complex or HIDS, other companies are fixing their offices in the regions, as Frame 21 shows.

**Frame 21 -** Elements producing new spacialities north Campinas'

| Land Use | Characteristics | Enterprises |
|---|---|---|
| Companies that demand high qualified labour | Take advantage from the technological and symbolic structures in north Campinas, as well as use big offer of qualified labour force to develop its activities. | Global Tech; CPFL; Santander; CLARK; XTAL; Cargill; CODETEC; Positron; TRB etc. |
| Real state endeavours aiming to receive companies/people with high technologic infrastructure | Create big and expensive infrastructure to receive offices and services of big companies with high technology and qualified labour force. | Smart Buildings (Galleria); Uliving |
| Workspaces focusing on flexible/neoliberal economic context | Similar to the above line, but with smaller companies or "individual entrepreneurs[50]", reinforcing neoliberal understanding on marketing | "Cooworking" stations; Startups at Unicamp Technological Park; Praça Capital. |
| Real state enterprises focused on expensive and fortified housing | Linked with ecological and sustainable development, people intend to live near "nature", without relinquishing good infrastructure, technology and security. | Mirantes da Fazenda; Arboredo dos Jequitibás; Jardim Botânico; Bellagio; Villagio Felicita; Village Conceição; Villa Toscana; etc. |
| Sophisticated and high aggregated value services | Aiming to meet the demand created by the other structures, offers expensive and sophisticated services, as haute cuisine, international schools, specialized stores and boulevards. | Galleria, Iguatemi and Dom Pedro Shopping Malls[51]; Spani Wholesale |
| Digital platforms offering convenience to the housing/working structures | Based on digital application, companies offer convenience services, mainly food delivery and car rides by ultra-exploiting labour | Ifood (created by Unicamp former student and developed in Campinas); Uber; Rappi; 99Taxi |

Source: made by the author.

Regarding the real state endeavours, we highlight two cases: the corporative "smart building" centre in Galleria Shopping Mall centre, that recently had two new towers constructed to attract companies that need high technology infrastructure to run its business (but don't have is own building due to many reasons (cost, size, administration etc). This centre represents a

[50] Multiple similar terms are very common in Brazil currently to refer to this process of individual workers to entitle themselves as entrepreneurs. "Micro-entrepreneurs", MEI (meaning Individual Micro Enterprise) or PJ (meaning that the labour contract was made with a Juridic/Legal Person, institutionalizing individual labour.

[51] Despite the Malls were first built during the decades of 1990/2000, both Iguatemi and Dom Pedro recently undergone major renovations, focused on luxury brands and restaurants stores.

new pattern of corporative building in Campinas, as it meets “Triple A” requirements on technology, infrastructure and energy management. Also, it is located and the edges of Dom Pedro I highway, in north Campinas. The building’s architecture also alludes to the neoliberal type of form, previously shown in this dissertation in London or Cardiff cases. Figure 39 shows one of the towers.

**Figure 39 -** Galleria Smart corporative centre (Smart Building)

Source: Author’s collection. Obtained in field (2023).

Second, the brand new “Uliving – University housing” building in Barão Geraldo, recently (10/2023) inaugurated to absorb high demand on Unicamp, PUCC and Facamp students. This new building has the potential to be disruptive because it represents a new management and business model on student housing in Barão Geraldo, which is already full of small student “studios”. This new endeavour, however, appeals to technology infrastructure, quick location procedures, surveillance and “sharing spaces and communities” to attract its

users, and is controlled by a big real estate and engineering group, GNO, that also provides this service in São Paulo (SP), Rio de Janeiro (RJ), Santos (SP) and Porto Alegre (RS).

This new approach to student housing in Barão Geraldo connects with a broader change for services pattern linked with “sophisticated”, “high-technology” and security business, commonly used in smart contexts. Although the word “smart” is not exactly mentioned in this new business advertisement, we identified these multiple similarities. Figure 40 shows Uliving unity in Barão Geraldo. Again, it reveals the private marketing offering “smart” solutions to “problems” in urban structure (safety, lack of infrastructure).

**Figure 40 -** New student housing endeavour in Barão Geraldo (2023)


Source: Author’s collection. Obtained in field (2023).

In smaller scale, the co-working stations, included in PECCI (2019) as an activity to be further developed, are also common in current urban space in Campinas. They are common to start-ups and single entrepreneurs and micro-business to decrease operation costs, being strongly connected to micro-cloudwork and represent a new approach to spatial division of labour. In a class divided society, while the big companies install themselves in buildings like Figure 39, small companies or individual entrepreneurs emulate that forms on this type of workstation. Figure 41 shows co-working station in Campinas.

**Figure 41 -** Co-working station in Campinas (2023)


Source: Author's Collection. Obtained in field (2023).

Another process linked to these dynamics that emerged and consolidated in Campinas (and in multiple other cities in Brazil and in the world) is digital services platforms and the geographic-tethered work. The space, in this case, have technological infrastructure that allows companies to exploit labour, while these new dynamics delivery demand for private transportation, food delivery and other services offered through application. The supposed smartness in Campinas, then, reveals its uneven reproduction: while high income families are part of a qualified labour, fortified enclaves housing and sophisticated services, spacialities connected to how Campinas dialectics deals with, among other process, the ideal of smart city, the precariat, ultra-exploited, is obligated to work long hours, get exposed to risks. These processes emerge and answer the question: *who is the smart city for?*

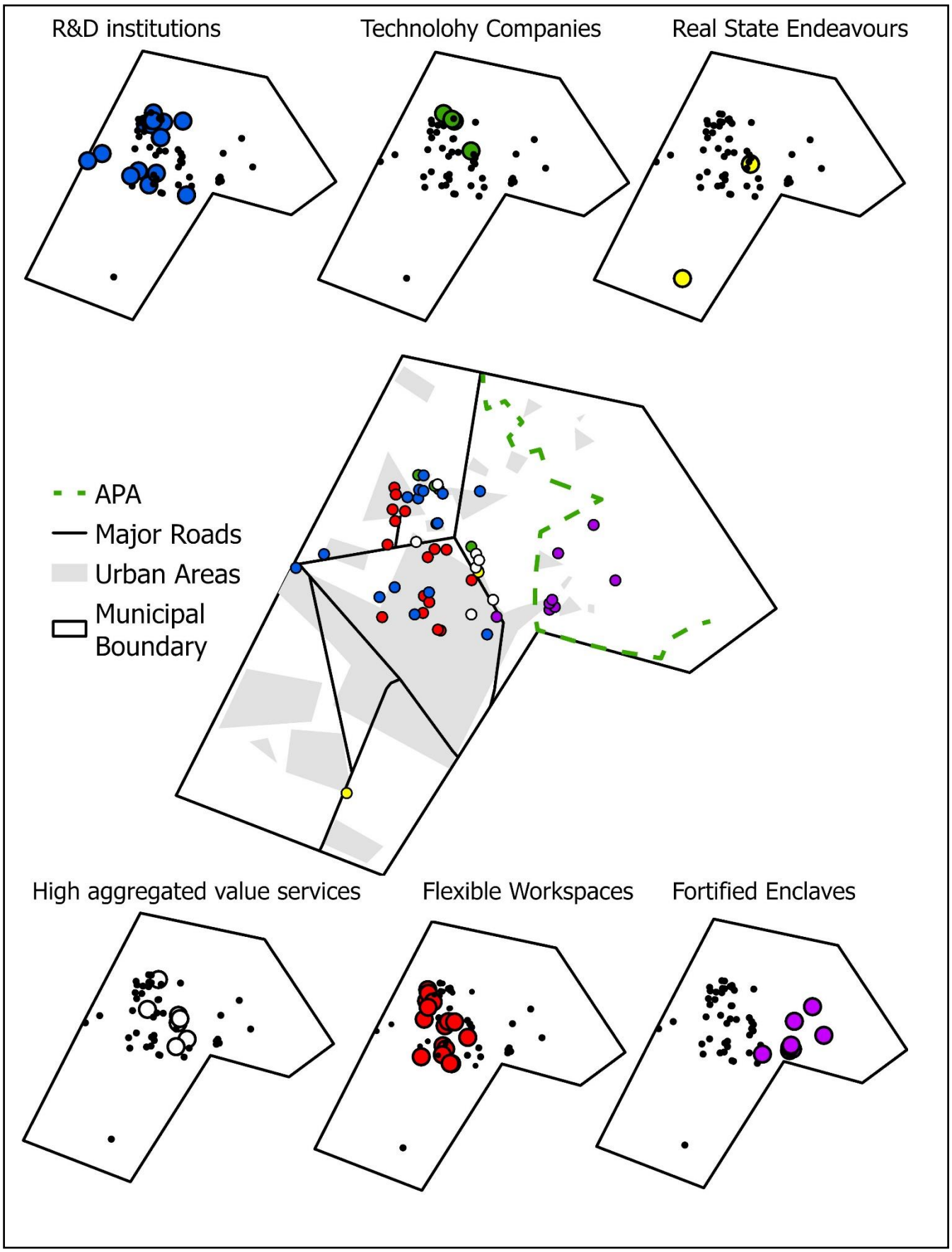
To represent and understand the relationship of this context with urban space in Campinas we produced Figure 38. The core questions in this case, beyond what me mentioned, were: How does these fluxes relate to territory? What other land use they help to create and enable? First, Frame 22 shows and explains chorems found in Figure 42.

**Frame 22 -** Representations and Sources to Figure 42

| Included Chorems | | Representations | Fluxes | Source |
|---|---|---|---|---|
| Municipal Boundary | | Fabric/Polygon | - | Made by the author based on PMC (2014) and GeoGet (2020) |
| Highways | | Line/Disposition | Cargo Vehicles<br>Passengers Vehicles | Made by the author based on DER (SP) (2022) |
| Viracopos Airport | | Point/Gravitation | National and International Cargo<br>National and International Passengers | Made by the author based on Viracopos (2022) |
| Urbanized Areas | | Area/Territorial Dynamics | - | Made by the author based on previous research available at GeoGet (2020) |
| R&D infrastructure | | Point/Gravitation | Knowledge<br>Qualified labour | Baldoni (2014, 2019); Deziró (2020). |
| Typical "smart" land uses | Tech companies | Point/Contact and Input | Information<br>Capital<br>Economical<br>Decision<br>Data | Google Maps (2023); Information obtained and verified in field (2023). |
| | Real state endeavours | | Information<br>Capital<br>Economical<br>Decision | |
| | Flexible workspaces | | Economic fluxes<br>Labour force<br>Data | |
| | Fortified housing | | Data<br>Consumption | |
| | Geographic tethered labour | | Ultra-exploited Labour force<br>Data | |

Source: Organized by the author.

**Figure 42 -** "Smart" related elements in Campinas




Source: Made by the author.

As it is possible to observe in the chorem above (Figure 42), each one of the mentioned and discussed elements has its on spatial pattern, due to multiple contradictory interests that shape the production of space. Some of the elements, like the fortified enclaves or technology companies are more concentrated than other, like “co-working” stations. We argue that these different patterns are related to the number of constraints, and the most specific and expensive activities tend to be more concentrated.

It is important to also highlight is the role played by EPA, that works like a barrier with flanks, specific to land uses related to housing (high-income and fortified enclaves housing) and sophisticated services. All the other activities respect the boundary imposed by EPA. Even with the tendency to agglomerate fortified enclaves since the 1990’s, the current stage of production of space is conducing the region to almost totally privatized space, being difficult to even circulate through the district due to closed/privatizes roads. The most impressive building site in construction currently (10/2023) is *Ville Sainte Anne*, that indicates four different condominiums. Figure 43 shows the size of this real-estate endeavour, with the circled area to highlight its length.

**Figure 43 -** New fortified enclave endeavours in Sousas, Campinas (2023)

Source: Author’s collection. Obtained in field.

Linked with the spread of high-income housing in Sousas and with the ideal of smart cities, the number of sophisticated services, to attend this up-middle class consumption demands increased, mainly in Sousas and Joaquim Egídio. It is possible to find multiple different types of business, since “gourmet” or “premium” version of regular products, luxury brands stores or sophisticated “cousine” restaurants, as shows Figure 44.

**Figure 44 -** Sophisticated-focused business in Sousas (2023)


Source: Author’s collection. Obtained in Field (2023).

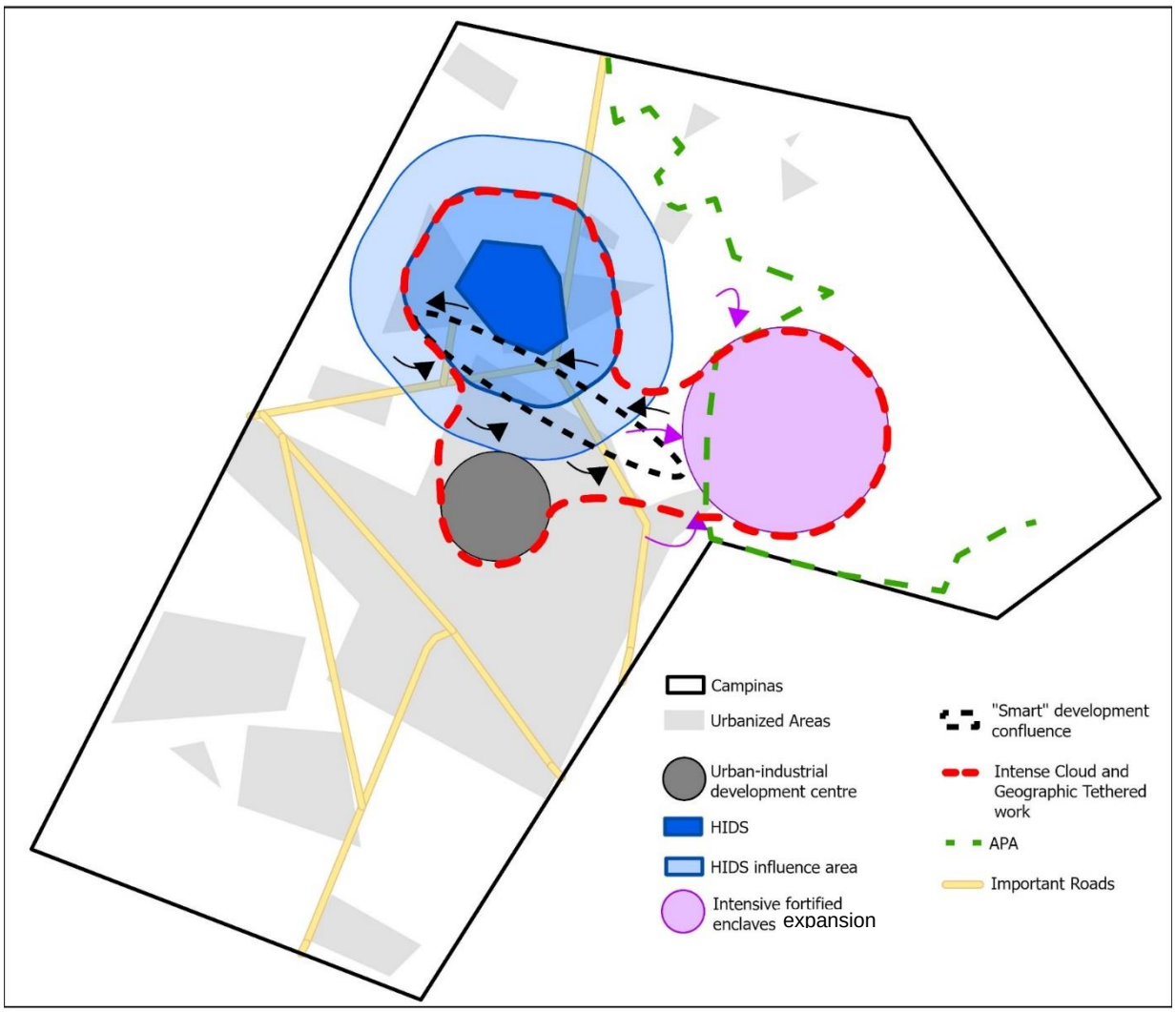
We also have to mention Dom Pedro I highway and its power to attract multiple of the elements shown by us (commerce, tech companies, R&D institutions). It becomes to work increasingly like a big avenue and less like a highway. One important use that it assumed is to connect people that live in Sousas to other urban structures. In addition to Galleria Smart Building, we also observed multiple new endeavours *currently in construction* – to reinforce how intense are these dynamics. In field work carried out in 10/2023, we observed new condominium buildings (also fortified enclaves) and two new hypermarkets: one to be inaugurated on 11/2023 while the other is still not finished. Figure 45 shows these cases.

**Figure 45 -** New endeavours at Dom Pedro I edges (2023)


Source: Author's collection. Obtained in field (2023).

Based on the patterns of the mentioned elements, together with the whole discussion proposed by us during this research, we elaborated one more chorem, synthetizing, on our approach, how the ideal of smart cities have been influencing in the production of space in Campinas and which spacialities it shapes. Again, we reinforce that many of the mentioned processes or elements might have its roots before the adoption of specific smart policies in Campinas or before the apex of "smartness" development. However, if we included the elements in our analyses, we consider that somehow, they are connected or was embraced by the ideal of smart cities. We present Figure 46.

**Figure 46 -** The ideal of smart city in Campinas chorem




With this chorem (Figure 46) we aim to focus on a few processes in Campinas, mainly in north Campinas, as it is possible to observe. The chorem shows, first, the fragmented urban space in Campinas and how the urban-industrial development centre was more connected to the biggest urbanized areas then the current centralities. Although still influential in some aspects, the chorem shows that at least when related to the ideal of smart cities or to the current "strategic planning" approach that Campinas gave to its development, this area is not the most important anymore.

Linked with technology development, HIDS (and Unicamp) became more influential in uniting multiple agents that take part in the process and creating a "region" on the city that favours "high technology developments" (qualified labour, technological infrastructure, specific land use regulation) on its surroundings. Also, part of other multiple

urban complex processes, the intense expansion of fortified enclaves in Sousas take part in the analysed case, as it is place to multiple high-income workers/entrepreneurs who wants to live close to "smart" gadgets and systems (private security, for instance) but also fake that live near "nature". These three structures (urban-industrial centre, HIDS and fortified enclaves) have in common the proximity of its "influence area" with Dom Pedro Highway, making its edges place for great interest, being this one of the most dynamics in Campinas, with a lot of current developments – that's why we decided to call it "smart development confluence". Luxury brands stores at Galleria, Iguatemi and Dom Pedro shopping malls, hyper-markets, smart building: all of them "converge" to these edges.

Mainly HIDS and Sousas are the "razor's handle" of the ideal of smart city, the virtuous and enlighten side, usually framed by rankings, advertisements, city marketing policies - detached from other urban spatialities in the process of fragmentation. The "sharp end" (as call it Ioris (2015)) of "smart" development's razor comes out when we frame the geographic tethered work and micro-cloudwork, very intense in these areas, due to the precarious work condition offered to these workers, while they are also connected to a very "innovative" and "high-technology" business. The technology and smartness used to mediate and control this work doesn't, in any dimension, aims to provide any guarantees to the "employees". The urban space has "digital infrastructure" and citizens have smart gadgets to connect with the smartness of development. At the other end, similar gadgets controls labour and amplify capital accumulation, accelerate the reproduction of space.

When approaching Campinas' strategic development by our critical ideological lens, we observed how the ideal of smart cities developed from the local territorial formation and deepened multiple urban processes, mainly by the capability of reuniting under new aesthetics, contents, regulations, and spacialities. Industrial production, flexible forms of labour, high-income housing gained new ties under the ideal of smart city: the (geo)technology enabled world reproducing neoliberal urban patterns.

For all these reasons, we argue that the ideal of smart cities, within our study case, comes "from a north to other", thinking from the global to the local scale. Spatial models, business approaches, "smart" gadgets or devices, strategic planning – all these elements have their roots in capitalist centre and got put in the centre of accumulation in multiple peripherical spaces, as it occurs in Campinas. Its periphery, however, barely sees smartness (except when at work).

## FINAL CONSIDERATIONS

When delving into the realm of urban geography, within the investigations of a set of socio-spatial discourses and practices that have taken shape and been named 'smart cities,' numerous challenges have arisen. From both a theoretical and empirical standpoint, urban studies in Brazil had ventured little into the path of understanding what potential spatial transformations could materialize in light of this recent context, a product of a crisis-ridden capitalism seeking to deepen its connections across spaces globally and under the aegis of neoliberalism.

Addresing what we conventionally refer to as the ideal of smart cities also brought forth a significant opportunity to bridge urban geography with non-hegemonic cartographic perspectives in the Brazilian context, marked by the consolidation of a more positivist epistemological framework of cartography. It is evident that there are numerous works in urban geography that depart from a critical social worldview and effectively incorporate cartography. However, in the case of this dissertation, the concern was more profound, as some of our premises sought to establish a counterpoint to the perspective of quantification and datafication of urban space as a solution that has become akin to what was known in Ancient Greece as 'Deus ex machina' - the divinity that arrives at the end to resolve all impasses.

The methodological choice to incorporate chorematics throughout the work proved to be sound. The spatial relationships between the discussed elements became increasingly evident with each new round of practice and reflection using representations. This approach also allowed for the inclusion of a large volume of structures with minimal loss in the visualization and interpretation of the models. Its potential can be further explored within the context of Brazilian geography. Nevertheless, at various points in the dissertation, we also resorted to more conventional representations.

The perspective of technology as a solution for the quality of social reproduction is neither new nor exclusive to the theme of "smartness." Since Goethe's "Faust," which contributed to perpetuate modernity, the drive to transform space at any cost in order to achieve something known as "development" has had technology as an ally. However, it is in the post-crisis context of fordist capitalism, more than 150 years after the mentioned publication, that smart cities have their roots. Between the decades of the 1990s, 2000s, 2010s, and 2020s, the ideal of smart cities began to bring together various processes stemming from different fronts of the production of space, composing itself as Frankenstein did with his monster, as we have already revealed throughout this text.

Efficiency, rationality, sustainability, technology, innovation – at some point during these over 30 years that the concept of a smart city has in some way been circling cities, all these concepts have played central roles in materializing specific spatialities of this time and space. Particularly, rationality, precision, accuracy, and control have a specific interplay with debates within geography and the epistemology of cartography and GIS: the new technological perspectives were seen as the missing link that would allow geotechnologies to simultaneously play a central role in the process of capital accumulation by "enabling spatially" smart cities and, “free from ideological assumptions”, make geography central in the context of knowledge production. The concept of smart cities, then, was also constructed within geography by creating models, plans, sensors, and systems to address the immediacy and the volume of events in large cities.

In addition to being composed of multiple elements, the ideal smart city is also flexible, much like the period in which it solidifies. Through extensive literature review and discussions with renowned experts in the field, three main phases have been identified, overlapping within the urban space. The initial phase, coordinated by technology companies seeking a new market, aimed to incorporate technology into the city, marking an important frontier to unleash their products. Years later, the initial drive, which was quite broad, identified two main areas of focus for establishment: transportation/urban mobility and security. Finally, digital platforms consolidated themselves as promoters of a daily life mediated and "facilitated" by technology, giving rise to the “current existing smart cities.”

These elements are already capable of leading the space in which they are first composed, the centre of the world-system, to important contradictions. However, when taking this set to the periphery, its potential to generate contradictions rises. The comparative study facilitated by the time spent researching abroad has proven to be a central component of the conceptual, theoretical, and practical approach. The experience of visiting famous smart city projects, engaging in dialogue with global experts in the field, and accessing literature that has had limited penetration in Brazil has significantly strengthened the outcomes. Investigating another case and comparing it with Campinas was pivotal in focusing efforts on the right aspects of the space production process.

Based on a comparative experience with Cardiff, the present research identified and organized central elements for the core case to which we have dedicated our efforts: understanding the urban space of Campinas, already known for its fragmented urban-regional characteristics and marked by socio-spatial inequalities.

We understand that the territorial formation of Campinas involved the quest for technical primacy by its hegemonic agents over many decades. Key milestones in this process include: the investment in industrial capital by those who had amassed wealth from the exploitation of enslaved labor, the adoption of multi-scalar policies for investment in education, research, and innovation infrastructure – which started to concentrate in the northern areas of the urban space in Campinas, and as an essential turning point towards the adoption of the ideal smart city: the establishment of the Municipal Council for Science, Technology, and Innovation in 2014. From that moment on, the reproduction of space in Campinas became strongly conditioned by the smart city project.

The scenario in question was shaped by the local government, which produced mainly two central documents to coordinate actions and reflections on the path towards becoming the desired "smart city" – the Strategic Plan for Science, Technology, and Innovation in 2015 and the Strategic Plan Campinas Smart City in 2019. The outcomes of these plans are both immediate and tangible, such as the expansion of the municipal fiber optic infrastructure, the construction of databases, and the process of digitizing administration. They are also organizational, as, at least officially, established structures like the Department of Development or EMDEC gained new designations during this period, becoming the Department of Development, Technology, and Innovation and the Department of Strategic Affairs and Smart Cities, respectively. Moreover, it had regulatory effects: the 2018 Master Plan and, especially, the Innovation Act of 2021, opened the doors of the public sector and the city to hegemonic and "smart" capitalism.

In this context, the focus of the ideal of smart city solidifies in Campinas, and urban disparities become evident. The northern districts are subject to new spatial developments for middle-to-upper classes and hegemonic groups, while the periphery of Campinas is overlooked in the strategic plans and rendered invisible in the city's promotion to investors. Within this context, a striking element reveals a protagonist in the process of space production under the banner of the ideal of smart city: the HIDS, led by Unicamp.

The falsely consensual global agenda exerts a significant influence on Campinas, driven by the HIDS, which propels land use and socio-spatial relationships characterized by the demand for highly skilled labor, real estate developments to accommodate individuals or offices with a high demand for technology and data processing, flexible workspaces typical of neoliberal capitalism, sophisticated and luxurious offerings of services and digital platforms providing comfort to groups who have access through the ultra-exploitation of labor enabled by technology. These conclusions demonstrate that the process we call the ideal of smart cities has

an essentially urban dimension, deserving attention from Geography, in order to unveil the increasingly intense traps of development.

The ideal of smart city will continue to perpetuate itself in the urban space of Campinas and extend beyond, to other municipalities and contexts in Brazil, Latin America, and throughout the world-system. After all, it represents hegemonic interests that have been expanding for centuries with a well-known drive. Nevertheless, this research hopes, even if to a small extent, to have been able to raise awareness about the dangers and contradictions of viewing urban space from a perspective so radically centered on neoliberal capitalist development.

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# ATTACHMENTS

**ATTACHMENT 1**


**UNIVERSITY OF CAMPINAS**

**INSTITUTE OF GEOSCIENCES**

**DEPARTMENT OF GEOGRAPHY**

Lucas Pinto Seixas

**Interview**

The following interview script aims to semi guide the dialogue about the research conduced by Lucas Pinto Seixas (RA 182668). The interview doesn't aim to collect personal data or information about the interviewed, but to collect objective data about processes at the local power administration.

**Part I – Basic Characterization on the sector**

1. How many employees does Strategic Subjects and Smart Cities Office have?
2. What are the training areas of the employees?
3. What are the main projects under development by this Office currently?
4. What was this Office founded?

**Part II – Characterization on Data, Technology and Geotechnology**

1. Are there databases relevant to project development in the Office?
2. The production or storage of data is made by the public or private sector?
3. Is there any public service feed by the database?
4. Are the addition costs to citizens due to these services?
5. The sector daily deals with data production/management?

**Part III – Smart Cities and Territory**

1. Are there redevelopments being implemented by the Office?
2. In each area of the city are these redevelopments located?
3. Are Geotechnologies important to achieve the Office's objectives?