Graduation Thesis MSc Management in Built Environment TU Delft

POTENTIAL ECONOMIES

using big data to analyse urban competitiveness of new urban communities; a case study on socio-economic indicators in Egypt

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to my parents

Samaa & Khaled

for your unconditional love & unwavering support

Preface

This masters thesis is yet another endeavor dedicated to my hometown, Cairo, the city victorious & conqueror. For those who live, dwell and love their beautifully most-reous cities. For 25 years I have been in love with Cairo, for the past 2 I have realized that the people have always been an integral part of it. For that I must thank the people with whom this has been made possible, enjoyable and memorable

I am so grateful to the day, my mentor Philip Koppels gave us the first lecture on urban economics, for it sparked this fireworks that drove me to explore new territories for the love of this glorious city. Many thanks to Philip Koppels for the mentorship. It was an enjoyable ride. Thanks to Yawei Chen for setting the bar so high. It was worth it.

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Abstract

Orthodox economic models often linked the size of cities to their economies. However, this changed through the last quarter of the 20th century; cities grew bigger, side by side to unemployment, inflation and falling wages and productivity (Davis, 2006). In Egypt, urban migration was considered the root of the city's density. In the seventies, New Urban Communities were developed with strategic visions, they deployed enormous resources and created supply for the economic and social aspects of urban life. However, today they remain vastly vacant and most of them contribute little to the region's economy.

The main research question of this research is: "How can attributes of urban competitiveness contribute to the development of sub-centres in new urban communities of emerging economies?" To answer this question two of the eight developments around Cairo are comparatively analysed with regard to their urban competitiveness. Theories of urban economics and its spatial structure are adapted for the context of this case-study. A new quantitative methodology is utilised to overcome data challenges in the context of emerging economies. Exploratory spatial data analysis is used to demonstrate the spatial distribution of socio-economic attributes and their relation to the resulting urban competitiveness. The comparison between city centre and NUCs is analysed to inform policies for urban growth using the framework developed in the literature review.

The research highlights the importance of autonomous urban management for each NUC. This is carried out within a framework of a collaborative polycentric urban region that ensures the differentiated roles of each region. The urban competitiveness analysed shows the system of cities within the metropolitan region, and the potential emerging sub-centres in NUCs. The mapped socio-economic attributes establish the possible correlation between urban competitiveness and access to these attributes. They also show mismatches in supply and demand, and shed light on particular effects of public urban spending.

Keywords: Urban Economics. New Towns. Cairo. Egypt Urban Competitiveness.

Table of Content

List of Figures

List of Tables

Abbreviations

CAPMAS	Central Agency for Public Mobilization and Statistics
ESDA	Exploratory Spatial Data Analysis
FIRE	Finance Insurance Real Estate
GCR	Greater Cairo Region
NUC	New Urban Communities
NUCA	New Urban Communities Authority
TfC	Transport for Cairo [consultancy agency]

Photo by Amr Elsamahi

1

Chapter
PROBLEM ANALYSIS

Problem Analysis

New towns development is a widely employed modal of urban planning, especially in emerging economies. In Egypt, one might notice that formal planning practices embody an array of arbitrary actions on short term, which haven't led to long-term visions for these new urban communities. Sims (2016) argues that the main challenge regarding enhancing the new developments is the autonomous governance mode with which the state mobilizes its resources and authority. The inadequacy to turn urban visions to short term actions and on ground plans and policies, has yielded the urban management sector a firefighting mentality, which deals with problems as they arise, rather than commit to the long-term visions. The cycle propagates with a lack of reflective studies that evaluate those urban endeavours.

Figure 1: *Cairo's Ghost Towns- Source: CNN*

Background Study- Continuous Urbanization

There is a widely used demographic, of the world's 55% inhabitants, living in urban areas (World Urbanizing Prospects, 2018). Cities have absorbed almost two thirds of the world's population growth since 1950's (Davis, 2006). There has been quite a few daunting speculations in the 1970's regarding urban growth and rural-urban migration. These population speculations coincided with the advancement of geographer planners, who developed concepts from pure transportation studies, and modelled centralized urban developments of regions and sub-regions, affecting many parts of the world (Hall, 2013). However, in the 1970's these paradigms took a hit on the hands of Jane Jacobs and her anti-centralized planning, sadly not everywhere. The expectation for cities developments proved too optimistic as cities grew faster beyond these expectations. There are more than 500 megacities today housing more than 10 million inhabitants (see Table 1). The most daunting is the emergence and growth of hypercities housing more than 20 million. In 2000, only Tokyo had surpassed this size; today, 20 cities are included within this category (World Urbanizing Prospects, 2018). So, fast urbanization met with transportation based planning created monstrous urban planning paradigms and eventually prodigious metropolitan regions.

Furthermore, theories and paradigms regarding the limits of the city and size of metropolitan regions grew significantly, in the hopes of curbing this phenomenon. However, the urban planning paradigm that sought for expansion beyond the metropolitan regions had already materialized. The hype of small conglomerations of rural industrialization and expansion of towns around the megacities was a great part of the discourse (Jacobs, 1967). Suburbs and new sleeping towns around cities were sprouting everywhere in the world.

Area of residence and size class of urban settlement (number of inhabitants)	*Population (millions)*				*Percentage*			
	1970	*1990*	*2018*	*2030*	*1970*	*1990*	*2018*	*2030*
Total	3 701	5 331	7 633	8 551	100.0	100.0	100.0	100.0
Urban area	1 354	2 290	4 220	5 167	36.6	43.0	55.3	60.4
10 million or more	55	153	529	752	1.5	2.9	6.9	8.8
5 million to 10 million	107	156	325	448	2.9	2.9	4.3	5.2
1 million to 5 million	244	467	926	1 183	6.6	8.8	12.1	13.8
500,000 to 1 million	131	208	415	494	3.5	3.9	5.4	5.8
300,000 to 500,000	87	159	275	320	2.3	3.0	3.6	3.7
Fewer than 300,000	730	1 147	1 750	1 971	19.7	21.5	22.9	23.1
Rural area	2 346	3 041	3 413	3 384	63.4	57.0	44.7	39.6

Table 1: Population Distribution- Source; UN World Prospectus 2018

The Case of Egypt

In the case of Egypt, the fast urbanisation was seen as a threat not only to the built environment, but to the agriculture land surrounding the Nile Delta. As urban migration to the capital coupled by population growth and advances in health utilities increased urban population (table 2), the built environment grew fast especially in informal areas within the peri-urban region of the capital (Sims, 2012). The rhetoric developed nurtured the plans for 8 different satellite towns, around Cairo. Through the last 50 years, four generations of new urban communities [NUC] were planned, with around 41 NUCs around Egypt. Today this planning paradigm is the defining part of urbanism and state planning (Sims, 2016). Additionally, conquering the desert on both sides of the Nile delta has created a prospectus for political and economic advancement (Sims, 2012).

Year	Formal Cairo	Informal Cairo	Peri-Urban Cairo (Mostly informal)	Desert Cairo	Total Greater Cairo Regoin (GCR)
1947	2,400,242	0	586,038	0	2,986,280
1950	3,905,670	100,000	955,166	0	4,960,836
1976	4,610,326	1,969,000	1,374,317	0	7,953,643
1986	4,650,000	4,248,866	2,063,376	32,615	10,994,857
1996	4,807,632	5,436,477	2,857,468	149,992	13,251,569
2006	5,005,824	6,742,416	3,942,262	601,767	16,292,269
2009	5,038,763	7,155,106	4,345,567	800,952	17,340,388

Table 2: Evolution of the Population of urban Cairo (Census of Egypt as cited in Sims, 2012)

Background study- Satellite Developments

Many new urban development projects default mid-way, creating unfinished highly vacant satellite developments that would take ages to get housed, resold, and occupied. Governments often resort to financial incentives and extreme fiscal measures of regeneration to attract communities within these ghost towns. Still, they fail in fulfilling their strategic goals: to alleviate city density; mobilize impoverished families to better housing conditions; and create micro-economies that can contribute to the regional economy. In the best of scenarios, these towns take decades to achieve milestones of target population and production (Sims, 2012).

In developing countries, most satellite projects may be a success from a financial stance; the houses are sold, mortgaged, constructed. Governments' treasuries are content with the payments of the sold and developed land. The economy captures booms with construction employment, transfers and taxes. Beyond urban activists and architects, there exists little discontent with these endeavours.

However, these developments are never fully occupied. Their strategic goals are never met. On a long term, these developments are a drain for public resources and a global-financing value-capturing mechanism (Rolnik, 2019). This phenomena propagates to create the modern day ghost towns, a new kind of ghost-towns that have never been inhabited to begin with.

The Case of Egypt

While Egypt offers a unique case of more than 50 years of new cities developments (Sims, 2016), it still falls within a greater realm of speculative urban development. Africa is the fastest urbanizing continent today (Keeton & Provoost, 2018). Egypt only falls third in Africa in terms of fast land reclamation and urbanization after Kenya and Nigeria (Keeton & Provoost, 2018). The uniqueness of the Egyptian experiment is that it offers ample room for exploration. There are already 27 new urban communities from the second half of the 20th century in Egypt (Sims, 2012). Today, the state is developing 21 new urban communities with a capacity of 30 million inhabitants, though so far only 14 have been developed; with current efforts of developing the new capital 40 km away from Cairo's Centre (ElDakhakhny, 2019).

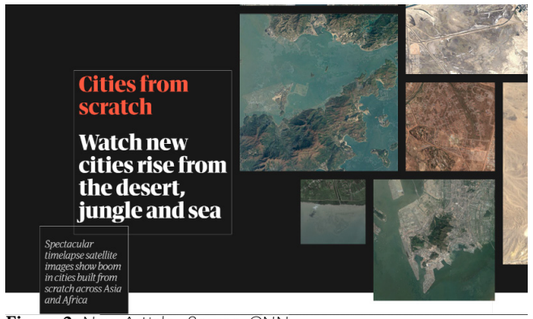
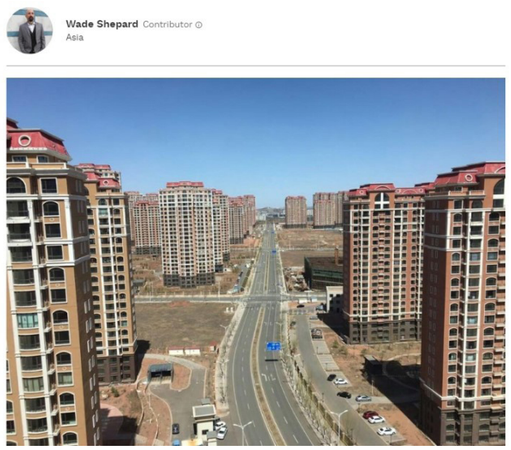


Figure 2: *New Article- Source; CNN*



Why Hundreds Of Completely New Cities Are Being Built Around The World

Wade Shepard Contributor
Asia

Figure 3: *News Article- Source; The Guardian*

Societal & Scientific Relevance

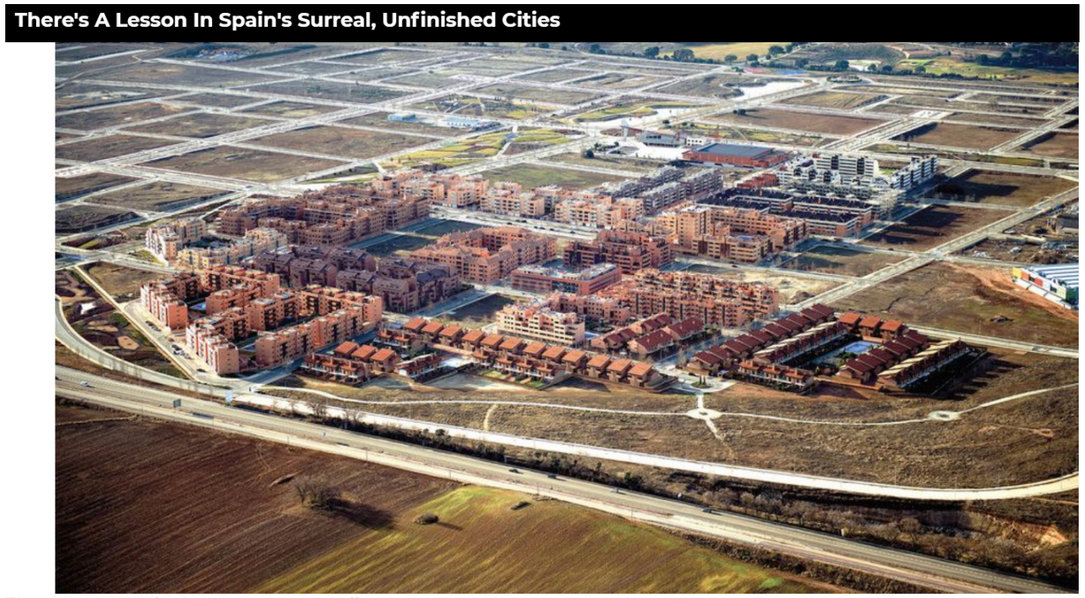


Figure 4: *Spain Unfinished Cities. Source: Huffington Post*

Many research endeavours focus on the quality of the urban planning and architecture design of new urban developments. Most proposed strategies go on to advice on the methods of design practice. Yet, there is noticeable absence in research investigating these new urban developments with respect to existing cities, specifically with regards to their economic activity and strategy proposals. Additionally, few endeavours work on developing research practices applicable to the context of emerging economies and the global south.

While the problem might be aggravated in emerging economies, there exist examples of new urban developments in many developing countries, eg. Spain (Spain Unfinished Cities. Source: Huffington Post). The question for so long was: "do people follow jobs, or do jobs follow people?" However, this research is trying to debunk the new urban planning paradigm of: "we will build, they will come." So much has been built, that is of great potential, yet remains a stagnant burden on cities and their economies.

Problem Definition

1/ Failure to Capture Strategic Goals

The first and most prominent predicament arises in the constant overestimation of the ability of these NUCs to attract inhabitants and initiate urban sub-centres of their own. The current census shows that new urban developments around the country have barely retained 5% of the urban population, as opposed to projected 25% of the urban population around the Greater Cairo Region (GCR). Decentralization as the basic goal of these towns has never been attained. So the first problem is the mismatch between the long-term vision and short-term strategies implemented to attain the strategic goals of new urban communities.

2/ Public Spending on Urban Areas

The second problem arises from the inefficiency of resource allocation for urban areas. The inequality of public spending on new urban communities versus existing urban areas is catastrophic. In Egypt, not more than 2% inhabit these new developments, yet more than 50% of the public spending on urban areas is spent on new developments (Shawkat & Khalil, 2016). The urban spending houses under it electricity, water, sanitation, urban development, social housing, and transportation (Shawkat & Khalil, 2016). The main driver behind public spending on urban areas, specifically urban infrastructure, is the IMF and World Bank proclamation that for emerging economies to develop, there need to be huge investment in infrastructure (Jacobs, 1972; Davis, 2006; as cited in Arimah, 2005). For Jacobs, the billions spent on infrastructure in itself brings about no development in production or providing service (1972). Jacobs (1972) referenced extensively many projects that remained economically pointless, because infrastructure in itself requires extensive initial investment and running costs for maintenance that can only be reclaimed if development actually takes place. For Batty (2018) these projects (transportation in particular) have been overly accepted as drivers of impact. There are simply too many "difficult-to-value externalities" that need to be assessed for enhancing government resource allocation (Tolley & Crihfield, 1987). The second broken link in the chain of urban management; correlation versus causation fallacy poses yet another mismatch in the planning paradigm. Spatial justice in public resource allocation and investment is undermining the socio-economic lives of urban dwellers.

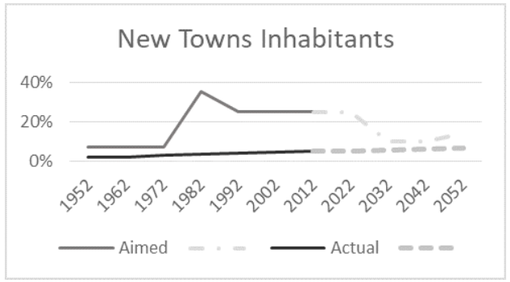


Figure 5: *Population of New Urban Developments (Aimed vs. Actual). Source: Marsad Omran*

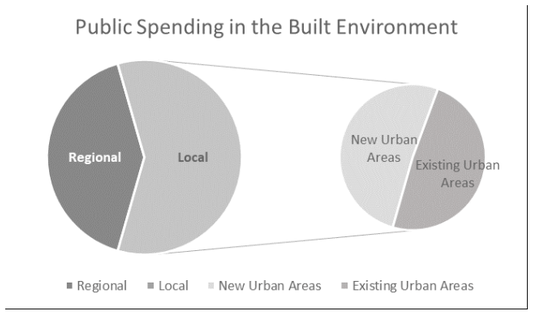


Figure 6: *Public Spending on urban areas (existing vs. new). Source: Marsad Omran*

3/ The Mismatch Between Supply and Demand

There is an extreme inefficacy within real estate markets. First, Egypt suffers from extreme housing shortage reaching 3 Million units (GPG), with annual additional demand of around 200,000 units. The shortage comes with almost 70% in the low-income housing sector and 14% middle-income housing sector (Office of National Censes, 2018).

The mismatch comes due to the quality of the supplied housing units within the NUCs which largely caters to the high-income sector. Additionally, even with many social housing projects developed by the government in these satellite areas; Sims (2016) has argued that location is a vital and a missing attribute of these developments. The mismatch isn't only in the quality of housing, though it is of crucial importance. Sims (2016) deduces that it is also the planning and zoning regulations that render the new built environment extremely segregated and low density. This contradicts with inner city urban areas that have high density and diversity of functions. The availability of economic activities, like micro and small business sectors, are of crucial importance. They present not only income for the local community, which can reach to 45% of local income, but also they add to the liveability of urban areas (Sims, 2012). In new urban communities, the common-practice is the restriction of such activities within residential blocks and neighbourhoods (Sims, 2016). The third problem is with the highly segregated, low-density, inaccessible, and unaffordable housing in new urban communities.

4/ The Ecosystem of Economic Activities

Finally, most of these developments were designed with a vision of creating their own micro-economy, which in turn supports the metropolitan regions or existing city. Mostly industrial, the economic activities within these urban communities have stagnated and never reached their full potential. For example, in 2005 only 14% of 22,680 hectares of industrial land was licensed in one of the NUCs (Sims, 2016). Moreover, the eco-system surrounding an industrial development has often been dismissed in planning. Its effects become clear upon closer look at the small and medium sized enterprises (SMEs) which have been zoned in industrial areas. These SMEs make up to 80% of manufacturing employment in Egypt (Sims, 2016). However, they have proved economically non-viable due to the absence of their nurturing environments. With the low density of new towns, SMEs lacked

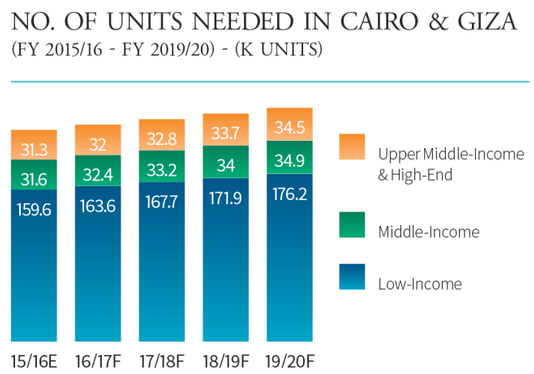


Figure 7: *Housing Units Demand. Source: CAPMAS*

the closeness to dense markets, labour force, social networks and linkages from and to suppliers (Jacobs, 1972; Sims, 2016). The main focus of governance is on the supply-side, not on the launching of the area and sustaining of industries and production (Sims, 2016). This makes the fourth block of our problem analysis that looks into the errors of urban management in identifying and supporting socio-economic attributes of economic activity and urban life.

Chapter 2
LITERATURE REVIEW

Literature Review

Aim

Establishing a framework to understand the conceptual variables and inform the structural design of the empirical research.

Methodology

An iterative exploratory research is used, since most theories had limitations with respect to the case study context. This way the literature examined could be refined and consolidated into an enhanced framework, applicable to the case-study context.

Overview

The theoretical framework is used to elaborate on two questions regarding understanding the role of NUCs within the metropolitan regions. "What to look for?" is positioned through elaborating on urban economic theories and the variables to be investigated; "how to look for it?" is studied through theories of spatial structure of regional economy, which supports the approaches and strategies of this research design.

Conceptual Framework	Analytical Framework
The definition of "City" (Maunier, 1910; Jacobs, 1972)	Base of Urban Life
The Resilient City (Hirsch, 1974; Jacobs, 1969 & 1972)	Urban Resilience
Central Place Theory (Christaller, 1933; Losch, 1940)	Systems of Cities
Agglomeration Economies (McDonald & McMillen, 2007)	Sustained Growth
Regional Spatial Structure (Meyer, 1962)	Spatiality of Economic Activity
Operationalization	
Economic Competitiveness Index (World Bank)	Computational Models
Exploratory Spatial Data Analysis (Luc Anselin)	Geospatial Mapping

Introduction

In Egypt, new urban communities development has peaked again after two decades of stagnation [see Table 3]. Though they are a product of multidimensional strands of causation, Egypt isn't singular in its experience. It is common in post-colonial nation states across Africa to have aimed for similar developments in the second half of the 20th century (Cote-Roy & Moser, 2019). Yet, Egypt remains an outlier with the magnitude of its endeavour, which isn't only creating unlivable urban areas, but hollowing out its centres (Sims, 2012). In the Greater Cairo Region (GCR), the original urban vision was to extend and decentralise the population of the dense metropolis, creating various urban sub-centres around it. With little understanding of urban management, capital city-regions and basic characteristics of urban life, this cycle would not cease to reproduce more urban areas. The mismatch between the vision for the city of Cairo and the on ground strategies and plans presents a great threat to the liveability and resilience of the twenty-so million inhabitants of the metropolitan region. This research is arguing that the state has been caught in a vicious cycle of urban development, as a remedy to the economic, social and political malaise of urban life.

In the first section of the literature review, urban economic theories investigating the role of urban centres and sub-centres within polycentric metropolitan regions are contested. The section starts with a wider understanding of cities' urbanity and urban economies; then moves to growth and agglomeration constituents, informing a theoretical framework of strategies employed; finally looking into socio-economic attributes of urban competitiveness. These comparative urban analyses methods are reviewed through competitive advantage indexing, taking into consideration the specificity of the case-study context within an emerging economy and the scale of the research within a single region.

The second section moves to investigate how the spatial structure of regions affects its urban economy and vice versa. Through overlaying economic analysis to spatial structure analysis, patterns and linkages inform the understanding of the urban economy of regions. Methods to categorize regions and centres using their economic attributes, linkages and flows of economic factors are studied, with respect to notions of applicability and scale, to be employed in the empirical data analysis in chapters 3 and 4

	Development	Year
1	10th of Ramadan	1977
2	15th of May	1978
3	Al Sadat	1978
4	6th of October	1979
5	New Borj Al Arab	1979
6	New Damyietta	1980
7	Al Obour	1982
8	Badr	1982
9	New Saleheyya	1982
10	Touristic Cities	1982
11	New Al Menya	1986
12	New Bani Suef	1986
13	New Nubariya	1986
14	North Suez Gulf	1993
15	Al Sheikh Zayed	1995
16	Al Shorouk	1995
17	New Toshka	1997
18	New Aswan	1999
19	New Akhmiem	2000
20	New Assiyut	2000
21	New Cairo	2000
22	New Fayoum	2000
23	New Qena	2000
24	New Suhag	2000
25	New Thebes	2000
26	East Ouweynat	2001
27	New Luxor	2010
28	**New Adminstrative Capital**	2015
29	Naser City (West Assyut)	2017
30	New 6th of October Gardens	2017
31	New Alamien	2017
32	New Alexandria	2017
33	New Fashn (East Bany Suef)	2017
34	New Malawey	2017
35	New Mansoura	2017
36	New Toshka	2017
37	West Qena	2017
38	East Portsaid	2018
39	New Rashid	2019
40	New Al Obour	2019
41	Sheikh Zayed Extension	2019

Table 3: Table of New Urban Communities in Egypt and their foundation date (Source: NUCA,2020)

Theory Literature: Part 1

There are numerous works that identify the socio-political and economic agencies behind new towns development. Socially, they are seen as the solution to the dense urban fabric that renders 80 million Egyptians [today 100 million] utilizing less than 5% of the total land (Sims, 2016). It is argued that new towns' urbanization schemes initiated post Arab-Israeli conflict have always been politically driven (Sims, 2016; Côté-Roy & Moser, 2019). Moreover, their roots go deeper in the African colonial legacy of planning, with emphasis on the urban centres that would perpetuate modernization across the rural poor (Moser, 2015; Keeton & Provoost, 2019; Lofchie, 1997). Over and above, there is considerable rhetoric on the top-down approaches of planning and developing these new towns (Côté-Roy and Moser, 2019; Sims, 2016; Shawkat & Hendawy, 2016). Most importantly, economically these towns were developed to provide land for the extension of investment and production opportunities in the metropolitan region. The opportunity investment shall balance the economies of agglomeration as per the proximity to the big city, with the diseconomies of traffic, pollution, limited land, etc.

While this research builds on these insights; it aims to investigate and inform better policies and strategies for the already developed NUCs, through geospatial mapping of the urban economy. The research elaborates on the conceptual variables to be investigated for the role of NUCs within the metropolitan region's economy; by understanding the basis of cities' urbanity, urban economics and agglomeration economies. Borrowing from urban competitiveness computation, the role of NUCs will be indexed in relation to the metropolis. This shall inform the socio-economic indicators of a proxy competitiveness framework to be utilized in the empirical part of the research. Second, the spatial analysis will provide insights into the methods and tools mapping metropolitan regions economic activity; the centres and sub-centres of social and economic activity; and the urban hierarchy within the system of cities.

Base of Urban Life

The review starts to explore the genesis of cities as grounds for understanding new urban areas. While it remains a common argument for dictionaries to cite big towns as the definition for cities (Cambridge dictionary); Jacobs (1972) argued that cities haven't grown from agriculture settlements. Cities have always been a centre of trade, mining and industrial production, not agriculture and animal breeding (Jacobs, 1969). Surpassing all limitations of previous endeavours; Maunier (1910) arrived at the conclusion that cities have two folds, they are about aggregation of complex communities and functions confined within limited territory relative to other territories. Through this definition we can understand that the city is about complexity and density, of demographic and functional attributes. This definition is unique in its exclusion of the level of development of commercial activities and production. his global definition of cities developed by Maunier, applies to both developing and developed economies, and thus can be employed in the context of this study to discern the essence of new urban communities

Diversity, Density and Resilience

Moving to the concept of growth, cities' evolution is not unidirectional; ata shows that less than a handful of settlements have been continuously populated across history (Compton, 2015). Not all cities manage to develop resilience and keep their diverse densities intact over time. One of the main fundamentals of city resilience is economic yield and employment (Jacobs, 1984). Similarly, Sassen (2019) views the city as a labour market. This draws the attention to the significance of employment and the urban economy in creating, maintaining and growing urban environments. Hirsch (1974) suggests that the city is a dynamic system of markets that are characterized by density and specialization. Jacobs (1984, p.92) contemplated this idea by describing the resilient city as "adaptable, vigorous and continuously in a state of import-replacing" economic activity. However, nowadays, there remain very few cities that coincide with Jacobs analogies of diverse resilient economies, many work within the treacherous specialized economies. Additionally, cities need more than a concentration of diverse people and employment, a city contains public facilities that ensure the health, comfort and growth of its citizens (Hirsch, 1974). The success of the city is the success of its places in creating spaces that function socially, economically and environmentally (Adam and Tiesdell, 2012). Therefore, employment and accessibility are factors of resilient urban economies, along socio-cultural amenities that create quality of life for urban dwellers.

Cities and Complexity

If cities are said to be devised of complex communities within their territories, then we ought to understand what this complexity implies (Maunier, 1910). For Batty (2000) complexity theories are the embodiment of theories of systems today. Though economic models generally point to a segment in time, it is a severe limitation to view cities in a static mode. Dynamism has become more important than structures; and our mode of operation is always in disequilibrium (Batty, 2000). So while we seek to understand how cities function with all their complex problems, we shall not be reassured by the simple models that undermine the continuous state of flux that our cities experience. Therefore, any data collection or analysis of systems of cities, shall look at variables rate of change over time, rather than singular snapshot.

Base of Sustained Growth; *City Regions and Sub-regions*

From monocentric to polycentric and expanding metropolitan regions, major cities have been extending and their forms and functions have shifted. What we see today are cities that are in complete interdependence with their surrounding regions. The original form of a city housed multiples of functions, products and services within a certain limited territory. As economies grew, cities started expanding and within new territories, new centres for commerce, technology and industry have sprouted. With the challenge of keeping markets interconnected, infrastructure systems were created to keep markets interdependent and functioning.

Understanding how a web of cities or a city region works is one layer of understanding expanding urban life. From governance, state aid, economic institutions, technological breaks, social life, population demographics, etc., these are all characteristics explained by urban economists for functional productive cities. Moreover, there is an important second layer of understanding how cities remain resilient as they expand, how they remain productive and competitive. Cities need to constantly be in a state of diversification, specialization and innovation, in order to remain competitive and sustain their growth (Jacobs, 1972).

With all this in mind, the next two subsections review theories used by scholars to understand, map and analyse cities and their state of flux.

Urban Economics

The earliest urban model was the Bid-Rent Model by von Thunen (1862). It looked into land rent within a basic equation of production costs, transportation costs and revenue. Moreover, in 1933 the Central Place Theory was developed by Christaller, which analysed the centre in relation to its sub-regions. The spatial proximity of market agents in cities fosters cost savings in consumption, production, search, matching and learning, knowledge spillovers and human capital accumulation (Abdelrahman & Anas, 2004). This process of cost saving is understood as the driver towards agglomeration economies and economies of scale. This system has made city regions more comprehensible for us. As long as we could estimate the magnitude and amount of consumable functions within a territory, we can understand its place within the system of cities.

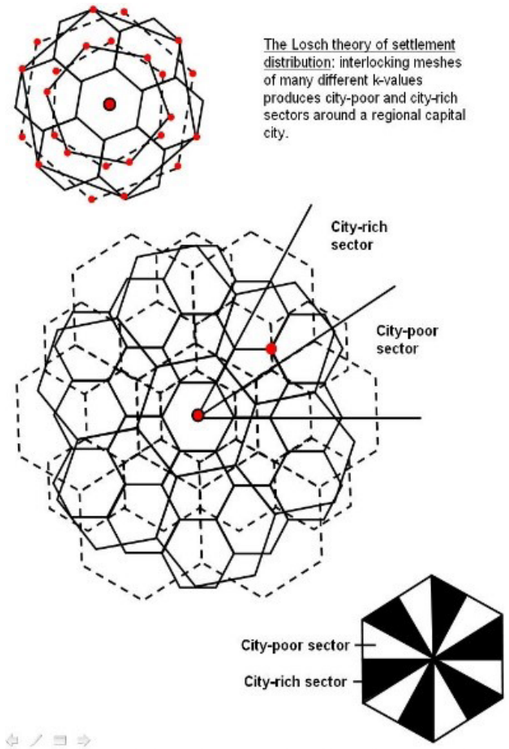


Figure 8: Central Place Theory- Walter Christaller modified by August Losch. (Source: Coronodon.com)

Systems of Cities

Modern urban economics is traced to the early 1960's work on cities internal structure as a function of land markets and zoning, i.e. Alonso's Location and Land Use. Economic theories of Systems of Cities are economic models explaining urban life and economic growth and characteristics. These theories are often a case of positive economics where data was collected about cities and then economic models were deduced and tested (McDonald & McMillen, 2007). Despite their limitations; systems of cities play an important role in understanding, studying and planning our cities, and informing the state in its policies and strategies. In our research, we shall employ a similar approach to New Economic Geography looking into how urban centres trade with one another and how this is distributed spatially.

Around the turn of the century, cities have started to grow larger; housing a growing number of centres and sub-centres; but systems of cities models still revolve around mono-centric models (Abdelrahman & Anas, 2004). Today, systems of cities can be divided into five schools of thought, showing the multiple scales with which it functions [Figure 9] (Peris, Meijers & van Ham, 2018). With a deep understanding that the macro scales don't necessarily explain what happens in the micro level of urban life, this research will make use of their analysis tools while taking into account the scalability of theories within a singular metropolitan urban region (Kaminer et al., 2011). It also serves to highlight the limitations of disregarding the other levels upon which capital cities in particular function

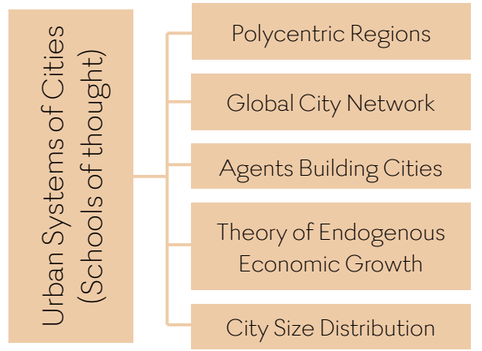


Figure 9: *Systems of Cities. Based on Peris, Meijers & van Ham, 2018*

Urban Hierarchies & Rank Size Rule

Zooming in closer, the diversity within the different urban centres and sub-centres of the metropolitan region is of interest to many urban economists. To begin, the basic model of urban hierarchy is based on the central location theory by August Losch. This is a geographic model that presents a linkage between the economies of scale and economic functions of urban areas (McDonald & McMillen, 2007). The model explains the spatial hierarchy of urban areas with respect to their population and economic activity; especially retail, consumer services and market-oriented manufacturing. The essence of this theory is how urbanization economies take place as a result of shared urban infrastructure (McDonald & McMillen, 2007). This highlights the importance of the type of an area's economic activity. In the technological era, the production economy which was replaced by service economy, has been captivated by high-tech and IT services. In the specific times of the Covid-19 pandemic, both have gained global significance.

Second is the rank size rule. The model basically draws a relationship between the size and rank of the city that remains constant within a nation. However, with the turn of the century, cities have grown well beyond prior set limits. Planning paradigms have shifted from polycentrism towards accommodating population and economic growth within sub-regions and sub-centres. Few models study the relationship of dispersion and productivity of urban regions (Anas & Xu, 1999). This poses a challenge as the research case-study calls for such a specific analysis. Therefore, systems of cities in their essence are adopted to the research case-study.

With regards to economic activity; the following models work towards the classification of urban areas as the building block of further analysis. The location quotients use two variables of employment in various sectors locally and nationally as a total of national employment, to determine the specialization of the urban areas (McDonald, 1992; as cited in McDonald & McMillen, 2007). The update of the Noyelle and Stanback system applies this model to metropolitan areas (Stanback & Grove, 2002). The classification creates three functional typologies [see Figure 10]. However, in emerging economies, the enumeration of basic economic functions in urban areas and employment data is barely ever available in urban areas and nationwide. Thus, the conceptual variables need to be readjusted to fit the research case-study, or innovative methods need to be developed to create these datasets.

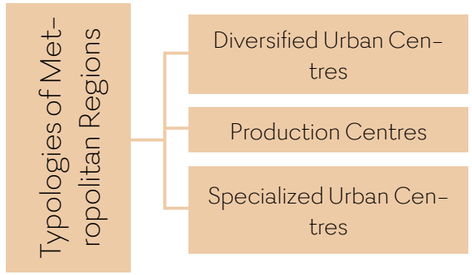


Figure 10: *Functional Typologies of Metropolitan Regions. Based on Stanback & Grove, 2002.*

In technical terms:

LQ= (ei /e) / (Ei/E)

ei = employment in a sector i in subject area

e = total employment in subject area

Ei = employment in a sector i nationwide

E = total employment nationwide

Critique of Rank Size

In relation to our case, the rank-size rule has some discrepancy; urbanism in African countries takes a different structure. There is usually one primate city with the next in line falling a bit behind in size and significance. Irrespective of the national and global political and economic agencies propagating this phenomenon; cities within the developing world had continued to grow at odds to the economic growth of countries (Davis, 2006). This classification can give insights into the state of development of the urban economy.

Evolution of Functions; Centres and Sub-centres

After looking at the Location Quotient, we now turn to After looking at the Location Quotient, we now turn to examine the relationship between centres' and suburbs' functions through time. What the previous part establishes is a hierarchy and classification of productive areas within urban regions, and the modes in which certain services and industries cluster together. In order to paint a more accurate picture, this exercise shall be carried out through time. As established earlier for the past two decades, cities have grown well beyond the polycentric model and sub-centres have all worked their way into the agglomeration economies of cities (Abdelrahman & Anas, 2004). This is quite important for the study of the original city centre and its development, to better position the new urban communities within the system of cities of the metropolitan region.

There have been three major effects; first, it is argued that the FIRE (finance- Insurance- Real Estate) services have claimed the declining centre, second, the suburbs have created a large centre of employment, third, the employment in the centre has shifted towards high education (McDonald & McMillen, 2007). The centre's significance has become limited to its cultural, recreational and educational facilities, the identity and "sense of place" that it bestows, as well as the accounting, banking and legal services that remain present in the centre (Ihlanfeldt, 1995). This is very interesting given the size and magnitude of the agglomeration economies that are still present in many urban centres. It is also important to note this evolution upon studying the co-dependence of evolving centres and emerging sub-centres.

On the other hand, this creates a planning and policy dilemma, which we will refer to at the end of the literature review. City centres in most cases present the core for urban problems, from poverty to crime, due to their high densities. Despite the persistence of these centre economies, the problems are aggravated with the flight of population and industries to the suburbs. Therefore, it is crucial for metropolitan regions to devise unifying strategies that eliminate the possibilities of thriving suburbs at the cost of declining centres (McDonald & McMillen, 2007).

City Size and Diseconomies of Scale

Moving on, Dixit (1973) argued that the optimum city size is the one at which the economies of scale in production balance the diseconomies of transport and congestion. This is hardly our case, since the metropolitan region has expanded more than triple its size in the last 50 years given this concept. Still, the same hypothesis is

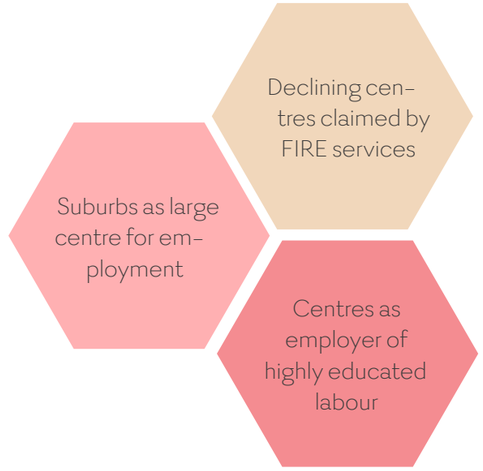


Figure 11: *The Effects of Expanding Centres & Suburbs (based on McDonald & McMillen, 2007)*

still valid today; there is a trade-off between the gains in agglomerating the production services and the diseconomies occurring due to transportation, pollution, safety, sustainability, etc.... Whether planners and policy makers acknowledge these disadvantages to city growth, they remain valid and undermine the benefits of agglomeration economies. Therefore, before moving forward into understanding the impact of size and growth on urban economies, it was crucial to mention the underlying shortcomings as well.

Agglomeration Economies; urban growth

Moreover, as production is established as the base of cities' growth, in this subsection we examine the relation between agglomeration and urban growth. There are a number of factors that affect production. The cost of socio-economic factors and their availability over space varies; therefore the location of one activity in one area over another would create (dis)advantage. These factors include, but are not limited to, labour costs (availability of capital, energy, land and inputs), knowledge and innovation centres, and finally taxes and public services (McDonald & McMillen, 2007).

There are two main kinds of economies of scale that belong to agglomeration economies; localization economies, which are external to the individual firm but internal to the industry; and urbanization economies, which are external to local industry and related to size of urban area. In this study, we are interested in urbanization economies (McDonald & McMillen, 2007). The key message is that a change in agglomeration factors creates a change in industry output; growth in size of an urban area affects the marginal and average costs of production, which affects the output of the industry. Referring back to the earlier section on basic function of urban regions, agglomeration factors affect the economic growth and resilience of urban areas. At a critical point, a growth beyond a limit can create diseconomies such as pollution, transportation cost and dispersion of densities. Similarly, a change in other factors of agglomeration affects the industry output.

With these in mind, we can wrap the discussion with a note on the four dimensions of agglomeration economies namely; (i) **industry factors,** which are present through localization economies and urbanization economies; (ii) **geographic factors**, which are a factor of density and distance of the agglomeration economy urban area; (iii) **temporal factor,** which looks into the static and dynamic effects on production; and finally (iv) **the organizational factors**, which relates to the degree of competitiveness of the local industry (McDonald & McMillen, 2007). The first dimension is narrower than the scope of this research. The second dimension will be discussed in the second section of the literature review. The last two dimensions relate to the type of agglomeration economies and will be discussed below.

Dynamic Economic Growth

Building on the temporal factors of agglomeration economies, factors of urban growth have varying effects on economic growth of urban areas. The basic feature of agglomeration economies is cost reduction, as a result of dense and diverse economic activities in a single location. Urbanization economies experience static and dynamic growth with respect to the size of the urban area. In this case-study, it is the size of the urban area that affects the economic growth to be static or dynamic. Dynamic urbanization economies often experience "cumulative causation" as the resulting effect of an agglomeration factor feeds back into the production process of the next economic cycle leading to more growth (McDonald & McMillen, 2007). For example, the existence of innovation within an urban economy supplies industries with a continuous stream of technical change that works on a continuous economic growth (Jacob, 1972). This dynamism is what supports the resilient growth of urban areas. The two main theories arguing for dynamic agglomeration economies are namely knowledge spillovers and market structure.

Knowledge Spillovers

Among the main variables argued to influence dynamic agglomeration economies is knowledge spillovers. The first and most important seems to relate to the production and use of knowledge (McDonald & McMillen, 2007). Jacobs (1972) has stressed extensively on the critical role that knowledge spillovers play within an urban area affecting the rate of product innovation and economic growth. "The Cross-fertilization perspective" argues for the flow of ideas with labour through industries, but also through territories; arguing for the benefits of labour migration (Glaeser et al., 1992). Moreover, this argument works alongside Jacobs' (1972) that even more dynamic growth occurs within a diverse industrial economy. Relation back to the tripartite classification of functions within urban areas. Opposing Adam Smith's ideas focusing on specialization as the driver for growth, Jacobs (1972) argued that specialization fostered multiplicity of economic functions, which in return created new work within. This is the sort of growth through resilient modes of production that has been referenced extensively in our initial inquiry of cities.

Market Structure

In addition, there is great debate on the type of environment that fosters knowledge production and makes use of it within its processes. The argument is generally for oligopoly and the capitalist market structure. In this view, the well-established firms have the capacity to invest in technological change; the power to reap the benefits of new innovations; and internalize the externalities of innovation within the production process (McDonald & McMillen, 2007). However, there has always been limitations to what could be left to the market to develop. On the other hand, there is huge debate pertaining to the effects of separating property rights from management as is the case with entrepreneurial small scale firms. Nevertheless, competition plays a significant role in stimulating innovation to differentiate products (Jacobs, 1972). With regards to our case study, within the scale of a single metropolitan region, there exists barely any variance across a single region. Therefore, market structure and characteristics are eliminated from the comparative analysis, though included in the background knowledge of the case-study context.

From Knowledge to Practice; Assessing Agglomeration

Factors of Agglomeration

If agglomeration is the goal of urban areas to sustain and enhance resilient economic growth, then it is important to investigate factors affecting agglomeration. This section not only examines factors of socio-economic growth, but also provides an overview of strategies for their deployment. In order to be able to adapt strategies, McDonald & McMillen (2007) compiled nine sources of urban economic growth from a number of economic models and theories. The following paragraphs review them to make use of them in the context of the case-study. The aim is to identify areas within which urban strategies can be employed for local economic development, succeeding the mapping and analysis of centres and sub-centres, and after identifying factors of agglomeration in relation to an area's functionality. These strategies are grouped under five main components, with the combination of them targeting an urban area fostering urbanization economies.

Production Functions

The first two factors pertain to an area's production. Keynesian models argue through exports quantity, two-sector neoclassical models focus on price of exports, input-output model examines local content within output through the "input multiplier". The idea is centres of production, whether manufacturing or service, should aim to increase production for exporting, as well as replace their imports. Data of local employment as the signifier of input analysis, instead of a complete input-output model, can be used to identify points that exhibit greater use for local input. The primary inquiry of this exercise is understanding which areas within the region adds more value through its processes.

Capital Growth; public and private

The third and fourth components relating to agglomeration are public and private capital. Economic growth is highly influenced by capital investment, which is often highly influenced by public investment. There are many widely used strategies involving direct and indirect fiscal strategies; from depreciation allowances, to capital gains, small and medium size enterprise loan programs, all the way to property tax cuts. The main aspect influenced by public investment is the development and maintenance of huge infrastructure projects like trade ports and transportation networks. A spatial analysis of public expenditure on infrastructure projects and fiscal incentives can show areas with intensified capital growth.

Labour Force

The next two components relate to the productive segment of the population, labour force's growth and aptness. The growth of the labour force nurtures growth in economic activity and employment needs. Also, the education and training provided to the labour market acts as a catalyst for economic growth. With more pressure on high levels of education and a highly skilled labour force, local governments are seeking market players to aid in preparing the labour force. Therefore, an inquiry into the numbers of employable labour is very important. As well as, their accessibility to available job opportunities as well as their preparedness for the market.

Innovation, Technical Change and Entrepreneurship

The next two constituents are interrelated with other factors of economic growth. Jacobs (1972) argues extensively for the need of innovation and knowledge spillovers as the major advantage of resilient economic growth. Moving on, the application of innovation through technical change stemming from research and development sectors, and in universities and research centres that are part of the national governments' agenda. The eighth factor is entrepreneurship and the emphasis on the creative class through business incubators. While there are some measures used to capture innovation and applied technical change as the case with numbers of patents and research centres, there is also a growing measure of knowledge economy, as with the case of co-working spaces, tech campuses, and incubation and venture labs.

Cultural and Social Amenities

Finally, the ninth source of economic growth is socio-cultural amenities available in the urban area; such as the local environment, cultural scene and social amenities. As industries are becoming less attached to raw materials, markets and trade routes, the quality of urban life attracts talent sustaining a higher quality of labour force. This relates back to the importance of city centres to urban sub-centres. However, if new urban communities wish to attract and grow their own agglomeration economies, these functions need to exist within the sub-centres and their hinterland. From basic social and cultural functions to recreational spaces and amenities, close access to these urban features is a factor of competitiveness attracting communities.

Critique for Theories of Systems of Cities

The importance of systems of cities is in how it informed planning and regulatory devices, as well as direct and indirect fiscal rewards (Tolley & Crihfield, 1987). Tolley and Crihfield (1987) argue that whenever externalities have been used to devise planning, more politics have been taken into consideration than quantitative falsifiable data. For example, while pollution, transportation and some utilities are translated into monetary terms of planning and zoning regulation, there exist more "difficult-to-value" externalities that might be beneficial on a subjective level and needn't be translated to monetary terms. These include degrees of diversity, integration and decentralization (Tolley & Crihfield, 1987). Therefore, while urban models focus on certain externalities, there are many more exogenous factors that should be put in effect. This research acknowledges these "difficult-to-value" factors of systems of cities mapping and analysis, and shall try to integrate these aspects in the analysis.

Here's a summary of factors affecting agglomeration economies within cities:

Agglomeration Factors	Variables	Operationalization
Production	Export Demand Import Replacement	Public purchasing of local produce- Identifying key imports and targeting local industries Developing products and creating new products through technical change
Public & Private Capital Investment	Infrastructure Fiscal Measures	Infrastructure Replacement Development and maintenance Revolving Loan Funds Industrial Revenue Bonds Venture Capital Funds Loans from public pension funds Real Estate Tax Incentives Land assembly and sale at low price
Labour Force	Employment per sector per urban area Size Quality	Basic Education Higher Education Vocational Education Job Training Programs
Innovation, Technical Change & Entrepreneurship	New products New production Diffusion of New Technology	Supporting basic R& D Public/Private Industrial Research Centres University research Public/Private Industrial labs Business Technology Assistance centres Entrepreneurship education programs in colleges Business Incubator Facilities
Social & Cultural Amenities	Conditions of central city Cultural Centres Quality of Life Sense of Space	Promotion of local culture, educational and recreational facilities Provision of high-quality basic public services with low-tax
Agglomeration Economies	Urbanization Economies	Targeting all the above towards a specific urban economy

Table 4: Agglomeration Economies: factors and operationalization strategies

From Knowledge to Practice: Computing Competitiveness

Before resources are deployed towards particular aspects of agglomeration, there must be an analysis of urban centres and sub-centres in the metropolitan region. The query is how to use socio-economic attributes to establish an understanding of the system of cities. This sub-section delves into the methodologies employed in practice to assess a current urban area's competitiveness among other areas. This analysis serves as the base for analysing the performance of new urban communities within metropolitan regions.

In order to create a case-sensitive analysis, several methodologies will be investigated. The base of competitiveness computation is the Porter's Diamond Model. Second, several models of computing competitive advantage of urban areas using statistical data are compared; using the EU's urban competitiveness report, Global competitiveness report by the World Bank, Urban Competitiveness of Chinese cities (Yuan et al, 2019), and finally competitiveness of American cities (Kresl & Singh, 2012).

Porter's Diamond Model

The methodology employed is based primarily on Porter's Diamond Model of mapping competitive advantage. The model is known to be composed of four criteria, with government and chance playing a role in some or all the four criteria [Figure 12] (Porter, 1995). The idea is to look at the demand side, the supporting system, the factor conditions, and finally the structure and strategy. Although there is some debate over the applicability of this model beyond the business environment, Table 5 highlights the attributes that can be borrowed in the case study from each factor, with the exception of firm strategies for its micro-scale.

Agglomeration Factors	Variables	Operationalization
Factor Conditions	Factor Conditions	Basic Resources
		Natural Resources
	Advanced	Skilled Labour
		Specialist Capital
Demand Conditions	Home Demand	Composition- Buyer Needs
	Size of Market	Sophistication of Demand
	Early Saturation	Consumer attitudes
Related and Supporting Industries	Suppliers Industries	Cost-effectiveness inputs
		Innovation and Knowledge Spillovers
	Related Industries	Sharing activities
Firm strategy, structure and Rivalry	Nation Conditions	Relation to Authority
		Social norms
	Domestic Rivalry	Competition

Table 5: Operationalization of Porter (1995) Diamond model of Competitive Advantage

Global Competitiveness Report

By far one of the most comprehensive and reliable data sets produced on urban economic competitiveness performance is by the World Economic Forum. This report provides "annual assessment of productivity and long-term growth" (World Economic Forum, 2019). It uses more than 100 indicators under 12 pillars. It provides a backdrop to compute economic growth factors and indicators. The methodology of analysis quantifies qualitative measures.

Following is a brief description of which of the 12 pillars can be borrowed [Table 6]. Institutions, macroeconomic environment, and financial market development are some pillars disregarded for their uniformity within a region. These indicators reference factors that are usually analogous within the same country of centralized programmatic organization. After elimination of indicators pertaining to regional or national aspects, we arrive at the list presented in the table below.

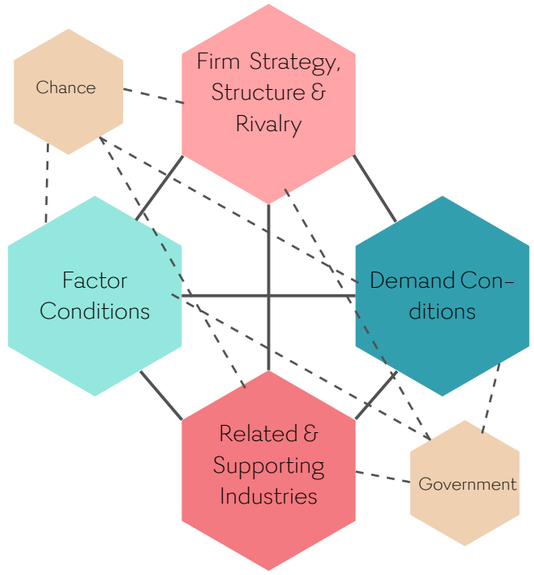


Figure 12: Porter Diamond Model of Competitive Advantage. (Source: Harvard Business Review)

The EU Regional Competitiveness Index

The EU competitiveness report is based on the world economic forum competitiveness framework's 12 pillars with elaboration. Over and above, the pillars upon which the competitive advantage is calculated are further analysed and grouped. The 12 pillars are classified under three groups of **basic, efficiency and innovation [Figure 13]**. The idea is that the sophistication of the attributes increase as the economy develops. The basic group has the basic drivers for economic activities. The efficiency group houses enablers of growth. The innovation group houses resilience factors.

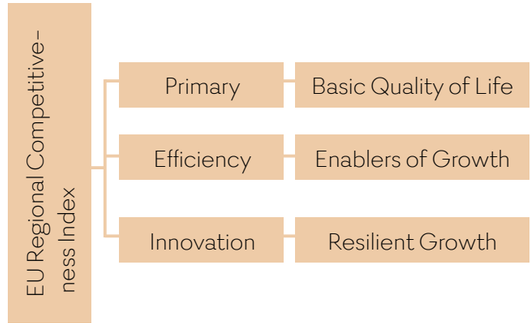


Figure 13: Constituents of EU Competitiveness Index (2019)

Pillars	Factors		Operationalization
1- Institutions			
2- Infrastructure	Transport Infrastructure		Quality of overall infrastructure
			Quality of roads
			Quality of railroad infrastructure
			Quality of air transport infrastructure
	Electricity and Telephone Infrastructure		Mobile telephone subscriptions
			Fixed telephone lines
3- Macroeconomic environment			
4- Health and primary education			
5- Higher education and training	Quantity of education		Secondary education enrollment rate
			Tertiary education enrollment rate
	Quality of education		Quality of the educational system
			Quality of math and science education
			Quality of management schools
			Internet access in schools
	On-the-job training		Local availability of specialized research and training services
			Extent of staff training
6- Goods market efficiency	Competition.	Domestic competition	Number of procedures required to start a business
			Time required to start a business
		Foreign competition	
7- Labour market efficiency	Flexibility		Reliance on professional management
			Country capacity to attract talent
			Female participation in labour force
8- Financial market development			
9- Technological readiness	Technological adoption		Availability of latest technologies
	ICT use		Broadband Internet subscriptions
			Mobile broadband subscriptions
10- Market size	Domestic market size		Domestic market size
	Foreign market size		Foreign market size index
11- Business sophistication			
12- R&D Innovation			Quality of scientific research institutions
			Availability of scientists and engineers

Table 6: Operationalization of Global Competitiveness Report by World Economic Forum (2019)

The Model utilized by Yuan et al. (2019) for Chinese Cities

The methodology used in this research was created backwards. Originally, the researchers looked at 123 indicators provided by the Urban Statistical Yearbook of China. The aim was to reach "targeted, systematic, independent, representative, available, and suitable" indicators [Table 7] (Yuan et al., 2018).

The main advantage of this method developed by Yuan et al. (2017) is the use of statistical data in their model for urban attributes, while using urban flows data as a verification data as they are thought to be reflective of urban competitiveness, rather than causing it. This is insightful as it uses flows to map urban areas, as an indicator rather than a determinant. Flows as part of mapping the spatial structure of systems of cities are discussed in the following section.

Concept	Operationalization
Economic Strength	Gross Domestic Product
	Local Government Budget within General Budget
	Total Amount of Foreign Investment utilized
	Total investment in Fixed Assets
	Total retail sales of consumer goods
Living Standard	Average wage of staff and workers
	Outstanding amount of savings deposits in urban and rural areas
	Registered unemployment rate
	Total number of secondary and tertiary industry employed people
Space Support	Per capita area of paved roads
	per capita residential land area
	Population density
	Urban construction area to total urban area ratio
Social Security	Number of college students per 10,000 population
	Full-time teachers to student enrolment ration in secondary schools
	Numbers of beds of hospitals and health centres per capita
Environmental Governance	Industrial solid waste comprehensively utilized rate

Table 7: Constituents of Yuan et al. (2018) Competitiveness Index

Urban Competitiveness of US Metropolitan Regions

The final framework is provided by Kresl & Singh (2012). This is the third development to the researchers' framework along a 30 year study [Figure 14]. Their basic model employs only three constituents to calculate competitiveness [Table 8]. Then the socio-economic indicators are tested for their significance to the calculated competitiveness index, using P-coefficient correlation analysis [Table 9]. Over the three decades, Kresl & Singh were able to identify indicators that rose to relevance and others that lost their influence on competitiveness.

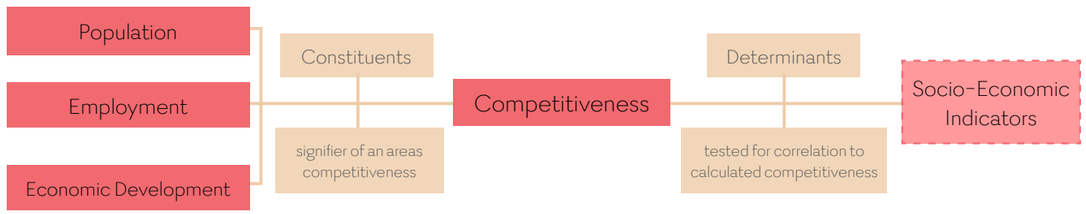


Figure 14: Constituents and Probable Indicators of Kresl & Singh (2012) Competitiveness Index

Competitiveness Constituents	Operationalization
Employment	Educational attainment of the population
Population	Expenditure per capita per area
Economy Development	Change in Sectoral employment of service economy

Table 8: Constituents of Regions Competitiveness. Based on: Kresl & Singh (2012)

Competitiveness Indicators	Operationalization	
Economy move towards entrepreneurship	Educational attainment of the population	Percentage of the 25 and older population with a BA or BS degree
	Firm size	The percentage of firms with fewer than 100 employees
Innovation	Research centres/labour force	University and government research centres/labour force
Accessibility	Transport services	Transport infrastructure and services
Amenities	Health care facilities	Hospital beds per 100 000 in 1998
	Cultural institutions	The number of cultural institutions
	Growth in manufacturing value added	Growth in manufacturing value added
	FIRE/labour force	Finance, insurance and real estate employment as a share of the labour force

Table 9: Tested Determinants Correlating to Competitiveness Calculated for US Metropolitan Regions. Based on: Kresl & Singh (2012)

Critique of methodologies with respect to the case study

It is important to note that there are a number of limitations when borrowing from these practices. The research case-study is concerned with NUCs within the same region in the same economy. Therefore, general national attributes are dismissed for their uniformity. Second, the EU competitiveness report concerns highly developed economic regions in comparison to the case-study's emerging economy. However, the three subdivisions of attributes give some guidelines for the created framework. Finally and most importantly, the methodology for computation adopted in this research is based on Kresl & Singh (2012), which maps first the competitiveness according to key indicators, then tests the correlation of the index to the socio-economic determinants to identify attributes correlated to competitiveness.

Operationalization:

As per the context of the research, there exists a huge limitation when it comes to availability of data. The Central Agency for Public Mobilization and Statistics [CAPMAS] collects huge amounts of socio-economic data, but most of this data is not public for national security issues. Only aggregate data is made public or in limited cases of international cooperation.

The methodology used investigates two sides of urban competitiveness: indicators and possible determinants. First, indicators of competitiveness signify if an area is functioning more competitively. Based on how this research defined urban areas, diverse and dense communities and functions, competitiveness is computed as a function of population density and productive functions. The productive functions look into employment within the metropolis, but also look into the kind of economy taking place. Therefore, it maps the manufacturing facilities as a signifier of the development of the industrial sector. It also looks into IT service providers as a signifier of the IT service economy.

Second, determinants are mapped and their spatial correlation to the competitiveness calculated is tested. If spatial correlation is found, then these attributes are of significance to competitiveness in the context of our case-study. If spatial correlation is non-existent, these attributes are dismissed as correlated to urban competitiveness. The list of tested determinants [Table 11] is based on the review of competitiveness reports categorized under three main groups of primary, efficiency and innovation socio-economic indicators. They are also case-specific, springing from a deep understanding of the unique context of the particular urban economy and social life of Cairo.

	Competitiveness Constituents	Reason
a	Population	Density is one of the most significant characteristics of an area's competitiveness. Population numbers signify an area's access to amenities of urban life and the state of economic activity
b	Job Opportunities	This research looks into how new towns have succeeded in decentralizing the city as their main goal, and it was established that cities are a factor of employment and the labour market. Therefore, mapping clusters of job opportunities gives an indication of the relevance of centres and sub-centres to the population
c	Manufacturing Facilities	As a part of the productive function of cities, capturing where centres of industry fall is relevant to understanding the urban regional economy, given that industry makes +35% of GDP. In addition to the opportunities mapped, this indicator works on identifying where small and medium sized enterprises function
d	IT Service Providers	As the economy moves online, software developers, IT engineering and computer system offices are the newest characteristics of the service economy. Mapping where these entities are located highlights the development of an area's economic functions in the service economy

Table 10: Constituents of Urban Competitiveness and the rationale for their mobilization

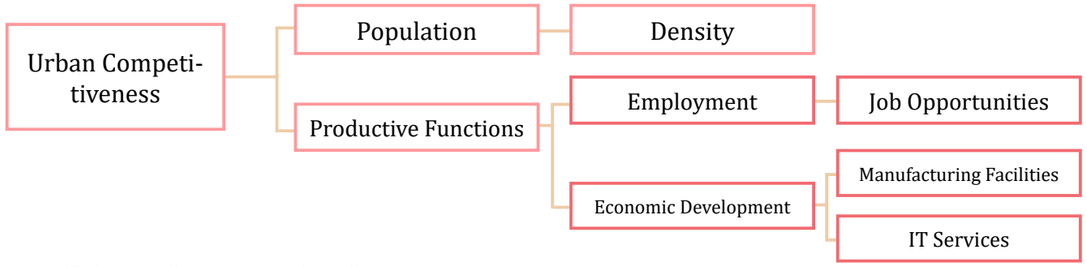


Figure 15: *Research Competitiveness Index Constituents*

	Competitiveness Indicators	Rationale
1.1	Basic Education	Basic education is one of the most repeated criteria for competitiveness. It is used as a signifier of the area's liveliness and the presence of a young population within the area
1.2	Accessibility	Public transportation is a signifier of the area's connectivity to other centres of demand and supply. Also, it aids in the job accessibility of the area, deeming its productive functions more appealing for job seekers
1.3	Telecommunication Centres	Telecommunication centres are a signifier of internet connectivity. As the internet boom continues to expand, good landline connections shall be examined
1.4	Post Offices	Post offices are a local signifier of access to financial institutions and civil duties. As per the context, post offices function as financial entities and pose a link within the governmental institutional bureaucracy
1.5	Supermarkets	Added post COVID-19 pandemic crisis. These attributes proved the significance of basic and important amenities of urban life. While most cities around the world came to a halt, these two functions were kept functioning and people never ceased to utilize their services.
1.6	Pharmacies	
2.1	Finance & Insurance	Banks and insurance companies provide the greatest support for economic growth
2.2	Higher Education	Higher education is a signifier of the skillset quality of the labour market. Whether prepared by universities, colleges and training centres
2.3	Government	Ministries are the core of formal governing institutions, and as centralization of governance is present in case-study, it is important to understand its link to new towns' competitiveness
2.4	Recreation	Recreation functions, like cinemas and theatres enhance the efficiency and quality of life of urban areas
3.1	Centres of Knowledge	As part of the innovation level of competitiveness, the presence of research centres and patent offices is a signifier of an area's capability of knowledge production and innovation
3.2	Centres of Innovation	As a signifier of the new economic trends, start-up hubs, venture labs and co-working spaces are telling of an area's integrative state in the new economy.

Table 11: Determinants of Urban Competitiveness and the rationale for their mobilization

Theory Literature: Part 2

Spatial Structure

The second part of the theoretical literature review delves into the regional spatial structure. In order to better position the previously-studied models of urban economics in a spatial context, we shall delve into tools of spatial structure of regional urban areas. This section will start by arguing for the importance of overlaying spatial and economic analysis to urban regions. The most prominent urban systems will be presented. Then geospatial analysis will be explained as a tool to map, analyse and understand regional spatial structure. Finally, there will be an overview of the factors and attributes utilized to map the spatial structure of the regional economy.

Urban Economics and Spatial Structure

We turn now to question the regional spatial structure and its relation with urban economic activity and evolution. It is suggested that urban economic change affects the regional spatial structure and in some instances, it [economic change] is enabled or prohibited to a greater degree by the spatial structure (Suarez-Ville, 1988; Parr, 2014). Parr draws on the comparison between two sectoral compositions of regional economic activities and the spatial structure that each principal economic base would employ, in terms of "internal economies of scale, locational orientations, and agglomeration tendencies" (Parr, 1979, p.825). Thus, a resource-based principal economy would deploy a much decentralised urban system than a much developed economic base where manufacturing would call for more specialization and concentration. This was explained in part by Friedmann's (1956, p.214) theory of "Dynamic Space Economy" which traced certain structural tendencies to economic evolution. This research aims to understand how the economic activity of urban regions evolve when the spatial limits almost triple in size

Earlier, basic urban economic theories were highly embedded in the spatiality of economic activities: their arrangement in space, distance and demographics along space i.e. Christaller's urban system of the 1920s, the Lösch analysis of the 1940s, and Tinbergen's contribution to the previous two models in the 1960s (Parr, 2014). However, in the later part of the century, the study of regional economic evolution and spatial structure grew distinct. The regional economic analysis focused on input-output modeling and theories of economic growth and agglomeration. Meanwhile spatial structure analysis grew less technical, focusing on distribution of economic activity and demographics, modeling transportation networks, and urban systems modeling, specifically the rank size distribution (Parr, 1979). The two aspects of urban economics grew distinct and therefore our understanding of metropolitan regions became fragmented.

A note on growth of urban areas

Within the context of this research, the forces of economic activities weren't the drive for the spatial evolution and expansion of the metropolitan region. There are three scenarios with which new urban areas with varying sizes are created. The first mechanism is mobilized by a local government for a specific size of population (Abdelrahman & Anas, 2004). The second is mobilized by a profit-maximizing developer that plans new urban and suburban areas according to residents' needs (Abdelrahman & Anas, 2004). The third is the self-organization mobilized by urban dwellers through atomistic defections. Though the firms and residents take action in developing and growing new cities, it is crucial in analysing the economic structure of a region to understand how it is driven and governed. Therefore, although this research doesn't concern governance models, it will be touched upon in the case-study analysis.

It is often the case that a governing entity is needed to "orchestrate the simultaneous migration of a critical mass of agents from the first city to establish the second" (Abdelrahman & Anas, 2004). there is a general agreement that it is often too late that defections create new urban areas; usually cities become too over-crowded before self-organization mobilizes to create new urban areas (Henderson, 1974). In line with the case study of Cairo, as the research will delve later in chapter 3, the NUCs in Egypt are top-down mobilized extensions for a specific population, which continues to grow. Therefore, understanding how the new sub-centres function within the entire metropolitan region is crucial in understanding the regional spatial structure and its effects on economic structure and change. Again, data sets in the developing world remain a major limitation to similar rigorous studies. Therefore, this research shall look into ways to mitigate lack of official geospatial data-sets in emerging economies.

Regional Spatial Structure Classification

Turning to the approach of employing structural analysis to regional economies, the next sections explain the factors, features and characteristics of urban areas, which are utilized to map, and analyse the spatial structures of regional economies.

To begin with, there ought to be a classification of the economic region that shall lead us to a spatial analysis of the area within its boundaries. The classical tripartite classification by John Meyer in 1963 categorises urban areas into 'homogeneous regions', 'nodal regions' and 'programming regions'. 'Homogeneous regions', as the name implies, constitute an area of homogeneous economic characteristics that distinguish it from surrounding regions; this can be seen in physical architectural styles and urban characteristics. 'Nodal regions' classification based on the interdependence between a centre and hinterland, in which one supplies for the demand of the other and vice versa. 'Programming regions' are the easiest to classify as they pertain to the administrative boundaries of an urban area. Moreover, scientists have built on Meyer's classification with the addition of the 'polycentric urban region' (PUR), referred to also as 'dispersed city' and 'network city' (Burton, 1963; as cited in Parr, 2014). The major characteristic of the PUR is the multiplicity of urban centres with self-autonomy, yet a well-developed interdependency among the various centres.

Returning back to Meyer's classification, we shall understand the various spectrum of each of these types, which Parr (2014) argues is sometimes a factor of scale and/or hierarchy. For example, the nodal region may be interpreted as a 'functional urban region' utilized often in labour-market analysis, where jobs, wages and employment flows decide the centre and hinterland; or a 'city-region' where one prominent centre controls, manages and provides for the hinterland, that in turn supplies raw materials or labour for the core (Parr, 2014).

For the context of this research

Furthermore, with these types in mind, there shall be a set of criteria upon which a specific classification is adopted. Parr (20114) explains three factors; first the scale of the area to be studied, second, the kind of research question asked, and third, the nature of the problem at hand. To begin with, in this research, the scale of the area

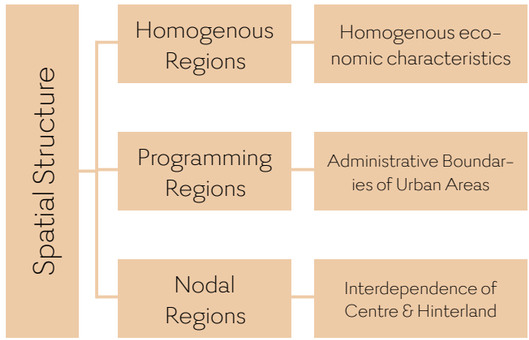


Figure 16: Methods for spatial structure classification of built environment (Based on Meyer, 1963)

to be studied extends beyond juridical boundaries of the 'programming region,' with eight new towns built around Cairo spanning three governorates (administrative city). Next, the research question at hand looks into the role of new urban communities within the spatial structure of a large metropolis with varying economic characteristics of magnitude, size and age. Therefore, the 'homogeneous region' is dismissed. Thirdly, the nature of the problem is related to the economic function and potential of NUCs within the greater spatial structure of the entire Greater Cairo Region [GCR], keeping in mind that there exists one city-region of Central Cairo, exercising power, control, ownership and management over the entire metropolitan region with varying urban centres and sub-centres. Therefore, the 'nodal region' classification is utilised in the case-study analysis.

Mapping Spatial Structure; approaches and variables

In order to map the spatial structure of various economically viable regions within the metropolis, there needs to be a set of variables to specify these areas, of centres and hinterland. Parr (2014) argues that the most comprehensive means of spatial structure classification is the urban-system perspective. This makes use of the hierarchy of centres, their size, frequency, spacing and functional composition. It also includes an analysis of economic flows among centres and their size distribution explained shortly. In order to define real urban centres, three quantitatively sets of data should be analysed; the functional distances between these settlements, their level of interaction and the magnitude of their activities (Abiodun, 1967).

The first approach is to classify spatial structure according to mapped attributes, as with the case of employing geographical information systems (GIS) (Parr, 2014). These attributes relate to demographics such as population, work force, employment and unemployment levels. These attributes could also relate to economic activities such as: financial institutions, available land for industrial and commercial development, research facilities and higher education and training institutions. The aim is not to view each characteristic of an urban area separately, but to create an aggregate to better map the complexity and analyse comparatively.

Moreover, the urban-system is classified through the location of urban centres and their hierarchical classification. This is related to the size, frequency, spacing within the city-region. Size is a function of a level where basic economies of scale can take place, i.e. infrastructure, commercial services and governance. Frequency is a factor of duplicates of similar economic and spatial attributes that exist within the metropolitan region. Spacing is a function of distance away from the city-region centre and accessibility to agglomeration economies of first level markets, explained here. The Christaller model (mentioned earlier), identified seven levels of centre, although only the first three had a population of urban region. Today, the first three-four levels of centre constitute urban regions [Figure 17] (Parr, 2014). The idea is the first level centre supplies for the first level market, first level goods and services, the second level centre supplies second and first level good and services, for larger urban market, and third level centre supplies first, second and third level goods and services to an even larger market (Parr, 1979).

The second approach is to look at the set of flows among various regions identified earlier. This can be done through a networks or routes analysis. It is more vital to look through an economic lens (Parr, 2014). Therefore, it becomes essential to look at trade flows, flows of wages and salaries, capital movements, and most importantly the flows of funds from the regional government to specific zones and areas. Other sets of data can be utilized in case of the unavailability of reliable data in some cases. There can be an analysis of freight traffic, shopping trips, commuter flows, and telephone and internet communications. In the context of this research, it is quite optimistic to assume these data-sets are available or even present. This is a call for more rigorous research institutions and collaboration among private and public service providers to work on better information dissemination.

Moreover, there are specific economic activities that influence the productive capacity at any point within the urban region, especially outside the city-region. Parr (1979) argues that in a decentralized urban area, there are a few more specific functions and linkages that affect the entire urban system. The first study is related to government institutions, their hierarchy and accessibility, especially in the case of an urban region falling within a juridical urban area, yet functioning as part of the metropolitan region that exerts macro-economic policies. Second, the location of the FIRE [finance- insurance- real estate] centre within the metropolitan region affects the linkage between the urban centres. Knowledge centres and their clustering and proximity to production centres create a third layer of linkages among the urban centres. Finally, as the metropolitan region produces far beyond its demand, aiming to supply various regions on a national level, not only the internal trade flows shall be investigated, but also the inter-regional transport connections, although it falls outside the scope of this research.

To sum up, the aforementioned review gives a clear picture on methods, tools and variables to use to map, analyse and understand regional economy in its spatial dimension. The three main variable groups are: (i) **attributes** related to centres and sub-centres; (ii) **flows** among the hierarchy of centres with varying spans over the region; and (iii) **in proximity to essential entities of productive capacity**. In addition, the previous section made clear the socio-economic factors essential for a resilient economic growth and agglomeration economies. Understanding the economic activity by mapping the centres and sub-centres within the metropolitan region deciphers the factors affecting the agglomeration of certain areas over others, which is vital to recommendations for new towns growth, as sub-centres attracting economic activity.

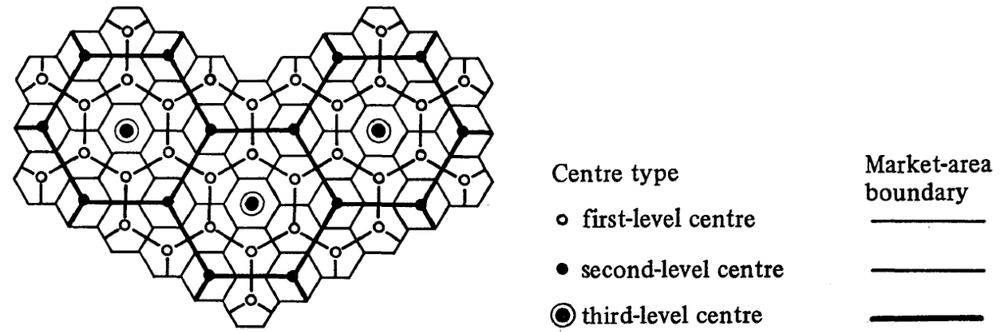


Figure 1. A $K = 3$ central-place system.

Figure 17: Central Place System (Source: Parr, 1979)

Research Theoretical Framework:

The aim of this literature review was to arrive at a theoretical framework that informs both the conceptual variables of the research and the structure of the research design. In order to understand the role NUCs play within the metropolitan region, the research looked into variables to be mapped and tools to investigate these variables. After researching theories of urban economics and spatial structure of regional economy, a framework for understanding and analysing the spatial structure of regional economy in the context of the Cairo Metropolitan Region is created. The framework shows the factors to be investigated and the tools and methods for this investigation [Figure 18].

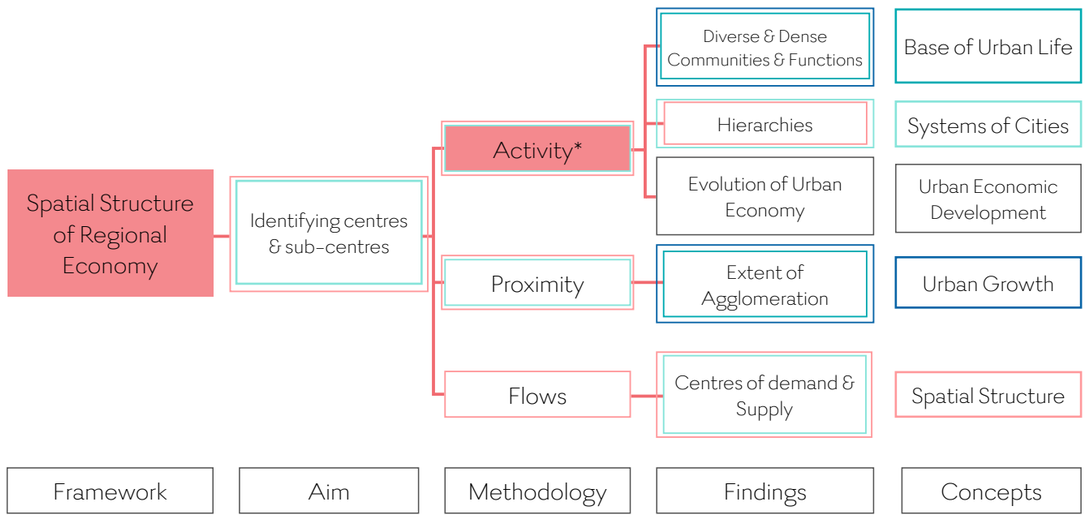


Figure 18: Research Theoretical Framework for Spatial Structure of Regional Economy

Second, after investigating practices mobilizing these theories in the form of urban competitiveness [see page 40], a list of socio-economic factors was drawn [Table 10 & Table 11]. This list is placed within the theoretical framework as part of the activities mapped and analysed to inform the understanding of spatial structure of regional economy [Figure 19]. With this the theoretical framework is complete with the conceptual variables to be studied and the structural design of the research.

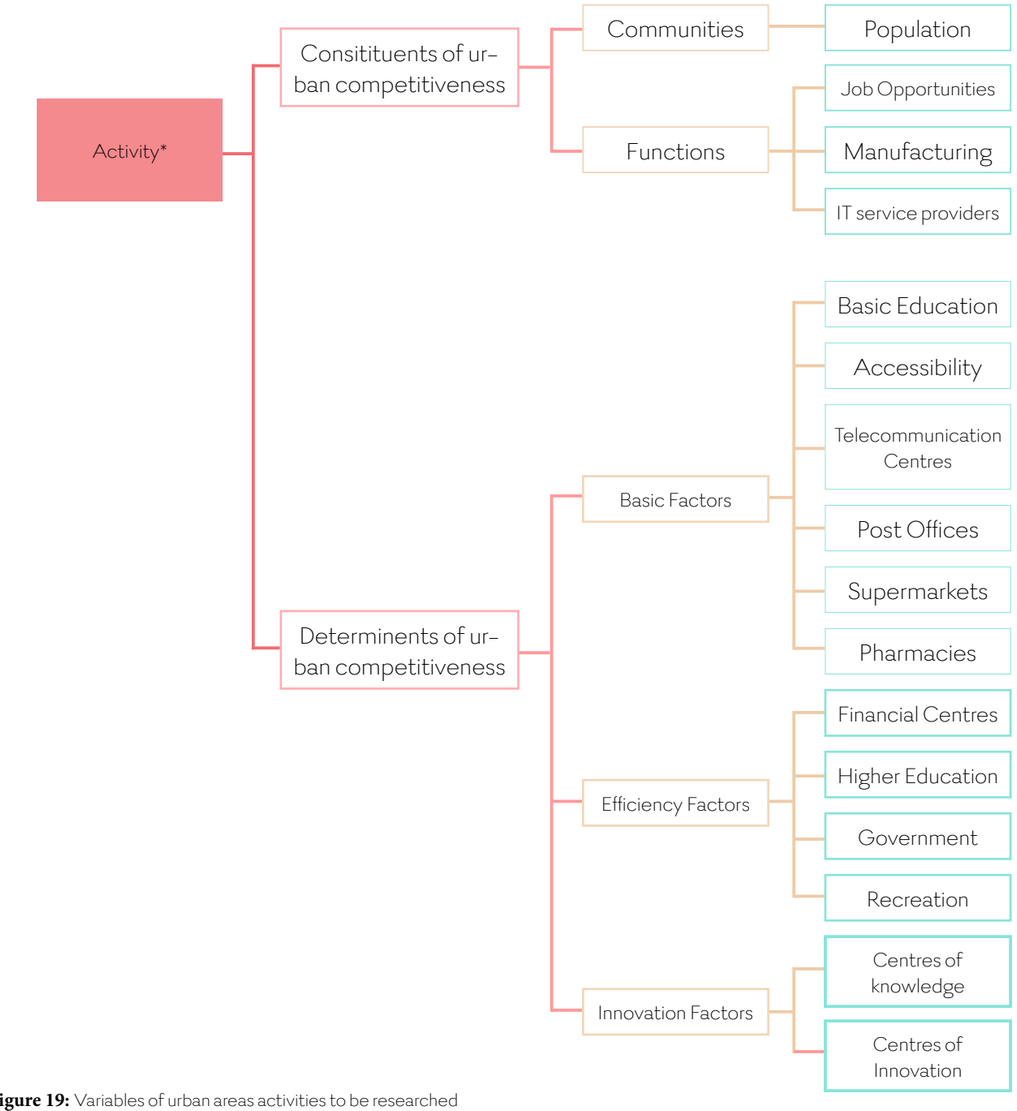


Figure 19: Variables of urban areas activities to be researched

Photo by Wilhem Joys Andersen

Chapter 3
RESEARCH DESIGN & METHODOLOGY

Research Design and Methodology

Aim

The aim of this research is to inform urban policies towards agglomeration for sub-centres in new urban communities. Through understanding how the metropolitan region functions and compare it to how it is envisioned to function; gaps within the urban management and planning of these cities shall be targeted using policy proposal for public and private entities.

Research Question

"How can attributes of urban competitiveness contribute to the development of sub-centres in new urban communities of emerging economies?"

Research Sub-questions

1. What are socio-economic indicators of urban competitiveness in the context of Cairo?
2. What's the role of new urban communities and their sub-centres in the metropolitan region's economy?
3. How to use open-source data to compute and analyse factors of urban competitiveness of NUCs?
4. How can policies be employed by public entities and private sectors to attract, retain and grow various economic activities within these sub-centres?

Research Objectives

This research has three objectives;

1. **Identifying the role of new towns within the metropolitan region economy and the relationship between centres and sub-centres**, through analysis of urban competitiveness of NUCs and the geospatial analysis of systems of cities to understand how the regional economy functions.
2. **Testing the usefulness of open-source data in informing geospatial analysis,** to enable future research endeavours to employ more and better datasets. Capitalizing on the limitations of the Covid-19 Pandemic times in which this research has been carried out, has led the world to acknowledge the vitality of online and publicly available data.
3. **Advising policies for agglomeration economies** to stimulate socio-economic factors of urban competitiveness, for urban growth of sub-centres in NUCs.

Research Methodology & Design

The methodology of this research is three tiers; following the literature review of chapter 2, a quantitative geospatial data analysis is performed in chapter 4, followed by policy analysis in chapter 6. The aim of this section is to explain the methods and tools of the quantitative analysis that's based on the theoretical framework of chapter 2, to be overlaid with policy analysis. The variables within the framework are highly context specific, though the methodology and theoretical framework have the potential for reproduction in other emerging economies.

To complete this endeavor, three tasks will follow.

1. **First, the statistical geospatial mapping:** of economic attributes of the various centres within the metropolitan region will be computed using available census data and online open-source data gathering.
2. **Second, exploratory spatial data analysis:** of various socio-economic attributes. Using methods and tools of spatial analysis in QGIS and *GeoDa* to
    a. map systems of cities in metropolitan region;
    b. identify patterns between mapped socio-economic attributes and their relation to competitiveness;
    c. highlight development of urban economy;
    d. reveal mismatches between centres of supply and demand; and
    e. identify key aspects for policy proposal
3. **Third, propose advice for enhancing urban policies:** based on a review of studies and published policy documents and the findings of this research.

Case-Studies

There exist eight new urban communities around Cairo that identify, on a varying scale according to their size and function, from a settlement to a city, with a variety of functions and bases for economic activity.

The Cairo Metropolitan Region consists of 3 programmatic governorates namely; Cairo (East of the Nile), Giza (West of the Nile), and *Qalyoubia* (North of Cairo). Then there are New Urban Communities (NUCs) east and west of the metropolitan region.

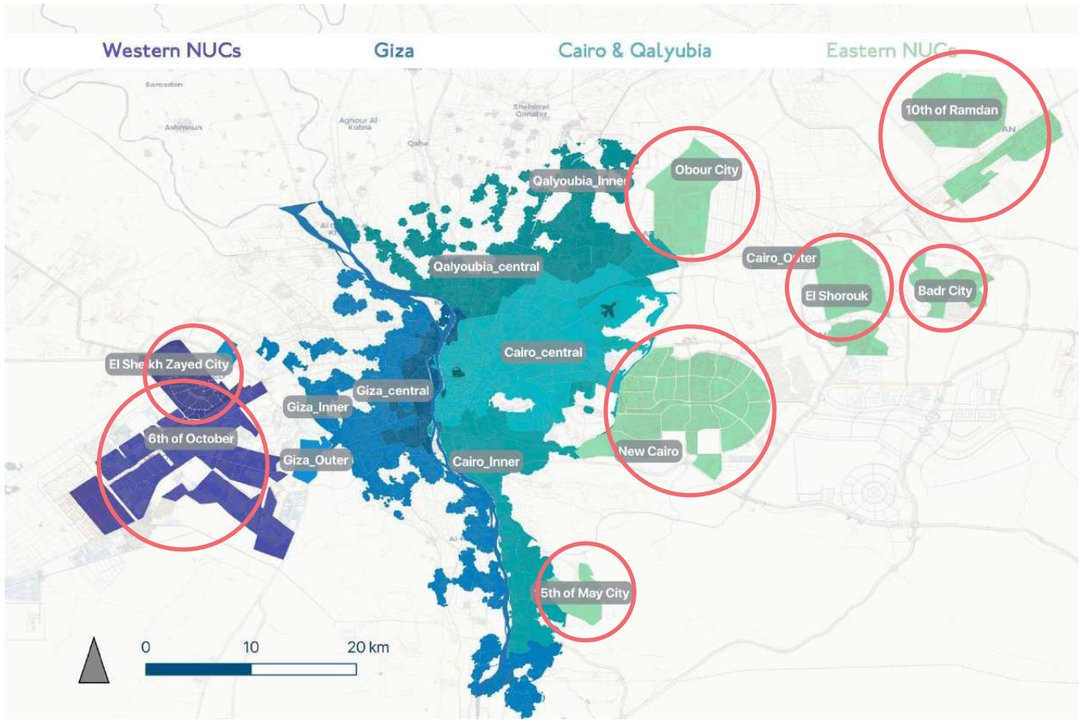


Figure 20: Visualization of Greater Cairo Metropolitan Region with New Urban Communities (Source: Transport for Cairo, 2019)

Case Selection

The concern of this study is regarding the eight new towns around Cairo. On the first level of macro analysis of the metropolitan region the eight towns will be taken in consideration. On a much deeper level, the meso analysis on the level of each new town independently will be carried out on two towns for the benefit of comparison. The two new towns chosen are Tenth of Ramadan ('Ashirh min-Ramadan) and Sixth of October (Sittah Uktubar). Both are named after the Arab-Israeli war of 1973 (Yom Kippur War).

Criteria for selection

The first criteria is the age of the new town. So we are looking into first generation new towns. The next criteria is the planning of a robust economic base as the foundation for the new town, which in the case of the first generation towns was manufacturing. Although through the years, multiple additional plans have added to the diversity of the economic base of these towns, they remain centres for manufacturing outside Cairo.

There is really little variance amongst their basic characteristics. However, this research is primarily interested in 6th of October city, due to the sheer magnitude of expansion this new town has had, with almost ten times its original target population. In order to better understand the effects of certain development policing and plans, another town would be analysed to better compare the effects and inform policies that could lead to uniform development.

	Name	Established	Foundation	Current Population (2019)	Current Target Population	First Target Population
1	Tenth of Ramadan	1977	Manufacturing	234,770	2,000,000	500,000
1	Sadat	1978	Manufacturing		1,500,000	500,000
1	Fifteenth of May	1978	Manufacturing	96,522	260,000	250,000
1	Sixth of October	1979	Manufacturing	360,549	5,000,000	350,000-500,000
1	Al-'Ubur	1982	Sleeping City	135,312	600,000	250,000
1	Badr	1982	Manufacturing	32,278	450,000	250,000
3	Sheikh Zayed	1995	Residential	93,742	675,000	
3	Shorouq	1995	Sleeping City	90,033	500,000	
3	New Cairo	(1995) -2005	Sleeping City	306,767	6,000,000	

Table 12: New Urban Communities Establishing Date & Target Population (Based on; Sims, 2016)

Methods and Tools

Aim

1. Collect adequate aggregates of data to map the metropolitan region according to attributes characterizing urban competitiveness
2. Big-data analytics; involving filtering and processing data to be useful for analysis
3. Explore the spatial structure system of metropolitan region economy using ESDA

1/ Methods; Data Scraping

Using online open source data to collect geospatial data on various social, cultural and economic functions is a form of data scraping off of online web pages.

Ethics of Data Scraping:

Data scraping falls in a grey area of web-ethics. For starters, the websites used are open source with data accessible and free for usage. Second, the method used in scraping makes sure the websites don't get overloaded or crash. Third, the data collected isn't meant for reciprocation or dissemination. The websites haven't specified data scraping protocols, though they tried to make it hard through various coding tweaks. Therefore, it is worth noting that there might be ethical considerations in reiterating the methodology with other open-source data.

Nevertheless, in today's world, data scraping remains widely used by web developers, coders and data scientists. Since the data is mainly on socio-economic functions and attributes, there is no breach of privacy for individuals.

.

2/ Methods: Spatial Structure

The spatial structure of geospatial data

The method used in geospatial analysis to create grids is Hexagon. It has been adapted through Uber's H3 system to aid in the analysis. This model can be remembered from the spatiality of systems of cities mentioned earlier within the literature review. It also has some engineering benefits namely:

1. Hexagons are smooth gradients; with a slight twist (19 degrees), 7 hexagons could fit within a reasonable error threshold inside a hexagon, enabling it to size and scale. This means that with bits of coding, the data analysed can be used for micro-scale analysis or aggregated for more macro analysis.

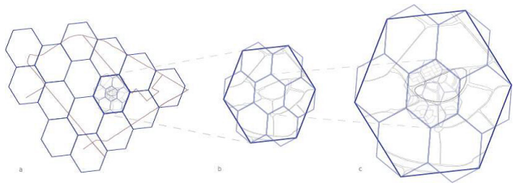


Figure 21: The sizing and scaling of hexagons. (Source; Transport for Cairo, 2019)

2. The tessellation of hexagons is continuous; super flexible with the exact amount of axis in a 2 dimensional grid. Triangles, squares and hexagons are the only shapes that tile and tessellate, however, hexagons provide the same number and scale of neighbours within the grid as opposed to squares and triangles having various kinds of neighbours, which makes it harder to compute relationships. The importance of this will be highlighted in the spatial autocorrelation analysis that deals with spatial lag computations.

Figure 22: Tessellation of triangles, squares & hexagons.

In summary, hexagons are able to subdivide, scale, index, and aggregate.

3/ Methods: Data Analysis

Geospatial visualization has moved towards becoming a representation of computed analyses, rather than a tool of analysis. This research will explore the latter, employing exploratory spatial data analysis [ESDA]. Since the research case-study has limitations in data availability, utilizing big-data on its own won't be sufficient in testing the hypothesis. Geospatial analysis will function as a tool to "facilitate thinking, understanding and knowledge construction" (MacEachren, 2004). In a sense, the spatial dimension of economic structure will work as the tool for an inductive methodology, where the hypothesis come after data mapping and analysis.

Aim

1. Explore the spatial structure of metropolitan region's economy using ESDA
2. Recognize patterns among socio-economic indicators and constituents of economic activity
3. Compare the emerging new urban economies to developed central regions

Mobilization within this research

For the case of this research, GIS spatial mapping of socio-economic indicator will be overlaid with correlation measures computed through *Geoda*. Below is an overview of the spatial correlation measures that shall be utilized in the case of this research:

3.1- Quantile Mapping using Natural Breaks

This is the first stream of analysis that shall be applied to the entire datasets. It provides a basic representation of hot and cold regions within the metropolis. It allows the definition of centres of demand and hinterland. The clustering of indicators uses Jencks natural breaks optimization method. Therefore, the values of variables are grouped to optimize the difference between each groups' mean and the following, while maintaining the smallest deviation among each group's values.

3.2- Spatial Correlation; Moran's I

It is a spatial autocorrelation measure that looks into whether patterns are spatially clustered or not. It calculates the value of the variable in question and its relation to its spatial lag across the neighbouring spatial structure. Its interference is based on the null hypothesis significance test of spatial randomness. Using this text with its univariate and bivariate options can show the clustering and correlations of specific indicators in space.

There are two kinds of neighbouring calculations: queen contiguity for side neighbours and rook contiguity for vertex neighbours. However using hexagons eliminates this dilemma.

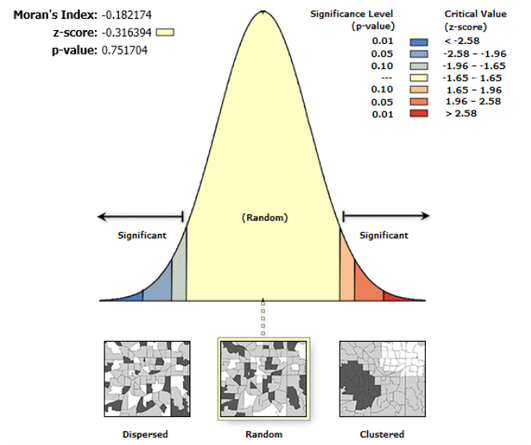


Figure 23: Example of Global Moran's I test.

3.3- Conditional Mapping

Conditional maps are a way to show interaction between multiple variables. Taking in the relationship between two variables; and their conditioning to a third (and fourth) variable. If a basic three quantile analysis is made for each of the two variables [low, medium, high], this creates a matrix of nine micro-maps [low with low, low with medium, low with high, medium with low, medium with medium, etc.]. The observations on each micro-map are those of the third variable, satisfying the state of the first two variables, e.g. low with low, etc. Distributions on the micro-maps can show the significance of multivariate influence on conditioned variables.

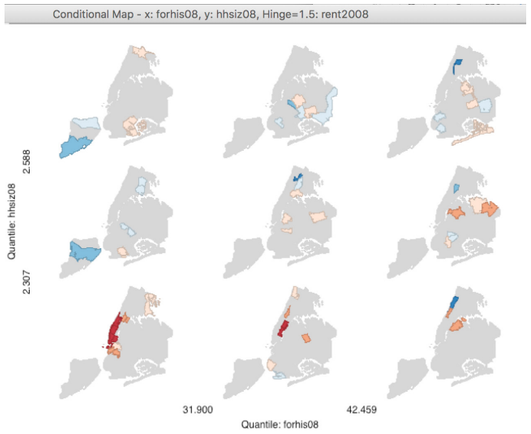


Figure 24: Example of Conditional map of Rent, graphed on y-axis of Hispanic population and x-axis of household size. (Source: The Centre for Spatial Data Science, University of Chicago)

4/ Methods: Policy Recommendations

By overlaying the findings of the spatial structure analysis of socio-economic attributes with a preliminary survey of urban policies implemented, the research shall identify challenges in need of active public and private involvement to arrive at the research's policy proposal.

Aim

1. Highlight mismatches between set goals, employed strategies and research findings
2. Inform better policies for agglomeration using the theoretical framework devised in the literature review

Methodology

- Through archival analysis using the Urban Observatory research initiative [*MarsadOmran.org*], which archives and categorizes the published policies and strategies for the built environment.
- Through secondary sources identified in a literature review offering critical overviews of policies.

Photo by Daniel

Chapter 4
EMPIRICAL DATA

Empirical Data

Case-study Background Analysis

First, this chapter shall start with background analysis to the empirical research case-study.

NUC: Genesis

"The city is not an organ and it shall not be viewed in isolation of the forces working in its transformation"- Urban Asymmetries

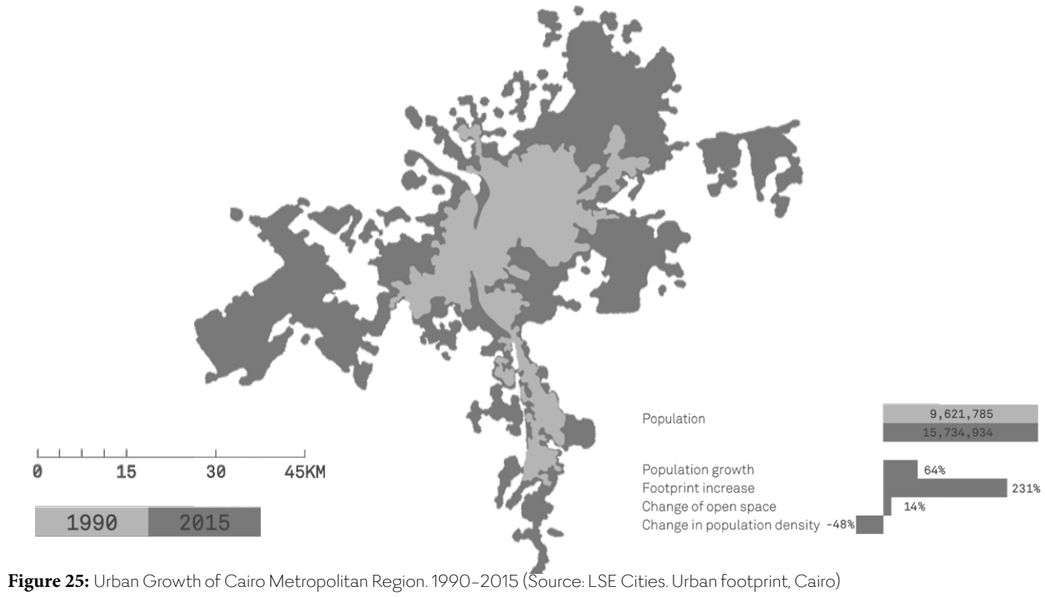


Figure 25: Urban Growth of Cairo Metropolitan Region. 1990-2015 (Source: LSE Cities. Urban footprint, Cairo)

Much is debated about the genesis of new towns. Official documents in Egypt claim that the earliest new town was created by President Sadat in the 1970's in western Cairo, while the earliest planning traces in modern day Egypt dates to the same period, but in war-struck zones of the Suez Canal and Sinai, aiming to establish new cities wiped of war traces (Sims, 2016). Within the wider context of Africa, it is argued that new towns are a product of British colonial legacy, with the same planning paradigms propagating with visions of economic and political centres for governance (Moser, 2015). To understand the genesis of certain planning practices, one can't look only on form and context, but rather investigate "social movements, economic changes and political decisions which construct the city" (Kaminer et al., 2011, p.15). This brings us back to the same limitation of urban economic models that only capture cities in a point in time. With this in mind, the genesis of new cities is looked at within the economic, social and political discourse of planning.

NUC: Political Environment- Welfare State to Neo-liberal State

"New Towns are planted urbanization schemes that don't cater to geographic needs through a top heavy approach from authorities (Keeton, 2019)".

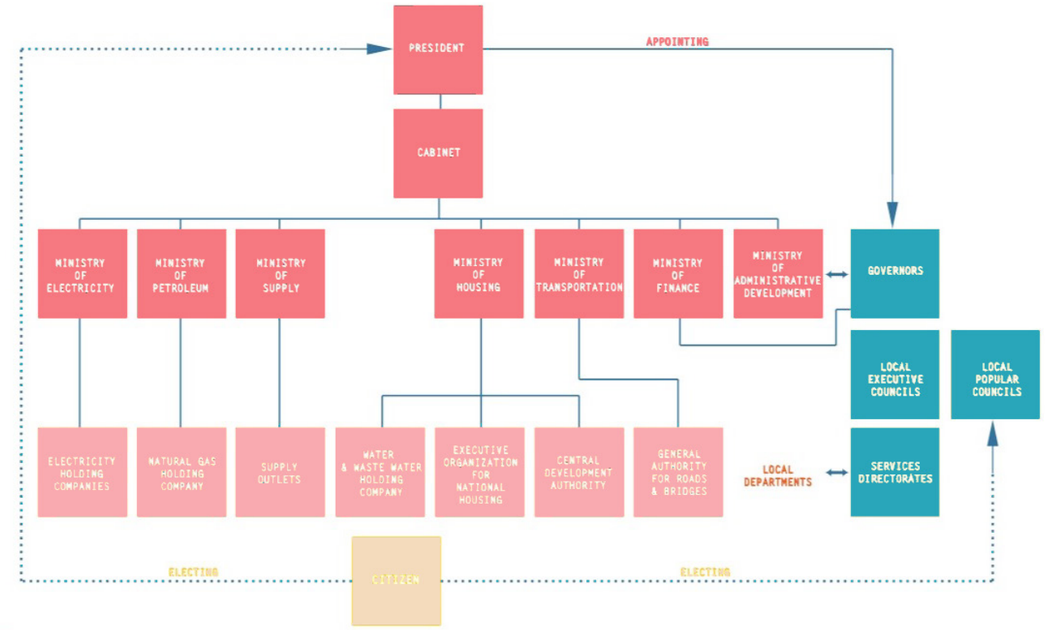


Figure 26: Existing Urban Management System. (Source: Shawkat 2013)

This section dives into the governance of the new towns in Egypt, with specific focus on the eight new towns around Cairo. As mentioned earlier, these towns have developed over 60 years, with what is now categorized under four generations of new towns development (see Table 3 in Chapter 2: literature Review). This section projects their current as well as evolutionary mode of governance. The main focus is on formal modes of governance. Although, there is definitely informal governing tactics, the size and magnitude of which is argued to not affect the governance of new towns as these communities experience huge autonomy in their decision-making (Sims, 2012)

Urban administration in Egypt is a complex process that is managed on varying levels. There are three main levels of categorization in urban areas, four regarding rural areas. On the highest level, Egypt is divided into 27 governorates (i.e. administrative cities). The president appoints head governors for each who report directly to him. However, they work along central ministries for planning, management and service provision [see Figure 26 & Figure 27]. On the second level, there exists the most complexity with great variance between four kinds of local administration. The first is for the primarily urban governorates. This is the case of five out of the 27 governorates today, like Cairo. The capital of the governorate is the entire city. It is thus comprised of zones, subdivided into urban districts (**Qesm**, i.e. Division); only third level districts reporting to the zones principal, as assistant to head of governorate. These urban districts used to have elected mayors and boards, however this has ceased since 2012, after the Arab Spring. The second type of secondary level administration is part of more complex governorates comprising rural and urban areas. Briefly, within these governorates there are the capital urban municipality with its urban districts (**Qesm**, i.e. Division), and rural or rural & urban municipality (**Markaz**, i.e. Centre). On the third level, the rural municipalities are further divided into local units (**Wehdat Mahaleyya**), which might be further divided into smaller rural areas.

The third type of secondary level administration is the focal point of this research, i.e. new towns. In case of the new towns in and around Cairo, they are recognized and referenced as cities. They are planned, governed and managed under the authority of NUCA, an acronym for New Urban Communities Authorities, which is an authority under the ministry of housing, one of 32 full ministries. In case of which NUCA has an agency for each new city or multiples for bigger ones, like New Cairo.

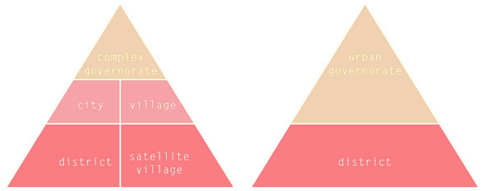


Figure 2.12 Hierarchy of Local Administration Units.
Source: Piffero (2009).

Figure 28: Hierarchy of Local Administration for first two kinds of cities. Source Piffero

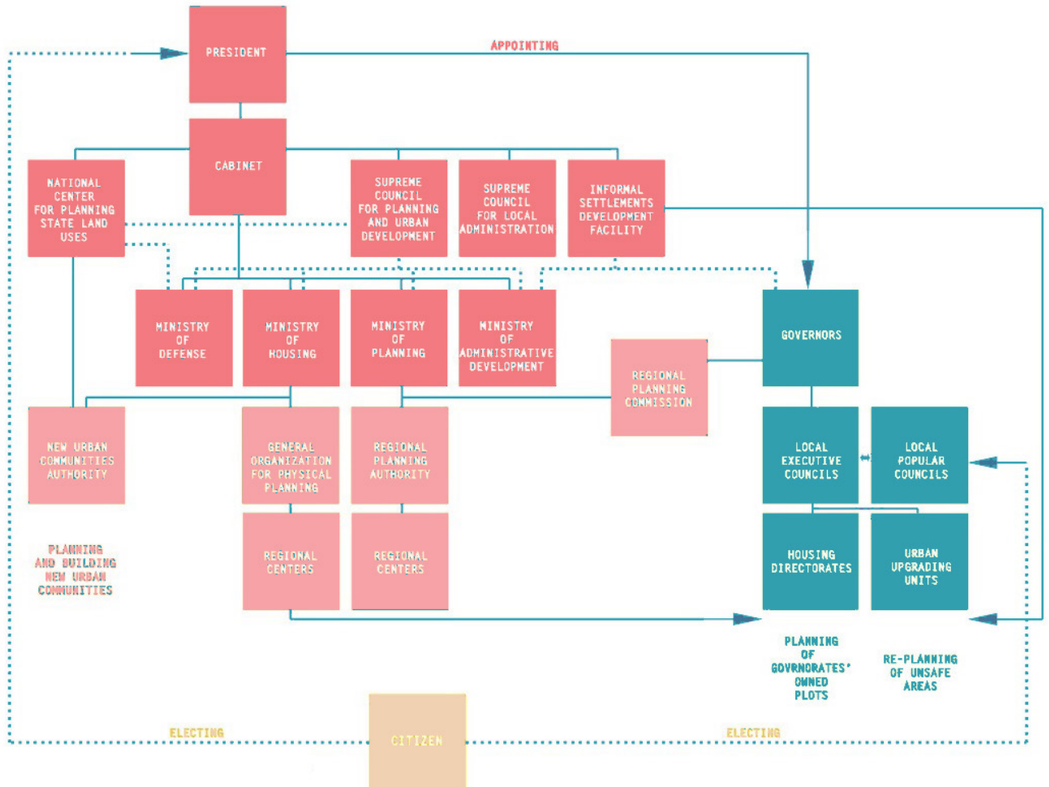


Figure 27: Existing Urban Planning System. (Source: Shawkat, 2013)

The spatiality of New Towns governance

NUCA's authority within the hierarchy of government bodies is quite exceptional as it is enabled to claim state land, sell it and retain most of the revenues; which are privileges only available to the armed forces (law 59 of 1979) (Sims, 2012). Moreover, the basic framework of the law stipulated that NUCA develops the new urban communities, manages it through a subordinate agency, then new towns would revert to local urban administration like standard districts of their respective governorates. However, this was only done once with the case of Sadat city, one of the first NUCs of the post-monarchy era. This has been disregarded in most NUCs as their agencies under the NUCA authority continued to claim more land for sale and development. Therefore, the process of officially developing these new towns never ended. Figure 20 shows the spatial expansion of New Cairo through a process of presidential decrees in a frame of two years.

This is the most important aspect of governance of new towns and one that has extensive effects and repercussions on their planning, development and management. The significance of this play around the law has led these urban regions to be managed for economic gains rather than for the creation of urban life. Components of functional urban environments, like transportation, remain far out of sight. This in turn has profound repercussions on the failure of these NUCs to capture their strategic goals of attracting inhabitants and activities as they are still managed by real estate developers.

Lastly, concerning informality, little has been referenced to new towns around Cairo. Although there are justified claims for the informality of formal planning and management frameworks. The lack of informal or citizen action comes due to the huge state control over civic society, which disables any mode of collective action after the 2011 revolution. However, these new towns house gated housing communities as a major component of urban planning. Within these gated communities, local collective action can be witnessed, through private developers enabled community councils. Through collective efforts they can enhance their urban environments. Additionally, those communities that house multiples of thousands can pressure officials to deliver certain services and get involved in governance. Nevertheless, their demands don't exceed basic streetscape enhancement, garbage collection, and security. Hence, the quality of urban life in those new urban communities remain highly basic with limited top down mobilization of socio-economic components of agglomeration.

Figure 29: New Cairo Development extents according to Presidential Decrees (Source: Based on NextArch Lab, 2018)

NUC: Economic Drivers

> *"..... thinking of an economy, much like an army" on planting development in distant regions- Jane Jacobs*

It is a wide claim of urbanists working across the globe today to point fingers at the global financial cloud of real estate. Rolnik (2019) describes the situation as a cloud of surplus profit looking for potential lands to invest their money, capture value and move towards the following investment scheme. Without diving deep into political territories, urban development and the building industry has acted for more than three decades now as the investment scheme for capitalists. While neoliberalism has pushed economies into the market's hands, it has given a free-hand to investors and developers into the urban arena (Kaminer et al. 2011). Furthermore, nations were stuck looking for employment for their labour markets. Jacobs (1984) mentions the fight for industrial development among states in the 20th century, as production lines grew too big for urban centres and started moving to fringes, American states were fighting for them. Today, it is seen all around the world how cities officials are fighting for development in the shape of real estate, and the global finance cloud anticipates a place to capture value (Rolnik, 2019). Today, real estate in Egypt contributes to 15% of GDP (Arab Finance, 2018; 2019).

New cities and towns grew from providing a space for urban development with all the economic and societal benefits, to a mere value extrapolating scheme. This has been evident in Egypt, since the start of the 1990s, when the minister of housing was replaced by Mohamed Ibrahim Suleiman, who is thought to have put the ministry on capitalist mode (Sims, 2012). Corporations of real estate developers which had been set up, and were enabled by NUCA to access huge tracts of land, concentrated their efforts on building gated communities and residential compounds (Sims, 2012).

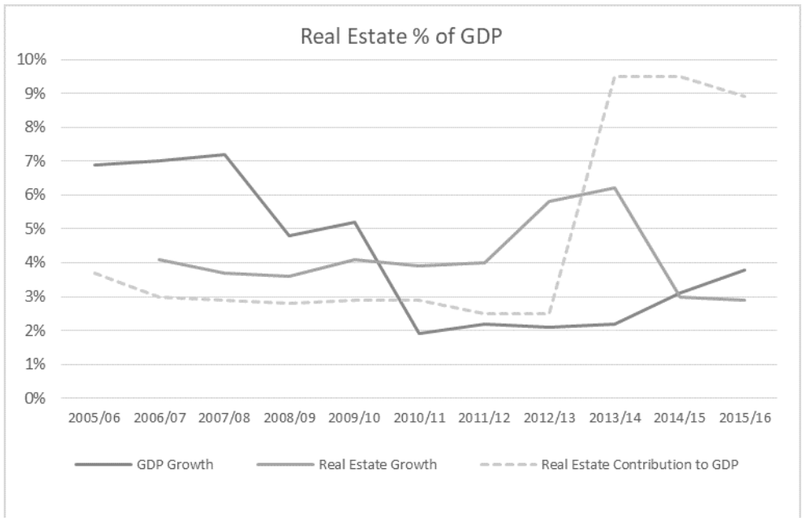


Figure 30: The Real Estate Sector role in Egyptian Economy (Based on Central Bank of Egypt)

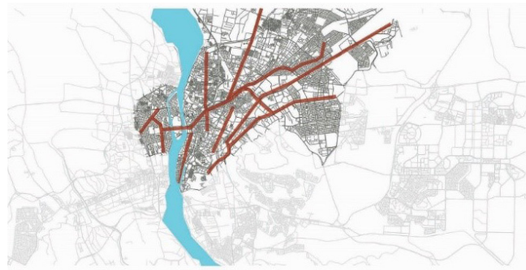
NUC: History of Urban from

600-1200

1800

1900

1960



1990

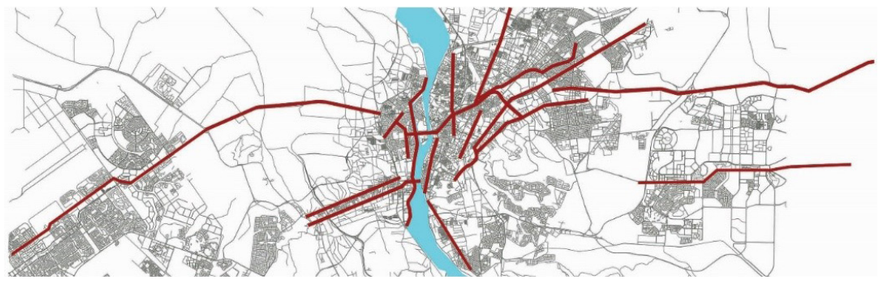


Figure 31: The Urban Boundaries of Greater Cairo Metropolitan Region through Time. Source: NextArch Lab, 2018.

The previous figure shows the evolution of the planning paradigm traced over time. The urban experience running along the Nile shifted at the turn of the 20th century towards reclaiming the desert on both the eastern and western sides of the Nile delta. The spatial analysis gives credit to more than the resulting urban form, but it refers to the social, political and economic environment. In the next few images more about that will be made clear. Figure 32 shows the city agglomeration around a major economic spine of trade and manufacturing in Islamic Old Cairo in the 11th Century. Figure 35 shows the planning paradigm in the early 19th century with Haussmann's boulevard design of Downtown Cairo. Figure 33 & Figure 36 show the mid-19th century planning. The shift in the eastern spine towards the desert with the creation of Nasr City, is a marker of the government's shift in planning paradigm. On the Western side, *Mohandessen* was made for an elitist strata of society with standalone houses and private gardens. It accommodated the pan-Arab league and streets were given the names of Arab countries and leaders. Nasr city was to accommodate the working class as well as government institutions, with its modular extension, built on a linear grid with the concrete cement housing units. The final two figures [Figure 34 & Figure 37] are the biggest new towns around greater Cairo, with their low density, car-oriented, planning. Their planning shows a huge shift not only in the outlook towards urbanising the desert, but also towards planning for profit from high-end market real estate developers.

This overview shows only a glimpse of the genesis and snapshot of the political, economic and social drivers of the new towns development in Egypt, with a focus on Cairo. While there might be huge debate on the history of these developments, this research is invested in looking for better practices for the enhancement of the input of these developments within the metropolitan region.

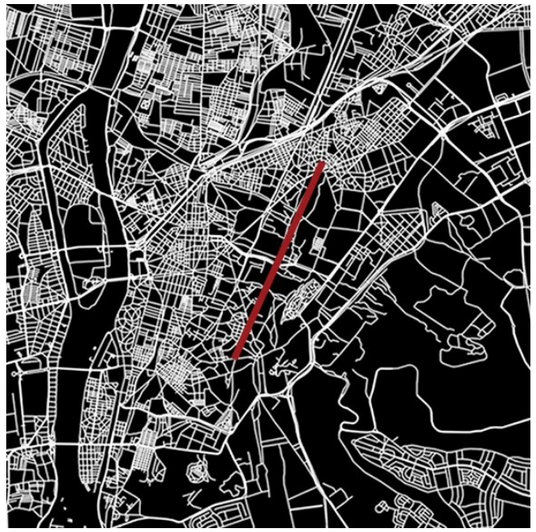


Figure 32: Old Cairo Spine in Red. Parallel to the river Nile. Source: NextArch Lab. 2018 [Top Left]

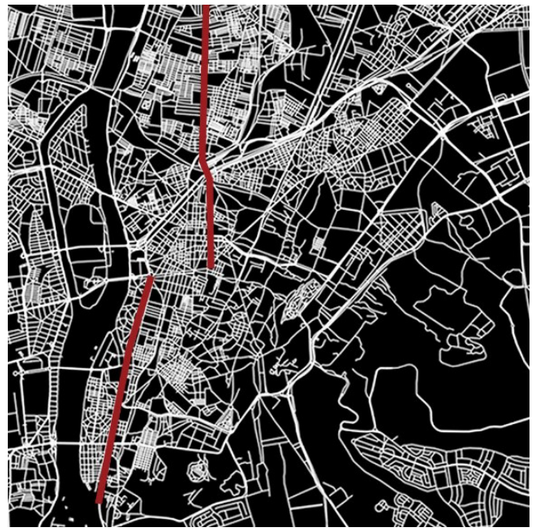


Figure 35: Downtown Cairo extends again parallel to the river Nile. Source: NextArch Lab. 2018 [Top Right]

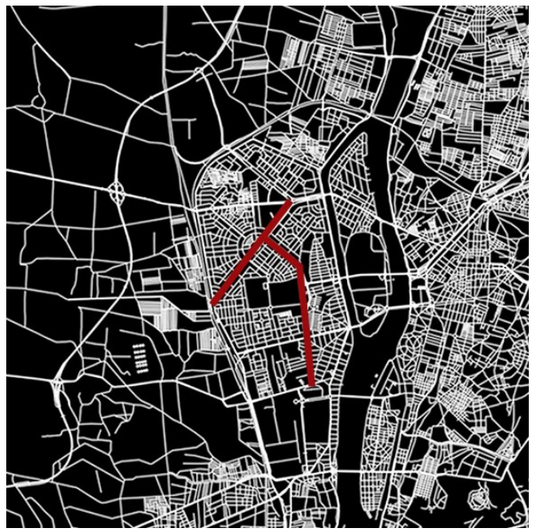


Figure 33: Mohandeseen (i.e. Engineers City) in Red parallel to the river Nile on western banks. Source: NextArch Lab. 2018. [Middle Left]

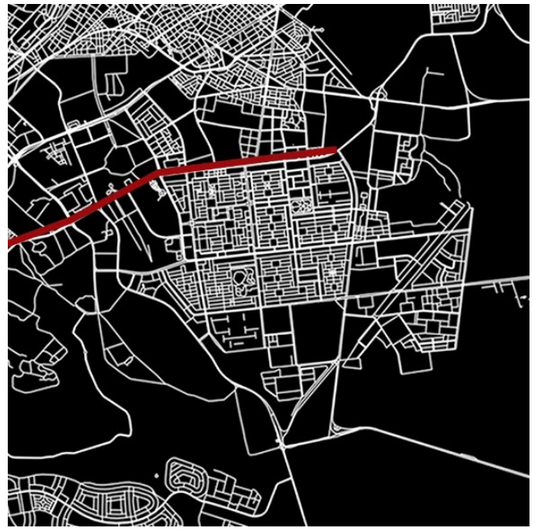


Figure 36: The shift of the spine towards the desert in Nasr City with its modular grid. Source: NextArch Lab. 2018 [Middle Right]

Figure 34: 6th of October a first generation new towns in 1979. Source: NextArch Lab. 2018 [Bottom Left]

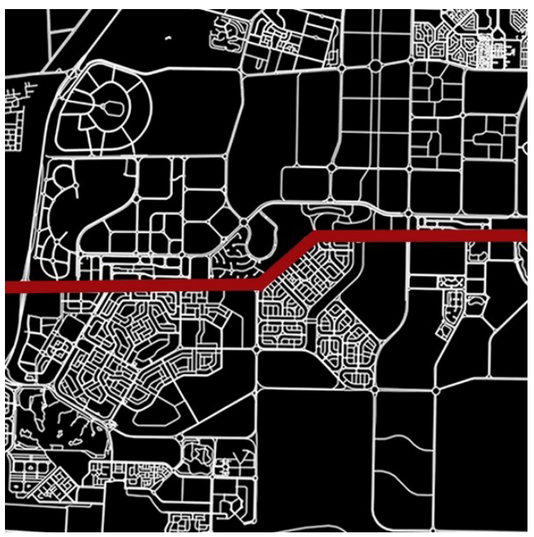


Figure 37: New Cairo a second generation new town of 1990's. Source: NextArch Lab. 2018 [Bottom Right]

Empirical Data

Urban Competitiveness Analysis

The first part of the empirical research is the indexation of economic activity within the metropolitan region, using attributes that are indicative of an urban area's economy. Using the literature review as the backdrop and looking at productive functions and population.

The initial attributes used as a proxy to the framework are:

1- **Population**- *Normalized*

2- **Job opportunities**- *Normalized* (computed as per aggregates of activity) (Transport for Cairo, 2019)

3- **IT service** & computer systems providers- *Normalized* (computed as number of IT and developer offices)

4- **Factories**- *Normalized* (computed as number of production facilities)

Urban Competitiveness Index =Δ Jobs
+ Δ IT offices
+ Δ Factories
+ Δ Population

Δ = Normalized values

The first step is to capture the current state of the centres and sub-centres. Using the definition of the city as a centre of production and labour market, relevant attributes will be the criteria for capturing an area's economic activity. Therefore, the proxy equation looks at population concentration, in addition to job opportunities available in an area, added to production facilities, and to computer systems and IT service offices and providers. Furthermore, using the aforementioned socio-economic attributes [in chapter 4] to investigate correlation and map determinants of the various economic activity indexes computed.

First: Aggregate data for urban competitiveness index

Population Concentrations

The population density shows rather a flatness within the NUCs, as opposed to the hot and gradient clusters seen within centre and inner Cairo and Giza. The central region, i.e. Downtown Cairo shows significantly low density. This is rather unhealthy for the centre responsible for part of the urban heritage, "sense of place", urban identity, as well as housing important centres of cultural and financial institutions. These dense regions belong to the so-called "informal" regions that house almost 67% of the urban population in Cairo (Sims, 2012). 6th of October shows signs of emerging highly populated regions, correlated to social housing projects.

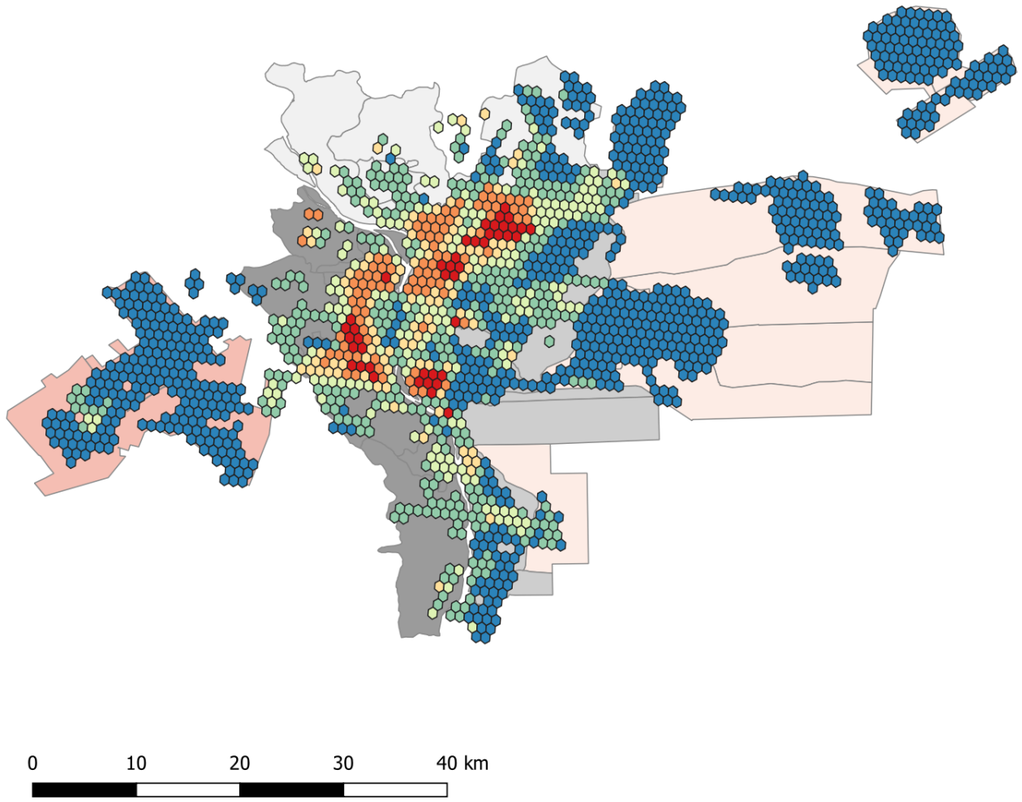
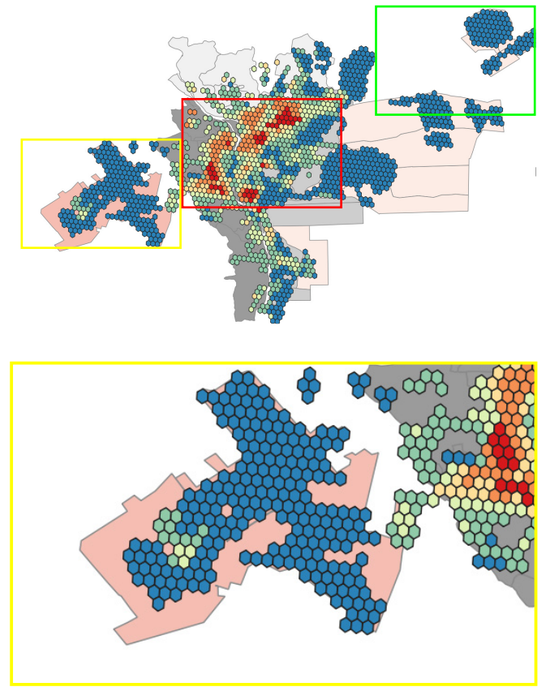


Figure 38: Population Density in the Greater Cairo Region (Source; TfC, 2018)



Centres of Manufacturing & Production

This is an aggregate of production facilities, with disregard to the size of these entities as it is argued that small and medium size enterprises make up almost 80% of the production facilities in Egypt (Sims, 2012). In the two case studies, there is evidence of the emerging centres of production and their clustering within and in proximity to the industrial zones within these NUC. If the central region is considered the centre of production, the NUC of 6th of October has established itself as a sub-centre for production. This is highly due to the industrial zone around the western edges of the city. There are traces of a potential sub-centre in the 10th of Ramadan in the east, although it is highly dispersed.

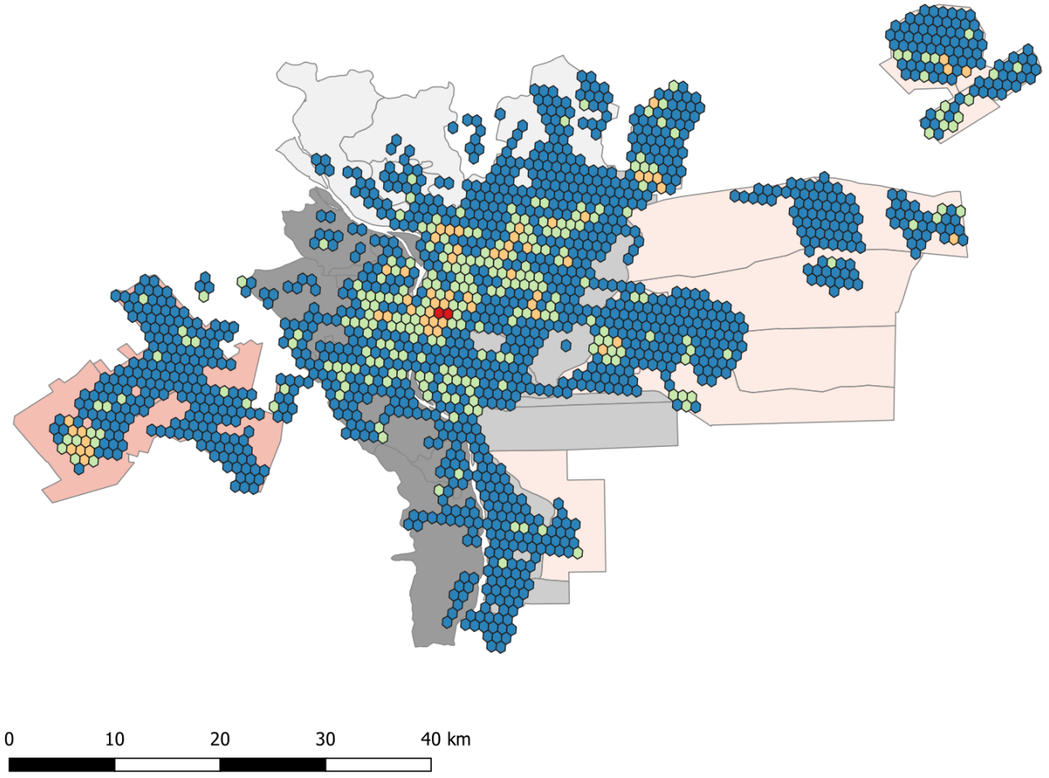
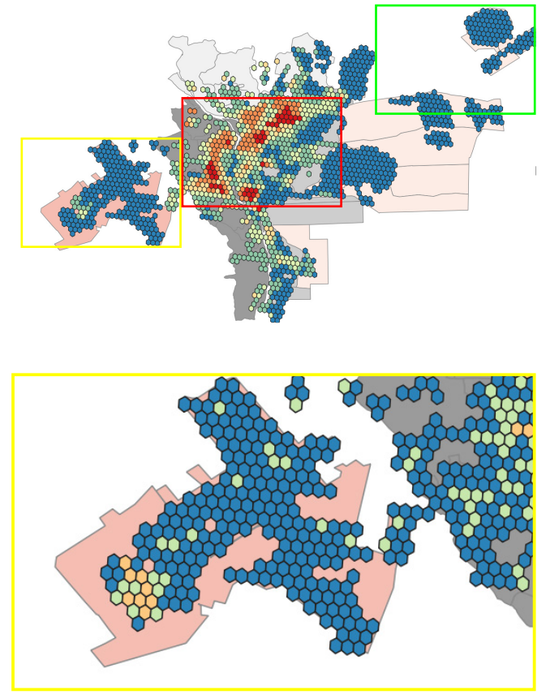


Figure 39: Centres of Manufacturing & Production in the Greater Cairo Region



Centres of IT service providers

The comparative analysis between the centre and the two case-studies shows the concentration of IT service providers within the central region; although there are traces of emerging sub-centres within the two NUCs. Nevertheless, the overlaying of this attribute with the previous analysis for centres of production, shows that they are not necessarily clustering within the same area, indicating a dispersion of the agglomeration.

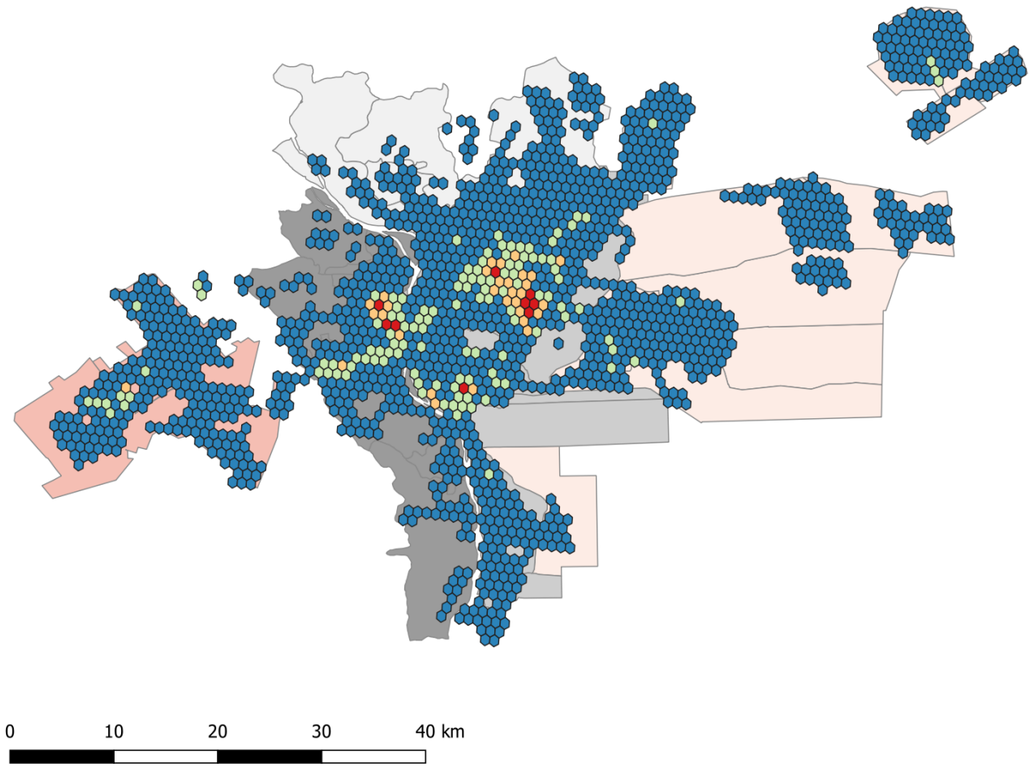
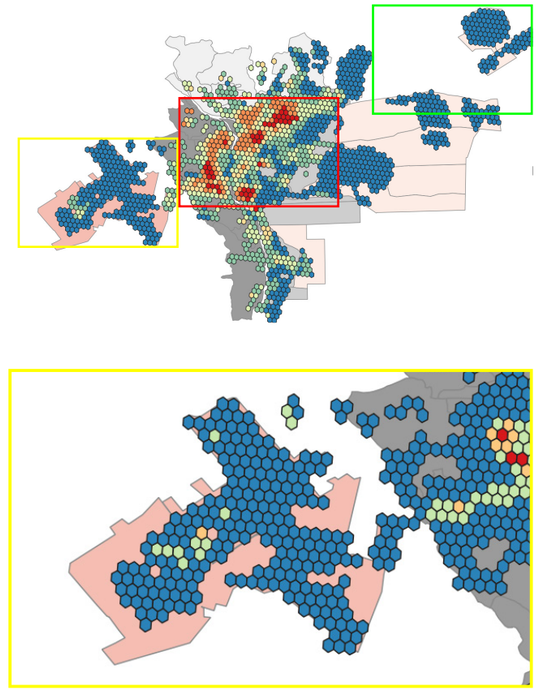


Figure 40: IT Service providers in the Greater Cairo Region



Job Opportunities

The importance of this dataset computed by TfC (2019) lies in the inclusion of job opportunities available in the informal economy, as opposed to official datasets. The geospatial analysis shows the existence of centres of employment outside the central Cairo region, besides the ones in central Cairo and Giza. There is a degree of normal distribution within the central and inner regions of Cairo and Giza, where there is evidence of multiple sub-centres and markets. With regards to 6th of October, in the west, the mapping shows a potential centre for employment, although it can barely be considered a centre of urban employment, according to Parr (1979). The western NUC of 10th of Ramadan, is rather disappointing in the flat distribution of job opportunities, suggesting the absence of hierarchy within the spatial structure.

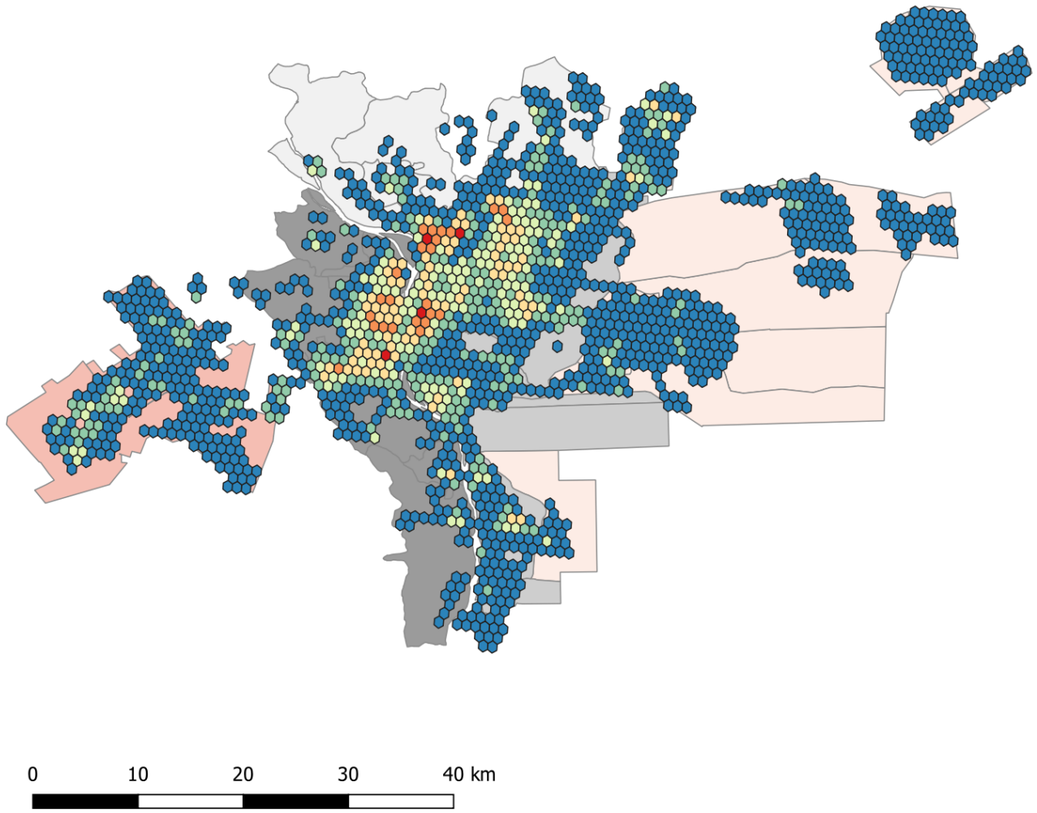
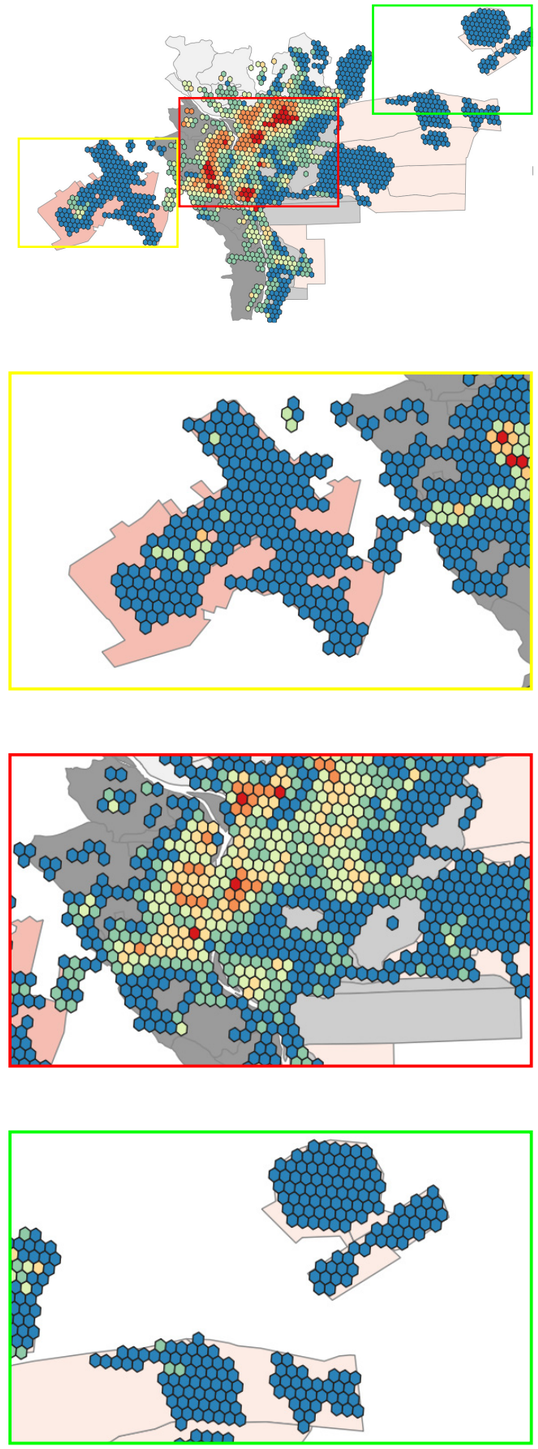


Figure 41: Job Opportunities in the Greater Cairo Region (TfC, 2019)



Urban Competitiveness Index:

The geospatial data shows the result of the equation:

Urban Competitiveness Index = Δ Population + Δ Jobs + Δ Factories +Δ IT offices

The use of normalized statistics to index urban competitiveness shows the following distribution. A normal distribution of 7 clusters is used to reference the central place theory (Christaller, 1933). There is a huge concentration within inner city centres, with an advantage to the eastern side of the metropolis, i.e. Cairo, housing two of the three first level centres. On the other hand, the two new towns in question also house third-tier centres of urban competitiveness. Finally, it can be noticed that most of the low indices regions fall in the NUCs

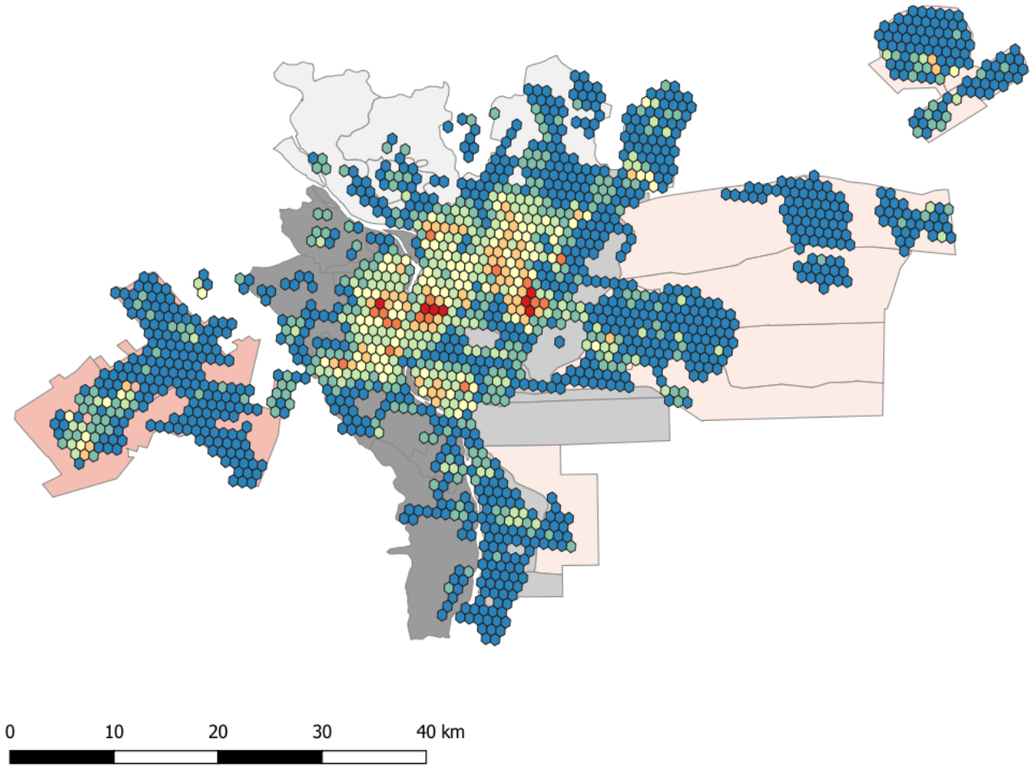
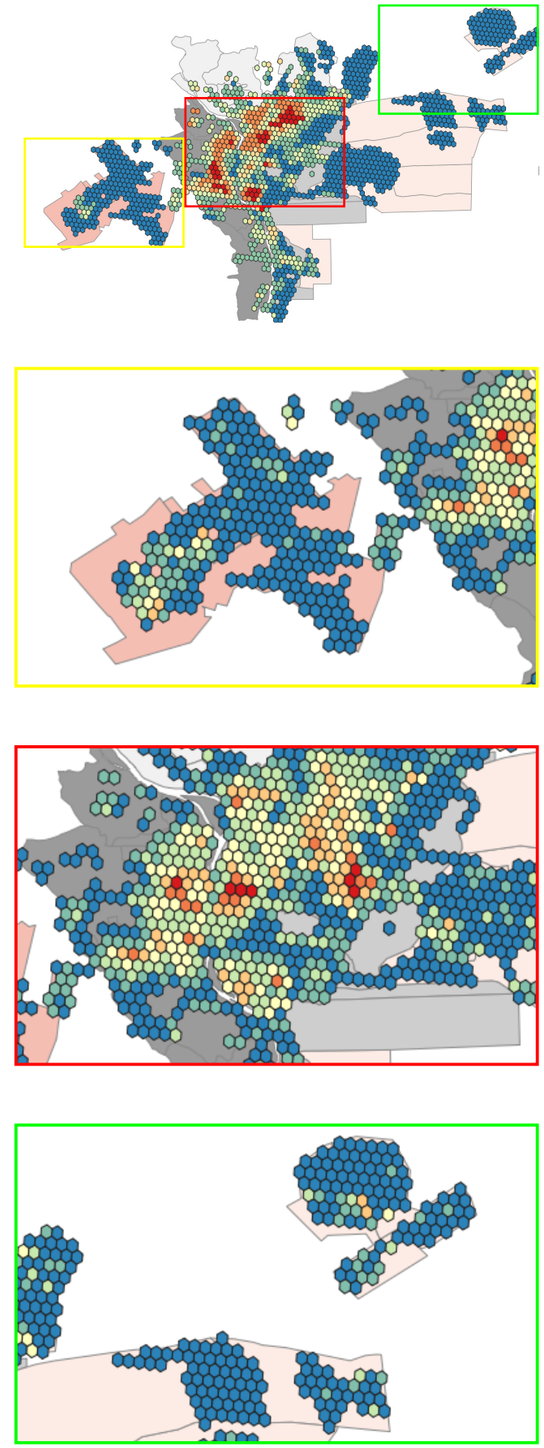


Figure 42: Urban Competitiveness index in the Greater Cairo Region



Economic Activity Index

For another iteration of just the aggregation of economic activity, comprised of production functions, the population index was removed to show the following equation:

Economic Activity Index =Δ Jobs + Δ Factories +Δ IT offices

The indexation shows a refined gradient of economic activity, with almost the same centres and sub-centres emerging. This supports the rationale of employing population concentrations in addition to economic activities, as city centres constitute both diverse dense functions and communities (Maunier, 1910).

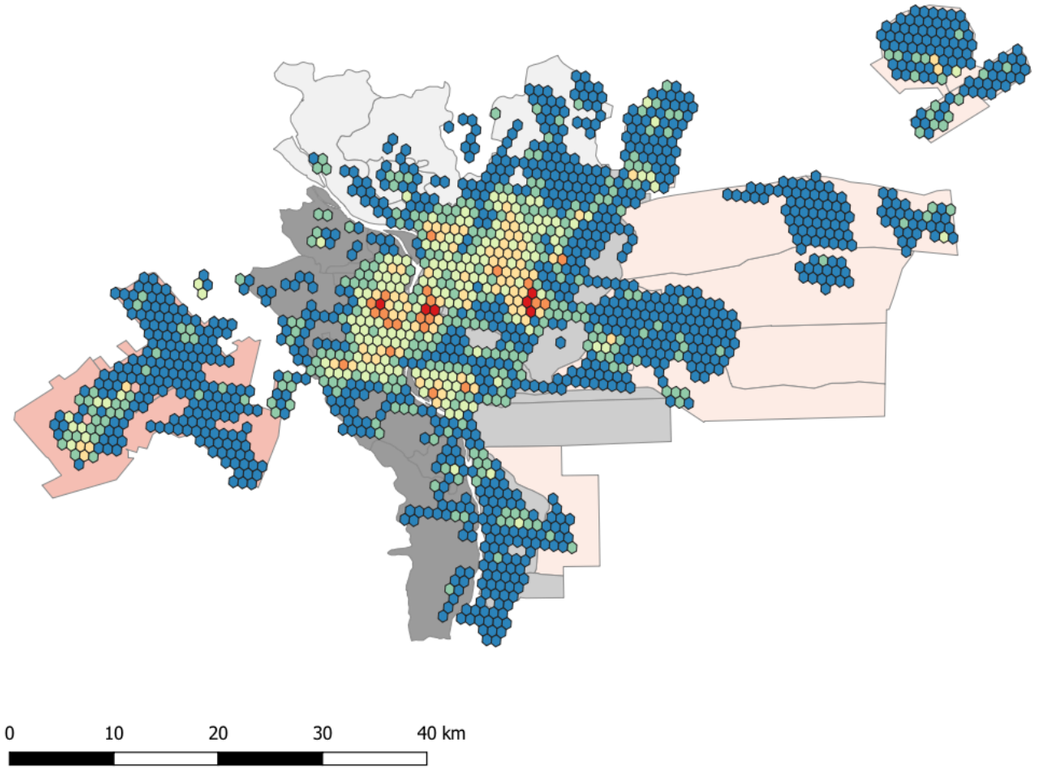
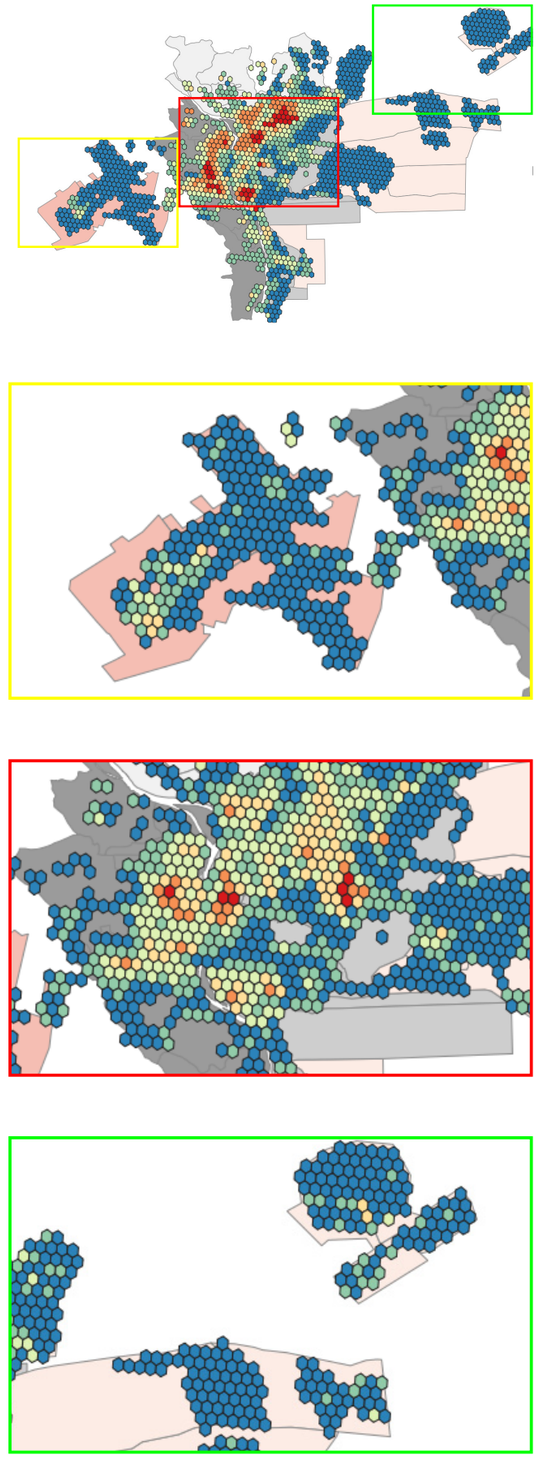


Figure 43: Economic Activity Index for Greater Cairo Region



Spatial Correlation Analysis for Urban Competitiveness

The Local Moran's I analysis shows patterns in the clustering of high and low economic activity. The weights area is tried multiple times with various levels of queen contiguity calculated.

1. Three levels of contiguity

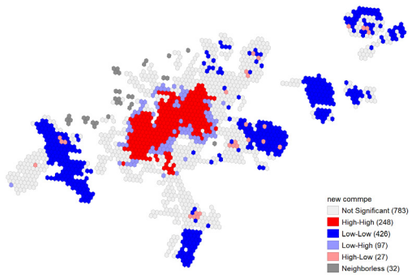


Figure 44: Local Moran I's-Cluster Map- Urban Competitiveness- 3 level Contiguity

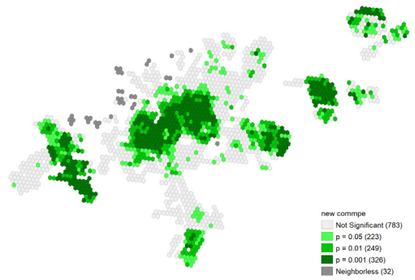


Figure 45: Local Moran I's- Significance Map- Urban Competitiveness- 3 level Neighbouring Weights

2. First level of contiguity

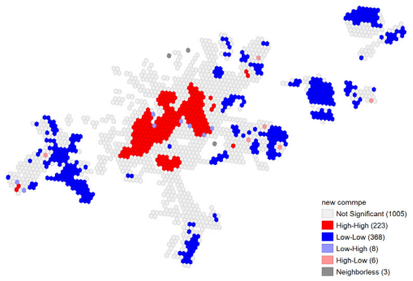


Figure 46: Figure 40: Local Moran I's-Cluster Map- Urban Competitiveness- 1 level Contiguity

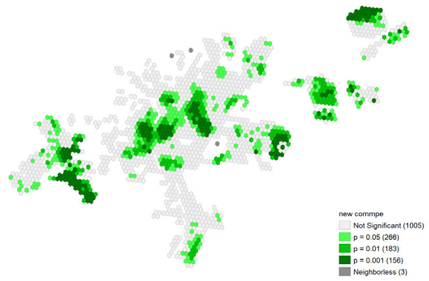


Figure 47: Figure 41: Local Moran I's- Significance Map- Urban Competitiveness- 1 level Neighbouring Weights

The analysis of urban competitiveness index over one and three levels of queen contiguity provide multiple observations;

- All cold spots lie within new urban communities, showing huge deprivation of economic activity.
- While the significance maps for 3-level contiguity show a blend out of the central region of the metropolitan area, the 1-level show that there might be hinterland amongst this centralised region with three different centres.
    - One centre west of the Nile, a second east of the Nile, and a third centre in the eastern extension of central Cairo.

There is clustering of the Urban Competitiveness within the centre of the metropolitan region, which remains highly centralised with disregard to the magnitude of new urban development expanding in new urban communities. This proves the failure of NUCs to meet their main goal of decentralising the high-dense metropolitan region.

- While the centres of Urban Competitiveness fall within the central region of the metropolitan region, they extend more towards the eastern side. The upcoming analyses of socio-economic indicators shall provide some explanation to this characteristic of the metropolitan spatial structure.
- The absence of sub-centres outside central regions
    - In case of 1-level contiguity, it was noticeable that there exists a limited number of hotspots in the 6th of October. The absence of these hotspots in the 3-level contiguity shows that their level of influence doesn't reach their third neighbour.
    - With regards to the 10th of Ramadan, there is a limited 3-level contiguity indicator of economic activity. Yet again, it is not corresponding with 1-level contiguity analysis.

Second: Mapping Socio-Economic Attributes:

Basic Education

A spatial analysis of basic education, i.e. schools, called for a subsequent qualitative analysis, to further investigate the discrepancies between the two case studies. Hence, a statistical study of the mode of school types per polygon was computed [Figure 49]. The main observation is the decrease in Arabic (i.e. public) schools as you get further from the centre. This shows the rise in the affluent class as you see a rise in private and international schools.

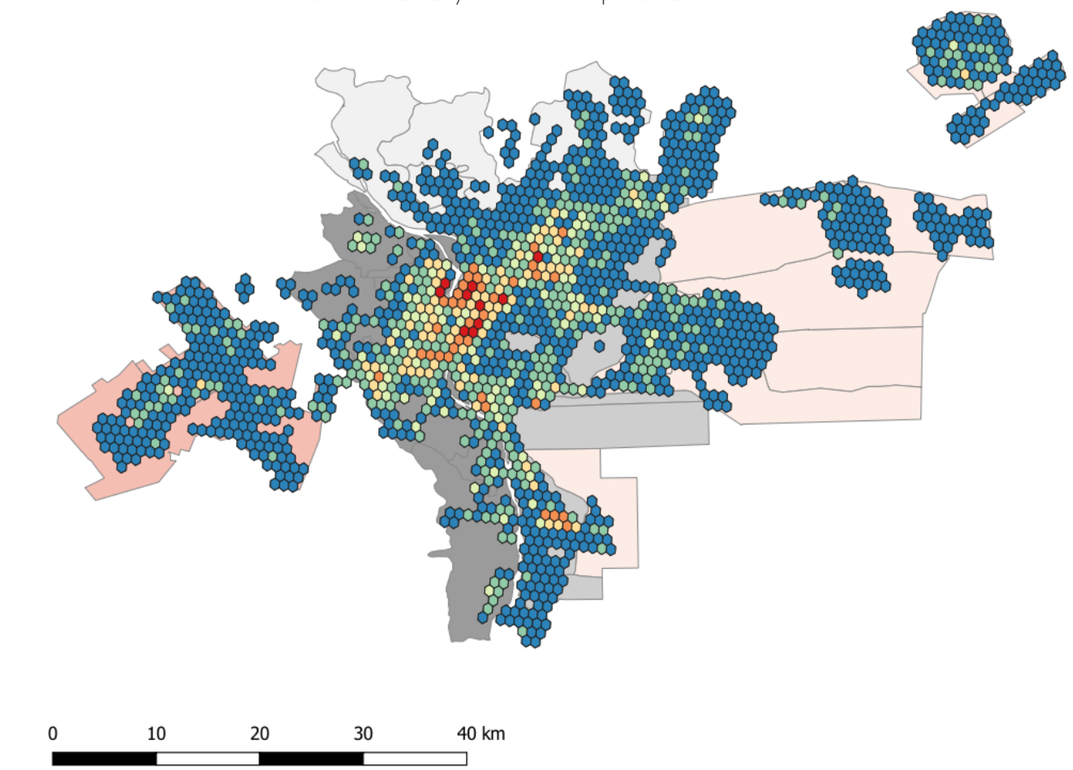


Figure 48: Number of Schools in the Greater Cairo Region

Basic Education; School Type

Moreover, the difference between 6th *of October* and 10th *of Ramadan*, lies in the presence of more Arabic schools in 10th *of Ramadan*, while 6th *of October* has an abundance of western Cairo's international schools. This is somewhat telling of the demographics present in each region. One can argue that the presence of *Sheikh Zayed* residential NUC at the edge of 6th *of October* has nurtured the rise of affluent society 10 km away, which wasn't the case with 10th of Ramadan. This is because the eastern sleeping NUC is New Cairo lies almost 50 km away. This might be indicative of the competitive role these NUCs played. Some were complementary (*Sheikh Zayed & 6th of October*), others were competitive (*10th of Ramadan & New Cairo*). Over and above, this shows that for urban areas to emerge, there ought to be potential for diverse communities to grow. While industrial NUCs called for working class and social housing, their growth is tied to the presence of capitalist wealth that pushes the micro-economy of the urban area. Furthermore, this comparison is indicative of the resources mobilised by the urban management, enabling the development of international and private schools, which is at stark difference to 10th of Ramadan, where resources were highly mobilized towards the working class and public schools. While both NUCs were developed as industrial cities, it appears that this vision changes for 6th *of October*.

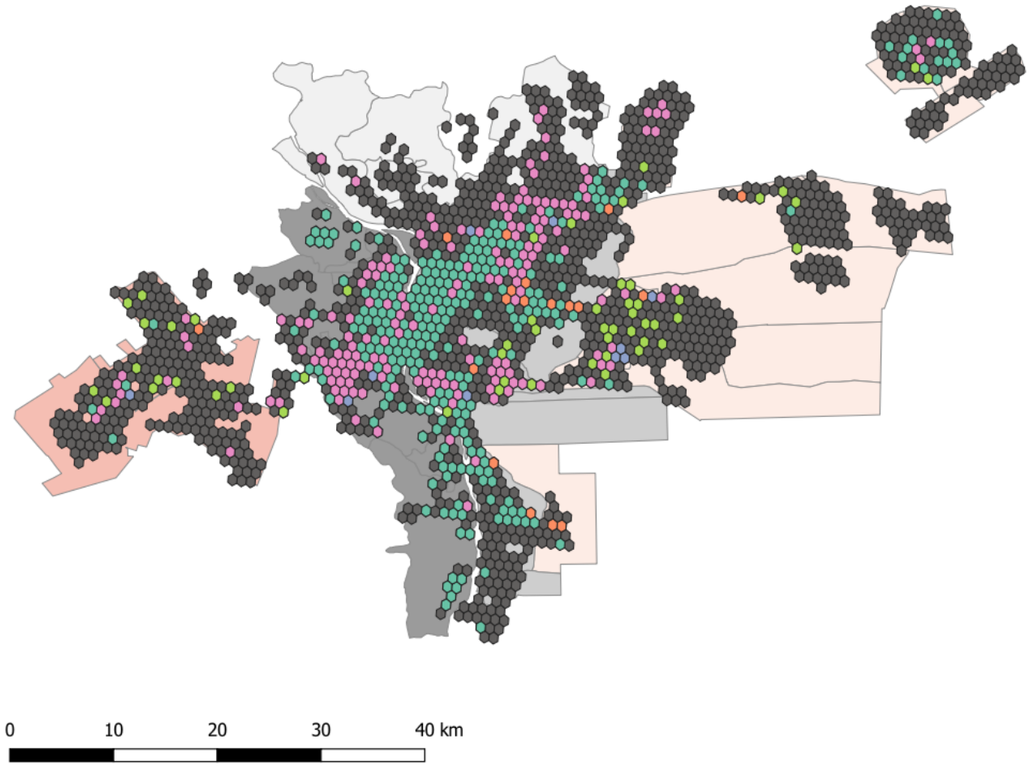
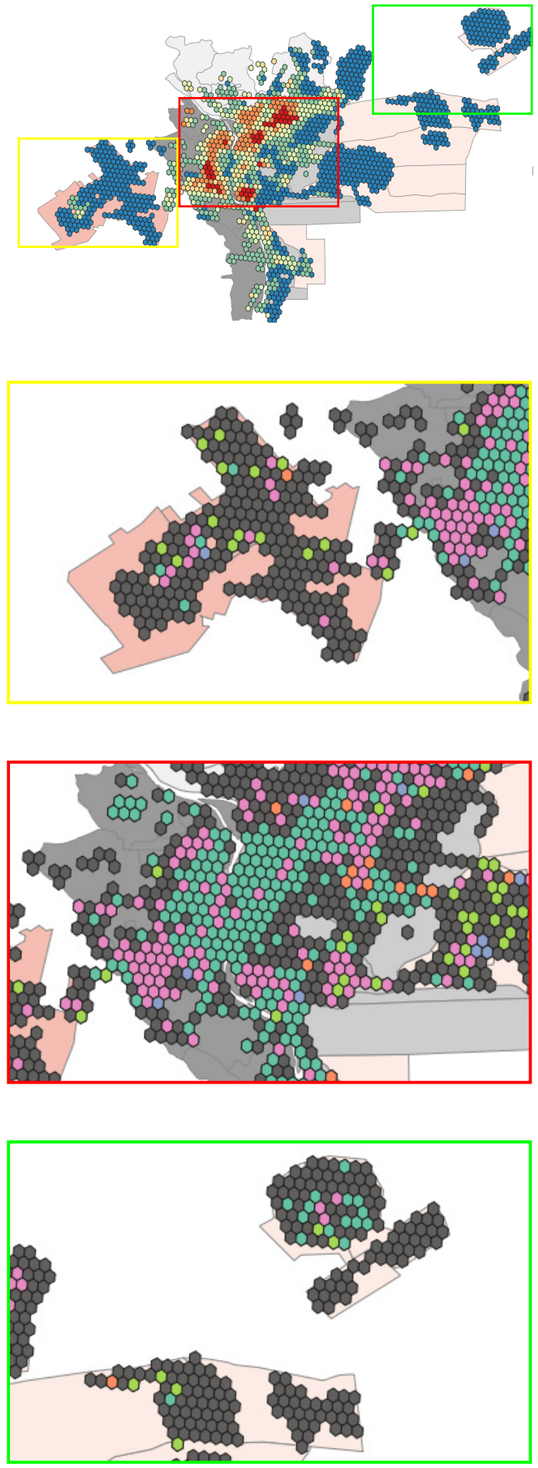


Figure 49: Recurrent School Type in the Greater Cairo Region



Job Accessibility

The basic data is computed by Transport for Cairo (2019), using public transportation mapping. The map shows gradual gradient for accessibility from central Cairo and Giza, all the way to Inner Cairo and Giza. The highest levels of accessibility index in central regions might be due to the underground metro system. Most NUCs have poor accessibility, posing a huge limitation on these regions to grow, attract and retain economic activity and population concentrations. As mentioned earlier, urban areas rely on infrastructure to keep markets connected and create interdependency among centres and hierarchies through various levels of sub-centres. Therefore, transportation might be posing a huge limitation on these NUCs to grow.

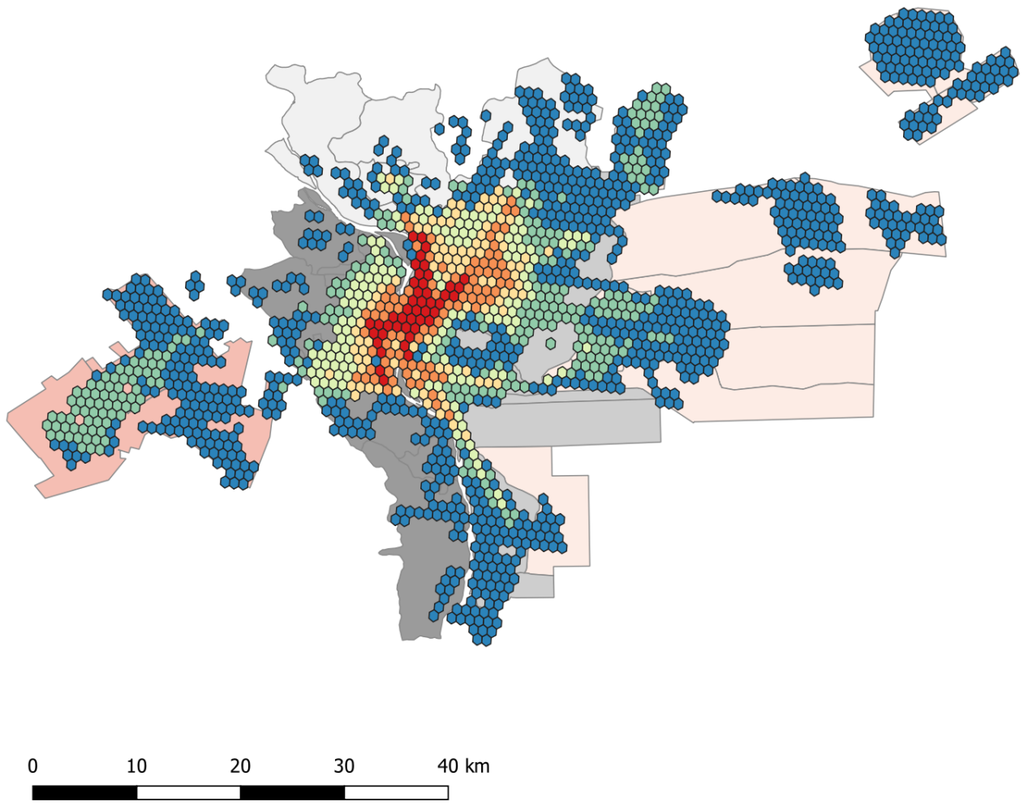
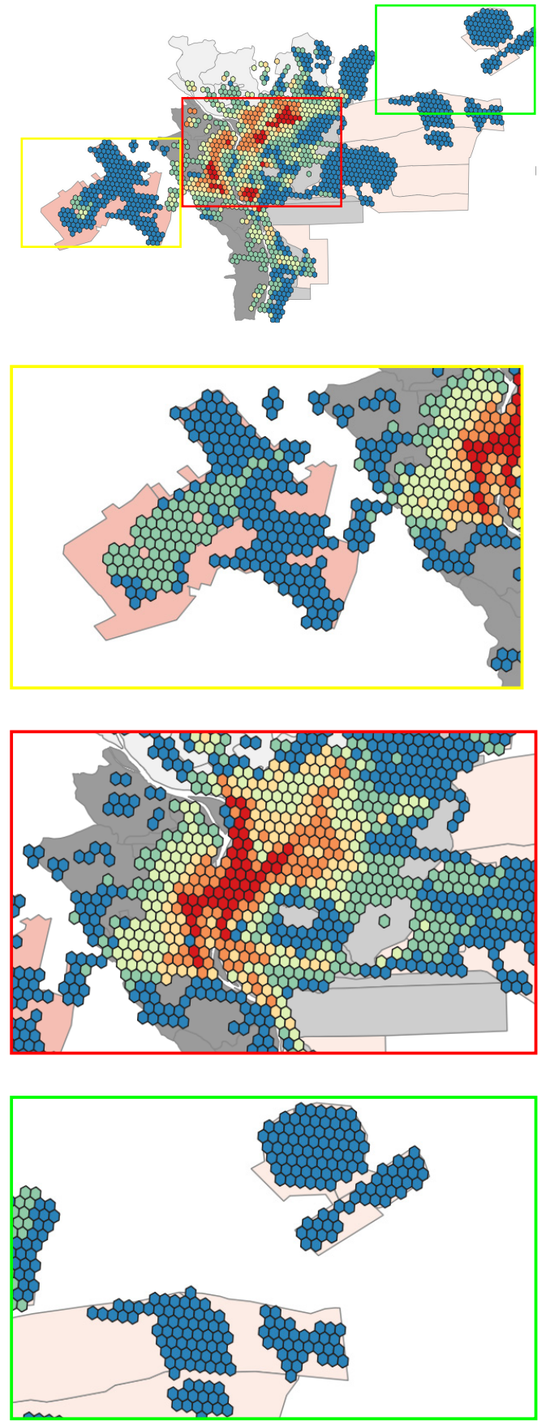


Figure 50: Accessibility in the Greater Cairo Region (Source: Transport for Cairo, 2019)



Telecommunication Centres

This indicator is computed as a signifier of access to the internet and connectivity. It is clear that the two case studies have a minimum number of these service centres, jeopardizing their functionality and competitiveness. With the COVID-19 crisis the world is experiencing in 2020, this signifies a low level of utility experienced within these NUCs for both their population and productive functions.

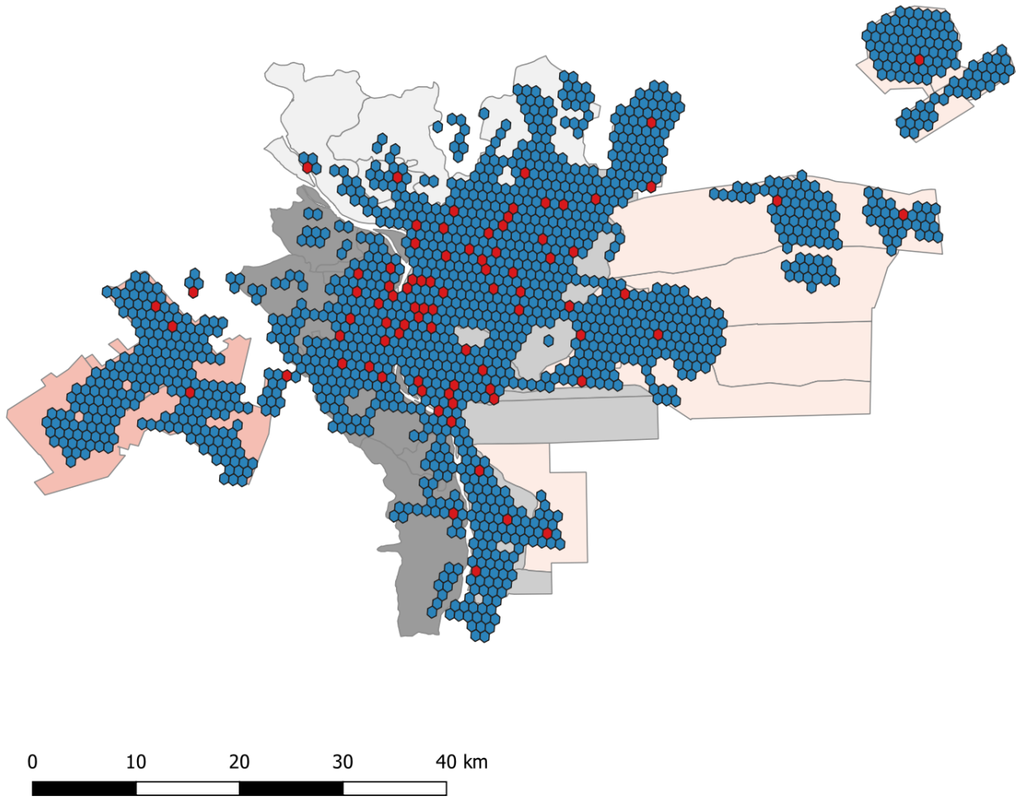


Figure 51: Telecommunication Centres in the Greater Cairo Region

In this case, another spatial correlation analysis is tried: Bivariate Local Moran's I. This study computes the value of telecommunication centres in relation to its neighbour for population density. In this way, Telecommunication Centres in the Greater Cairo Region shows the low levels of correlation between numbers of telecommunication centres and spatial correlation of population density. It is apparent that NUCs are suffering from shortage while the entire central region has low levels of centres, with high levels of population correlation.

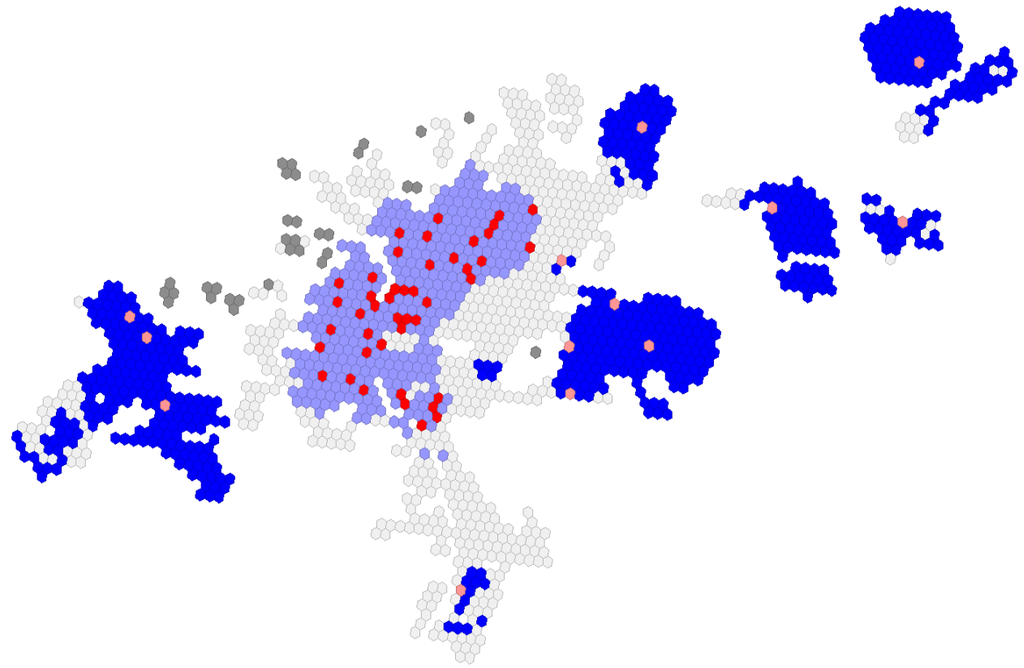


Figure 52: : Bivariate Moran's I for Telecommunication centres and Population density using 3 level contiguity

Post Offices

As mentioned earlier post offices function as financial institutions and part of the bureaucratic civil institutions. Their availability is indicative of the area's access to primary governmental services. It is clear that there is abundance in post offices in central Cairo and Giza. The gradient is sharp from central to inner regions, with deprived regions in peripheral inner Cairo and Giza areas. NUCs show again dire deficiency in access to this basic amenity.

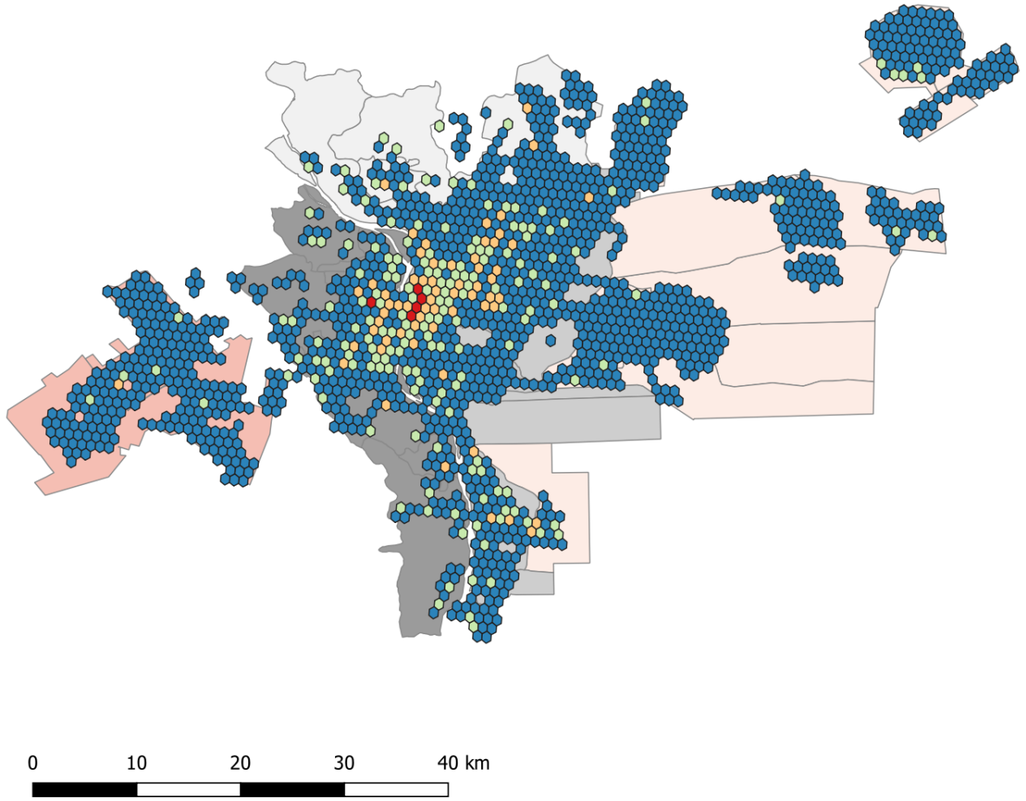
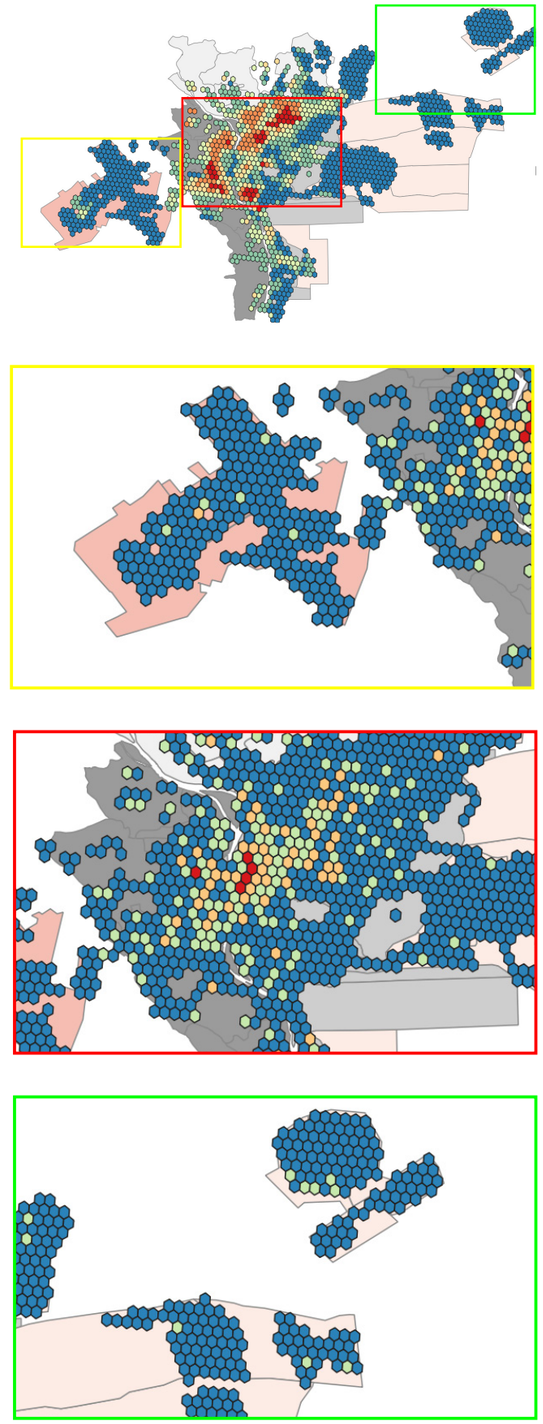


Figure 53: Post Offices in the Greater Cairo Region



Supermarkets & Pharmacies

The times of the pandemic of COVID-19 when this research was conducted has highlighted some urban attributes. Urban life stagnated in many cities around the world, except for basic functions that sustained life for people. Mapping grocery stores and pharmacies as a basic indicator of the quality of life and the supply of livelihood for inhabitants. It is also an indicator of market centres of demand and supply. Moreover, these indicators are highly comparable to population [Figure 46], where great similarity in the patterns of centres emerging is evident. The patterns give way to the population densities and the emergence of sub-centres of the GCR in NUC's.

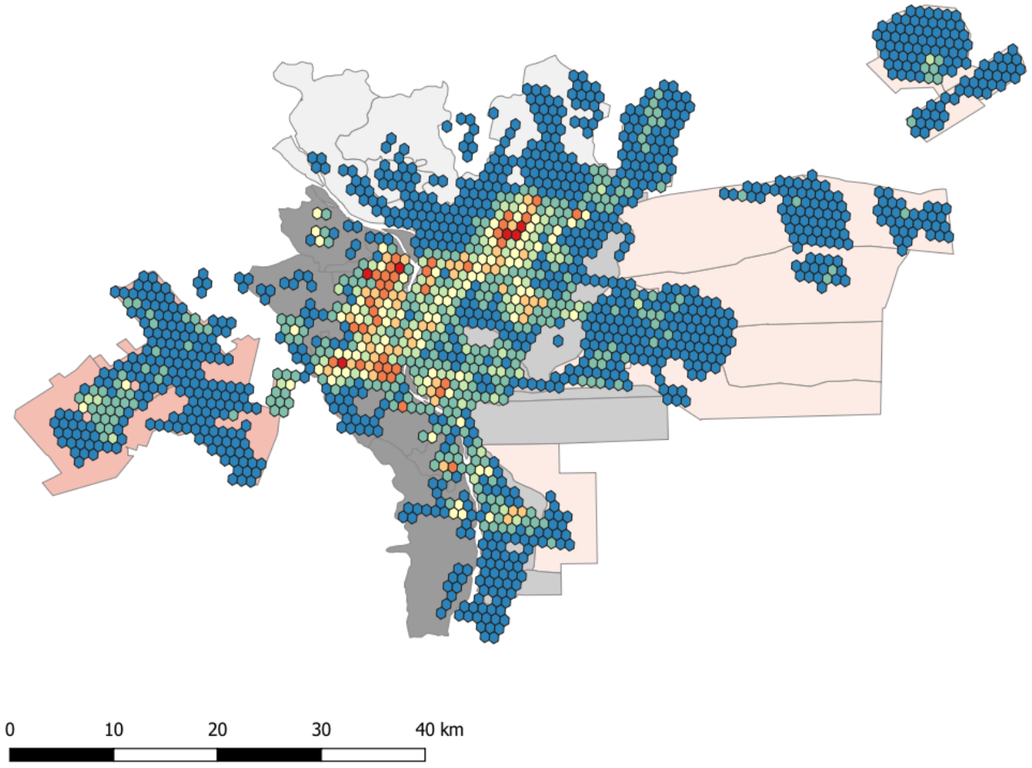


Figure 54: Supermarkets in the Greater Cairo Region

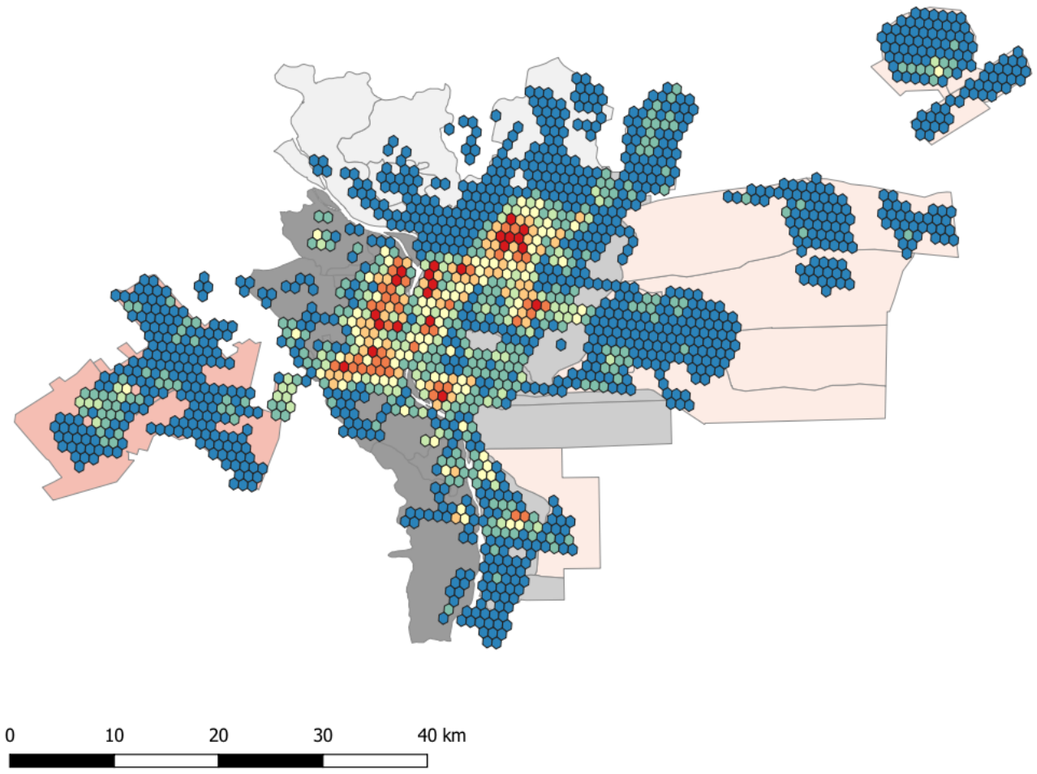


Figure 55: *Pharmacies* in the Greater Cairo Region

Finance & Insurance

The financial institutions analysis shows multiple first-level centres in various districts in Cairo: *Qasr El Nil/Abdin* (Downtown Cairo) in central Cairo, *Heliopolis* in north eastern, and *Maadi* in the south; in central Giza: *Al Dokki* in central *Giza*, and *Al Aguza* to the north. It is interesting to note that all these districts house affluent neighbourhoods, with the exception of downtown Cairo, which lost its elitist tenants post 1952 military coup. However, the Egyptian stock market is in the downtown area, which justifies its relevance. In general, it is common for financial institutions not to be footloose, with their sizable real estate and their interdependent nature.

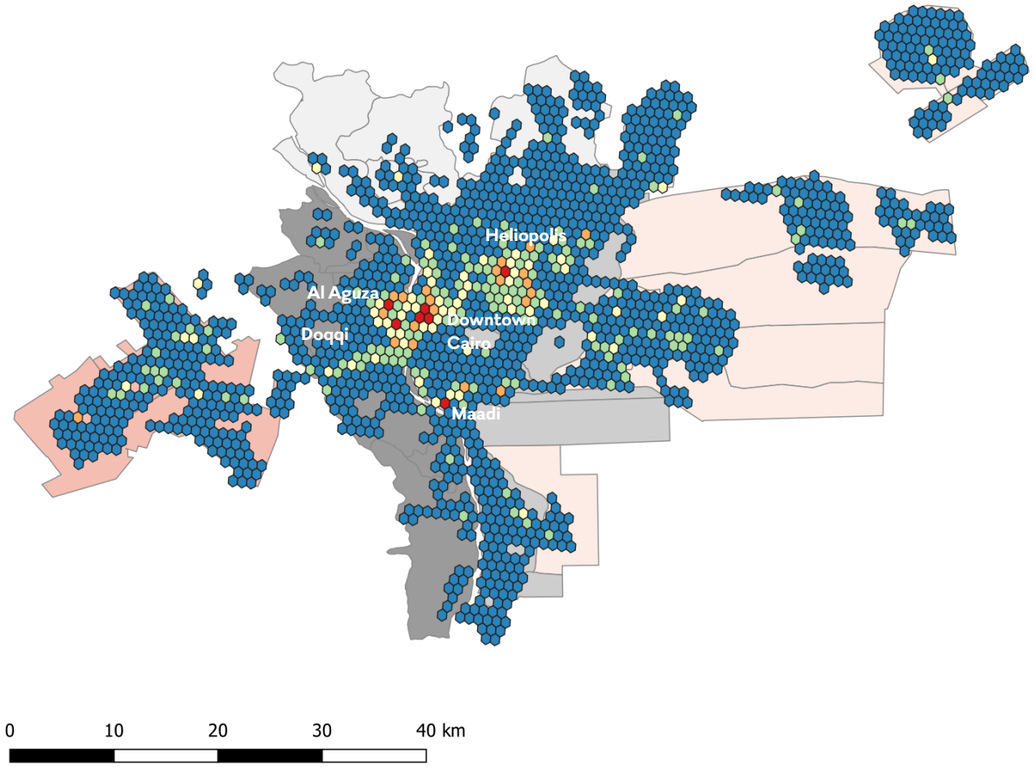


Figure 56: Centres of Finance in the Greater Cairo Region

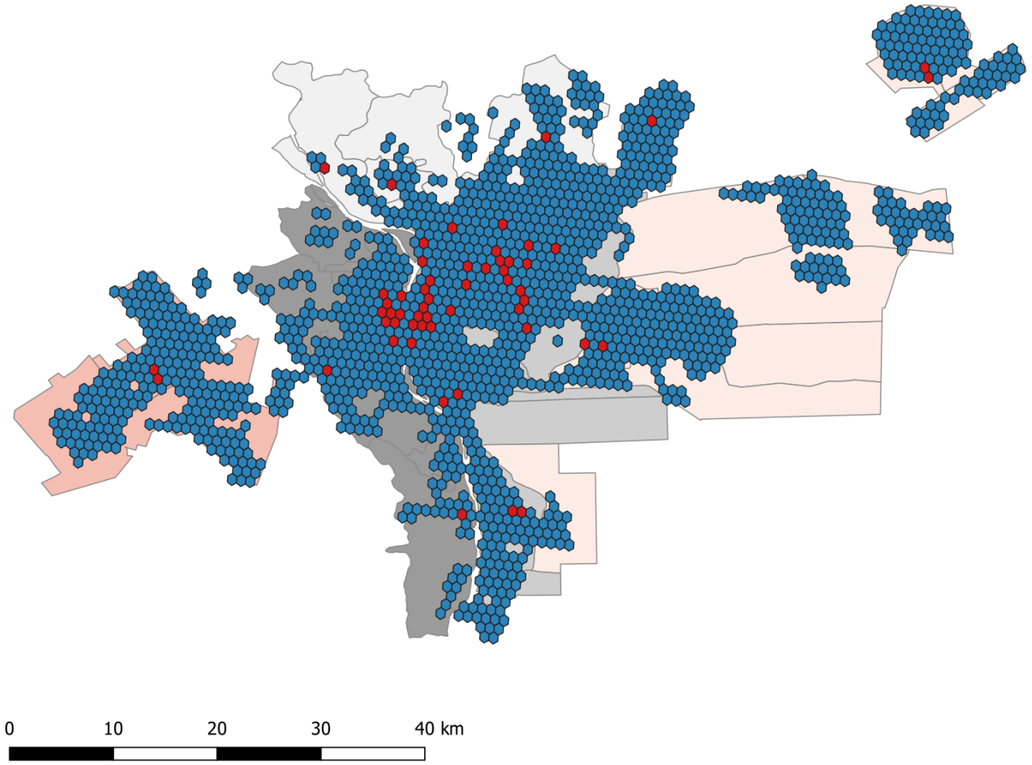


Figure 57: Centres of Insurance in the Greater Cairo Region

For the case of this analysis, both institutions were combined for an overlaid analysis With regards to the extent of development of centre and suburb, the graph shows the reclamation of the central city by the financial and insurance institutions [part of FIRE].

This analysis in comparison to the analysis of production facilities (earlier) and analysis of centres of entrepreneurship and universities (following), reflects back on the three stages of city centre and suburbs evolution by McDonald & McMillen (2007). As city centre is reclaimed by FIRE, production functions move to suburbs and the city centre starts employing highly educated professionals. If this is argued as an indicator for the rise of suburbs, then there is significant data to support this argument. The final stage is that the city centre becomes an employer of highly educated professionals which hasn't been looked into.

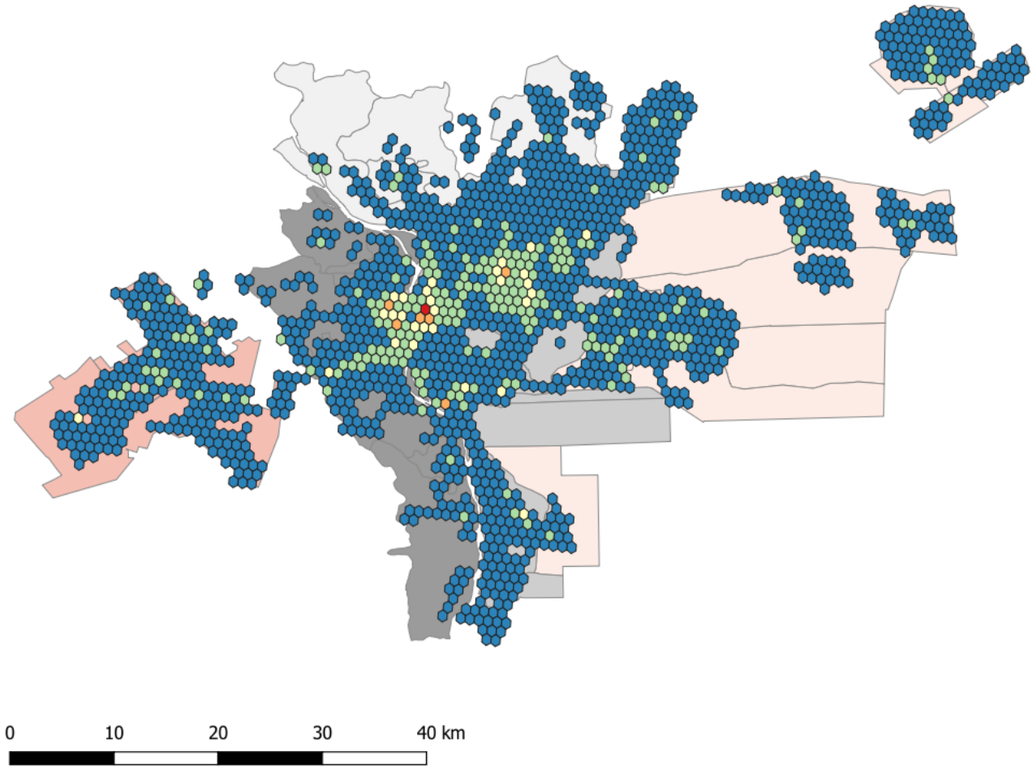
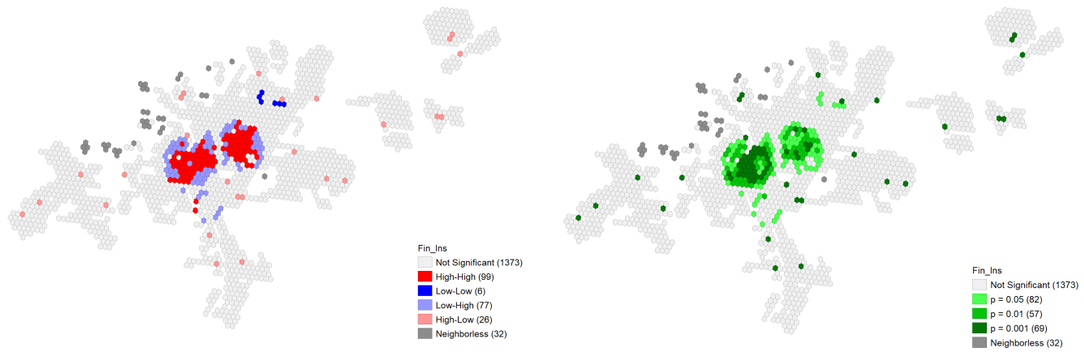


Figure 58: Centres of Finance and Insurance in the Greater Cairo Region

The combined data was analysed for spatial autocorrelation using Moran's I significance and cluster map with 1-level contiguity. The financial institutions remain highly centralised with limited attempts at decentralising around the metropolitan region. The few clusters of high-low values [light-red] available in almost all new towns refer to the clusters of low values surrounded by higher value clusters.



Higher Education & Training

Some good signs emerge from this indicator as a first level centre of education in the NUC of 6th *of October* competes with central GCR. It is also worth noting that the western central region of Giza, shows primacy over eastern region of Cairo. This is largely due to Cairo University which is actually located in Giza jurisdiction with more than 240 thousand undergraduate students and its new campus in 6th *of October* (CU, 2010). There are traces of dispersion of universities, colleges and higher education schools all over the metropolis, which is rather healthy. However, a similar analogy to schools can be made, with most NUCs housing private institutions which limits the accessibility of these educational amenities.

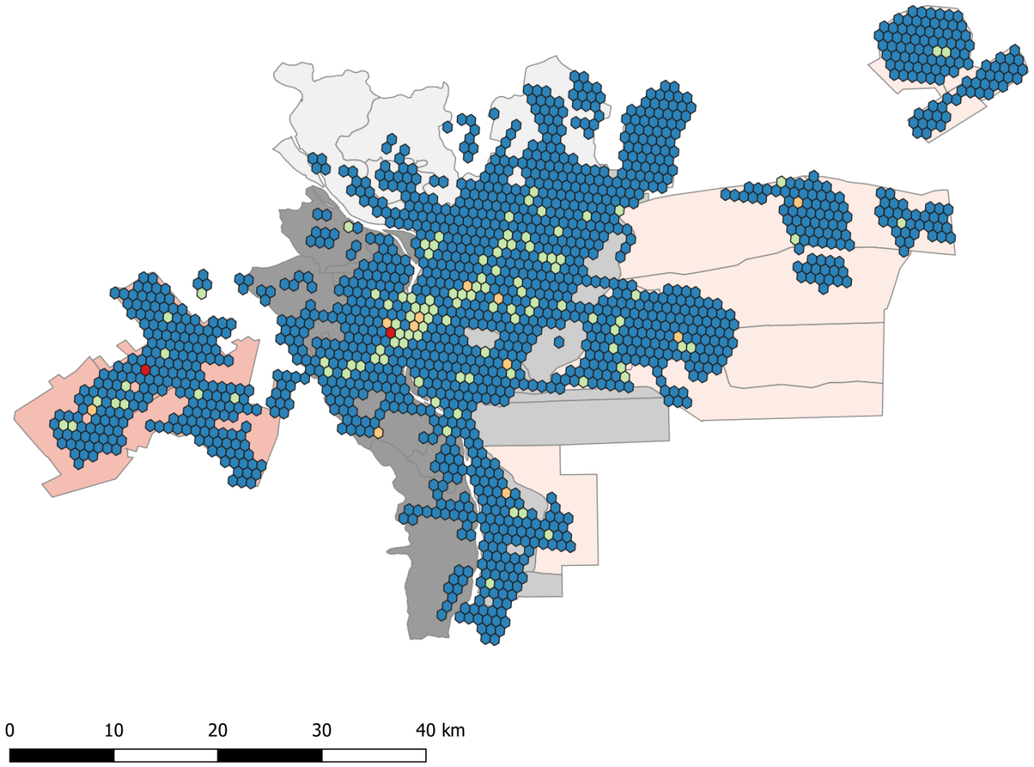


Figure 59: Centres of Higher Education in the Greater Cairo Region

Centres of Government

The same pattern for centralization persists, with an extension in the east. There is only one exception with the Ministry of interior in New Cairo in the east; and the Ministry of Telecommunication and IT in the west NUC in the Smart Village office development. Whether government institutions shall bundle in a certain spatial structure remains an extensive debate with almost seven million civil servants in Egypt (Hafez, 2015), it poses a high density problem. Therefore there were calls for decentralization, in the 60's with *Nasr City*, in the 70's with *Sadat City* and today with the *New Administrative Capital*. The precedents show that the new capital plan for relocating government centres will face many challenges.

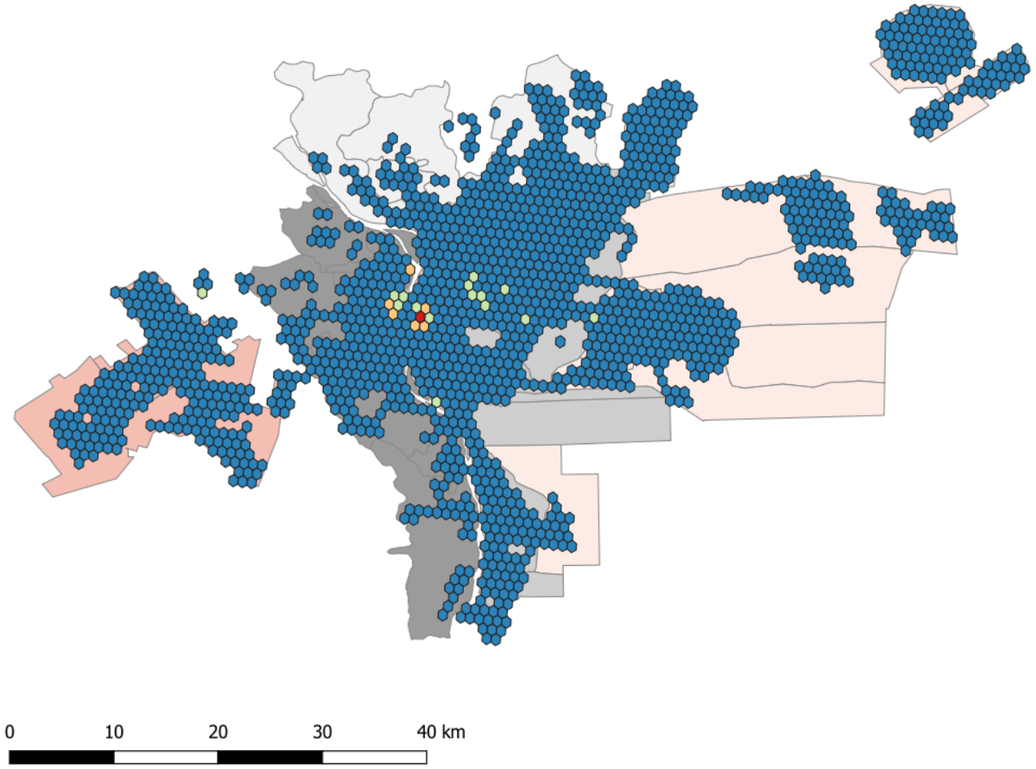


Figure 60: Centres of Government in the Greater Cairo Region

Centres of Recreation

The GCR centre remains the hub for culture and recreation. There is also little presence of such amenities in the entirety of the metropolitan region, showing great signs of urban deprivation and co-dependency on the centre. Nevertheless, this is somewhat expected with Cairo's downtown bestowing a "sense of place" and identity for the entire metropolitan region and housing cultural amenities besides the financial services as mentioned by Ihlanfeldt (1995).

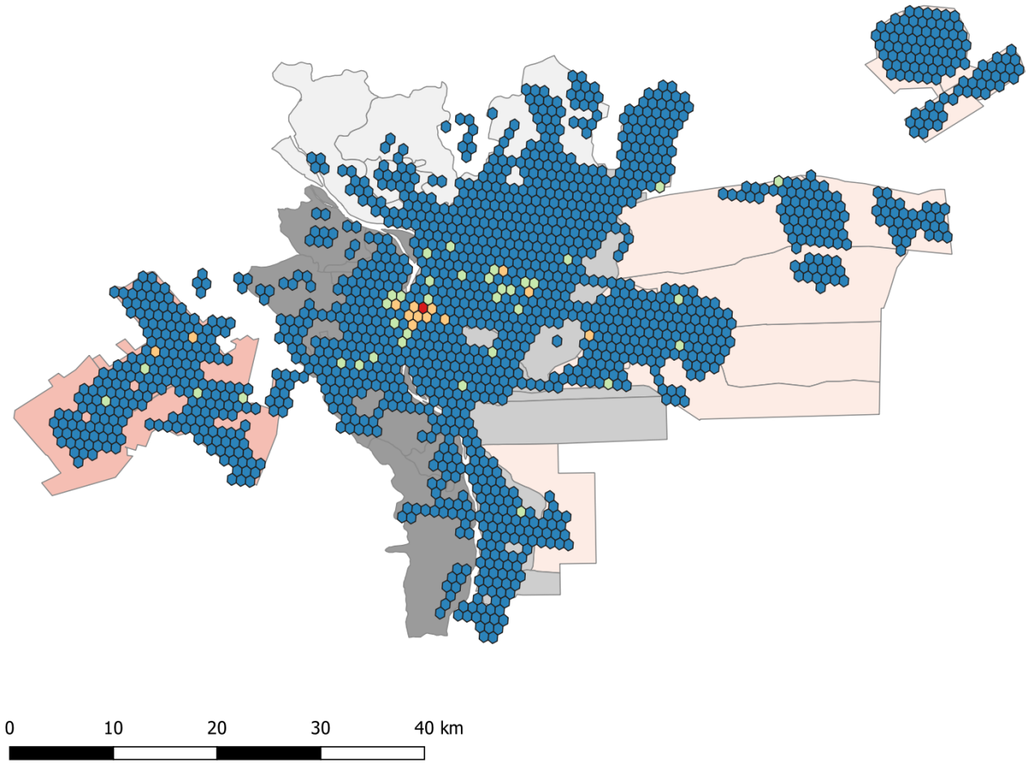


Figure 61: Centres of Higher Education in the Greater Cairo Region

Centres of Knowledge & Entrepreneurship

These sub-sections are a forecast of the resilience for urban areas as argued by Jacobs (1972). This subsection is a signifier of the adequacy of the previous primary and efficiency indicators, which give way to innovation level indicators. The city centre still poses higher indicators, although there is evidence of some emerging sub-centres in 6th *of October*. The deficiency of 10th *of Ramadan* calls for analysis of all the previous indicators and beyond. The fact that an entire industrial zone might not house a single research centre is quite daunting.

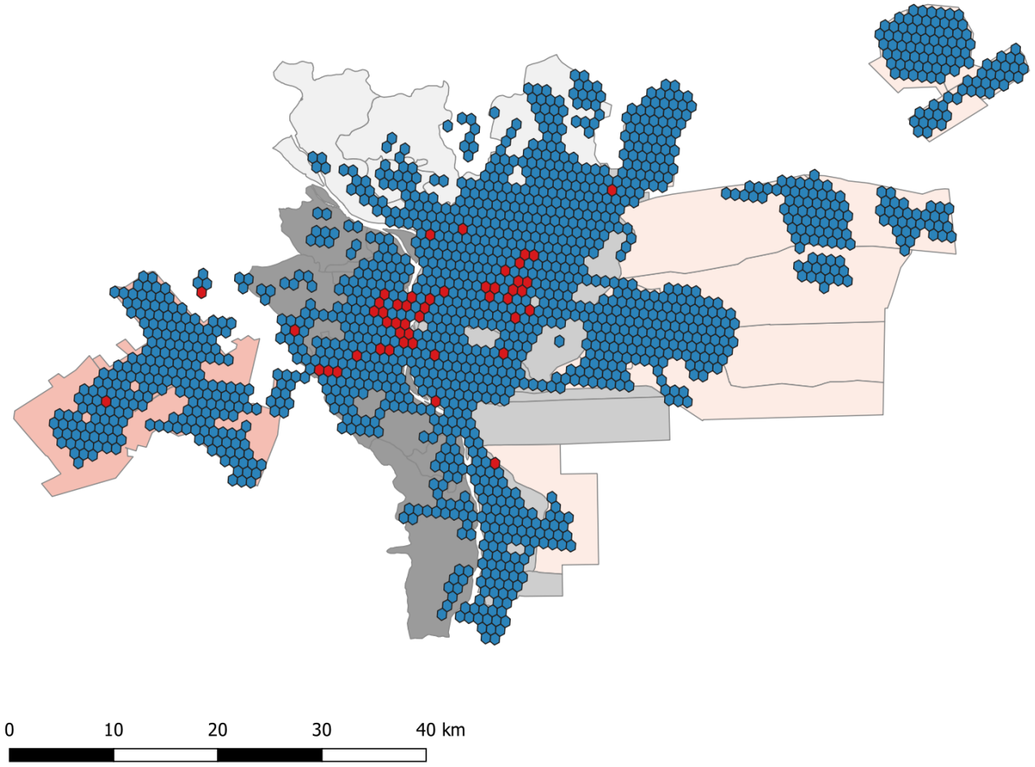


Figure 62: Centres of Knowledge in the Greater Cairo Region

Centres of Entrepreneurship

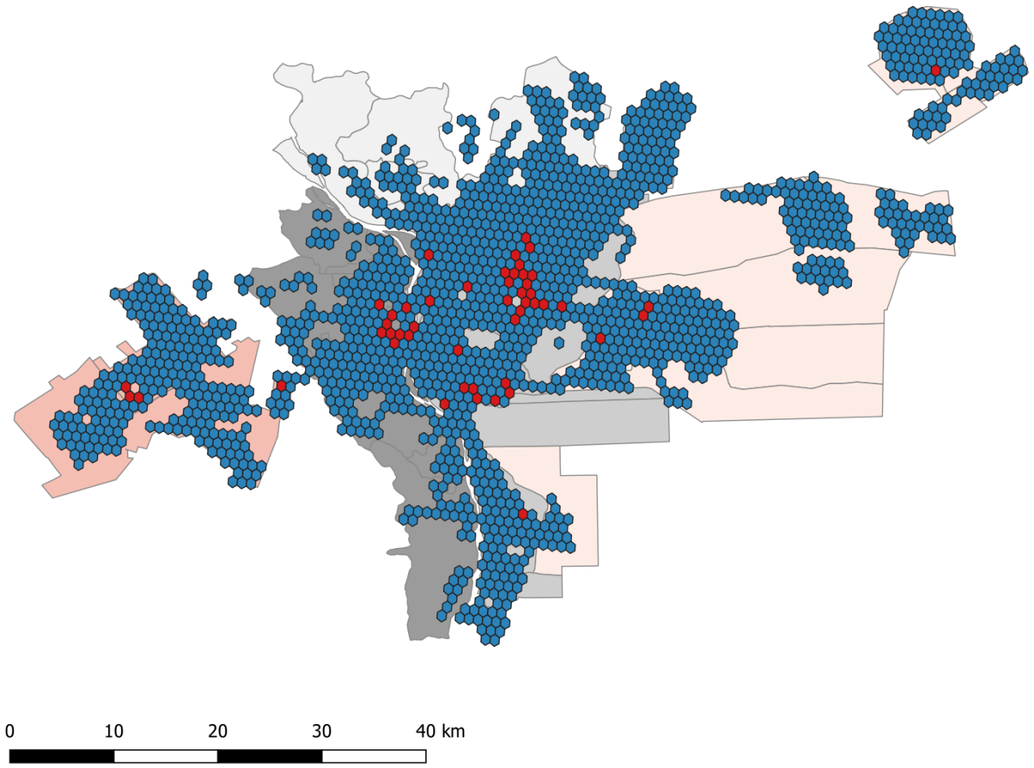


Figure 63: Centres of Entrepreneurship in the Greater Cairo Region

Third: Comparative Micro-maps

The findings from the previous sub-section investigate univariate or bivariate analyses at best. To work around the complexity at hand, a matrix of all these analyses has been grouped next to one another in order to allow for a better inductive analysis and hypothesis.

Findings:

1- There is evidence that centres of production are in the hinterland of centres of finance, this shows a hierarchy in the Urban Competitiveness of the urban area

2- Accessibility seems like the most correlating indicator of the other socio-economic indicators and shall be investigated further using conditional mapping.

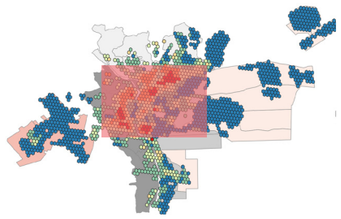
3- There is a noticeable discrepancy between each attribute mapped and the basic population concentrations. This might be a call for normalizing each data-set against population to map areas of shortage and in need for action.

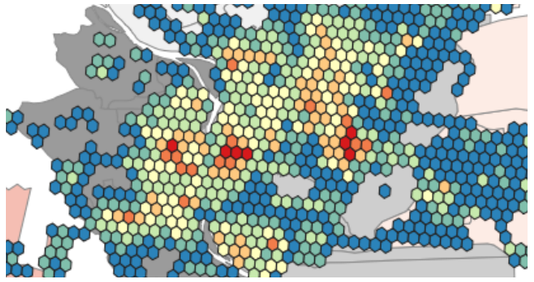
   a. Whether or not production and population values are intertwined call for the qualitative data of demographics, enabling a more thorough analysis of areas which supply employment and imports income, and areas which supply economic activities.

   b. Whether or not education and population values are intertwined call for qualitative data of demographics, enabling a more thorough analysis of which areas supply education to its surrounding; but more importantly which neighbourhoods are growing older population

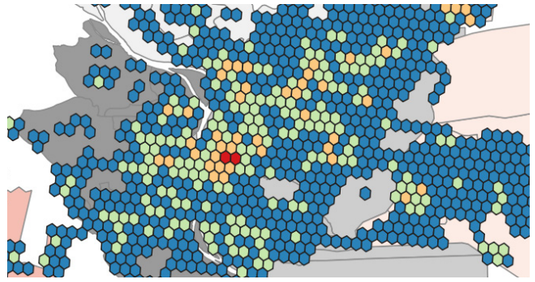
4- There is a relationship between centres of IT service providers and centres of entrepreneurship, indicative of a spill-over effect that might be resulting from start-ups growing within the proximity of venture labs and co-working spaces. This is in support of theory of knowledge spillovers and cross fertilization of urbanization economies.

Comparative Micro-maps; Central Greater Cairo Region

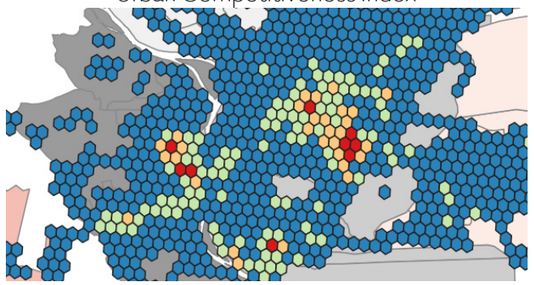




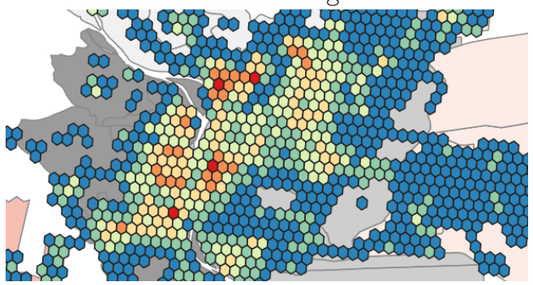
Urban Competitiveness Index



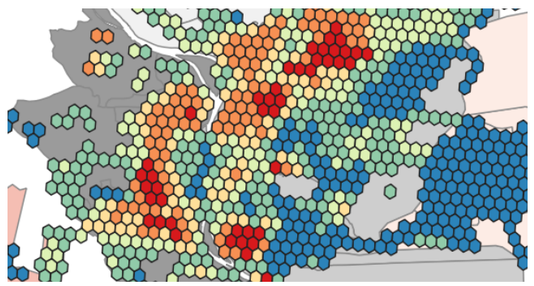
Centres of Manufacturing Production



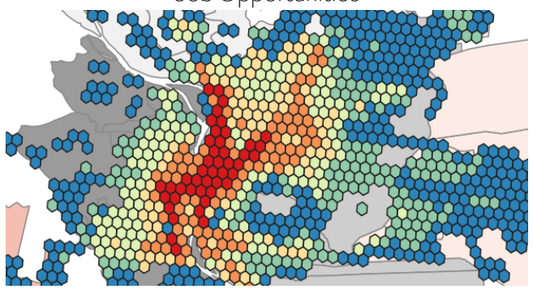
Centres of IT Service



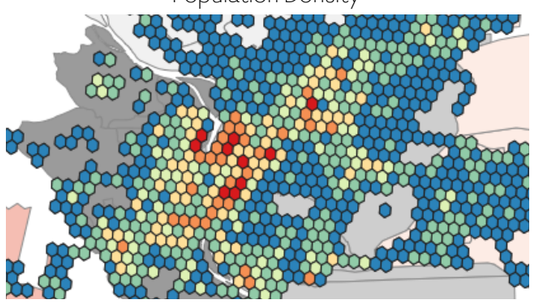
Job Opportunities



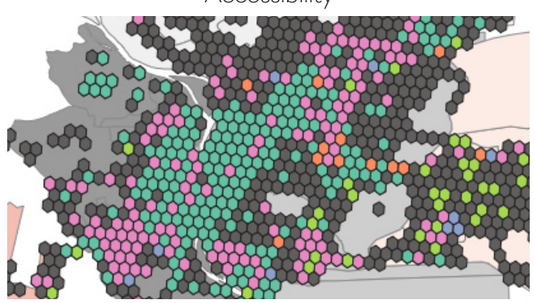
Population Density



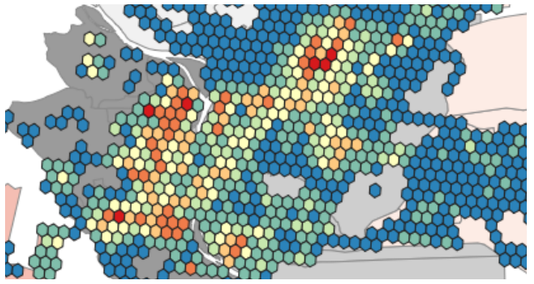
Accessibility



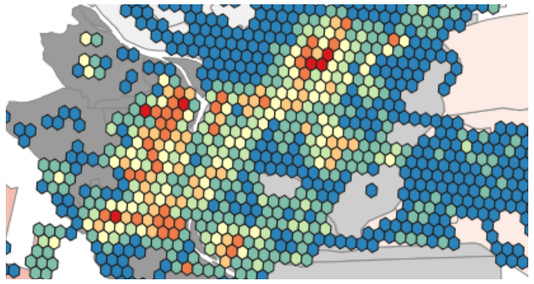
Basic Education



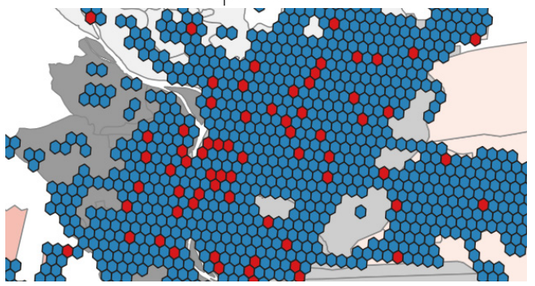
Typre of Education



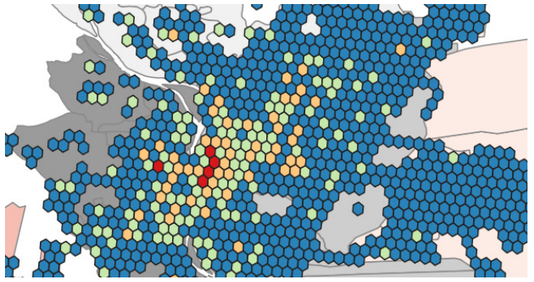
Supermarkets



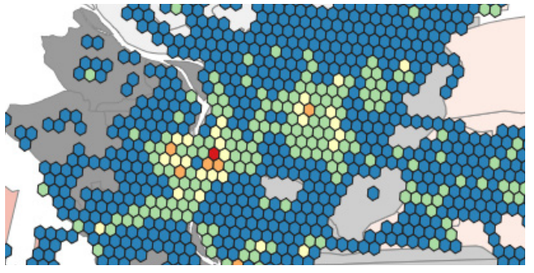
Pharmacies



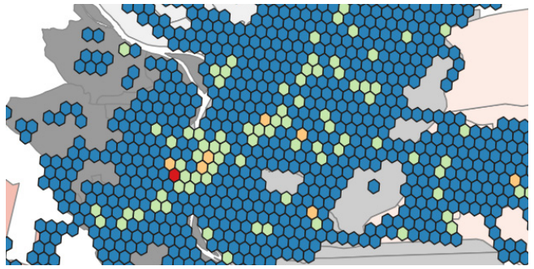
Communication Centre



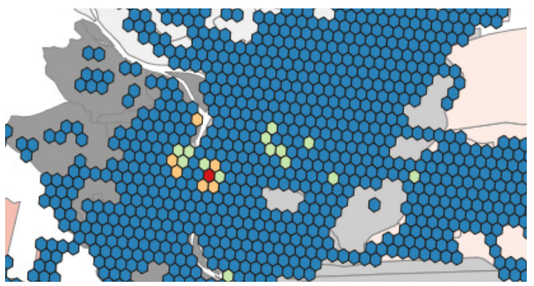
Post Offices



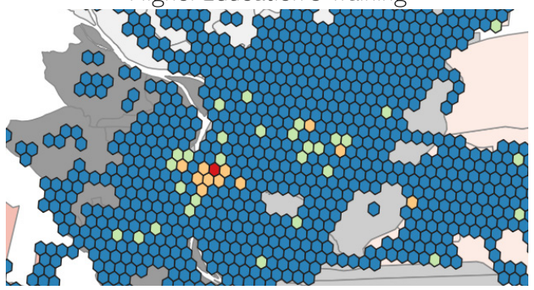
Centres of Finance & Insurance



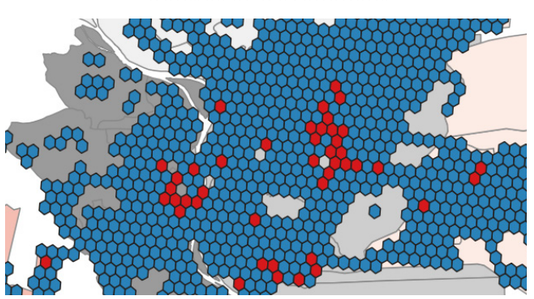
Higher Education & Training



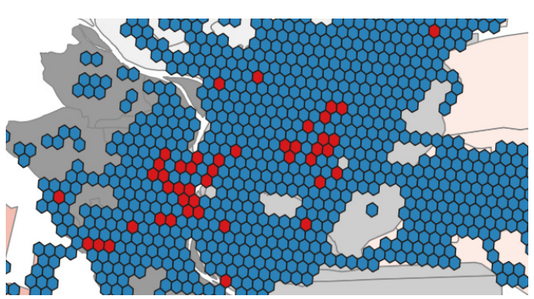
Centres of Government



Centres of Recreation

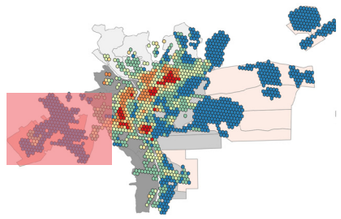


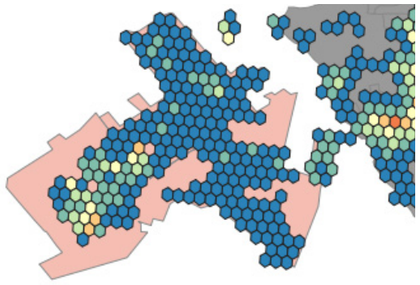
Centres of Innovation



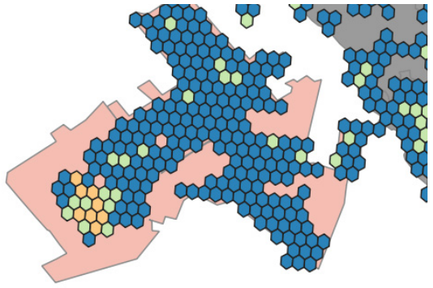
Centres of Entrepreneurship

Comparative Micro-maps; *6th of October*

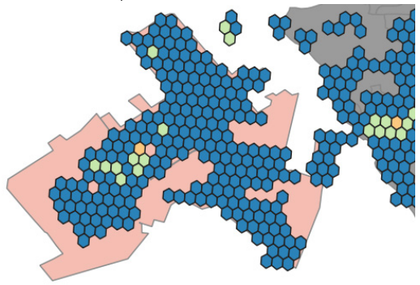




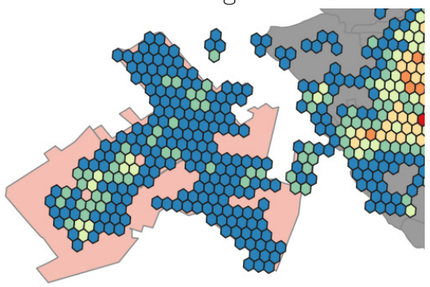
Urban Competitiveness Index



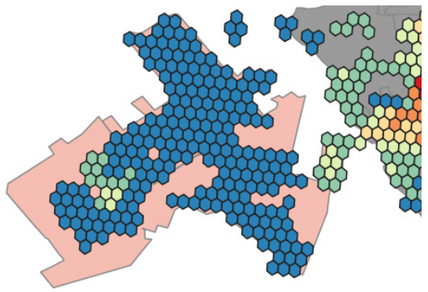
Centres of Manufacturing Production



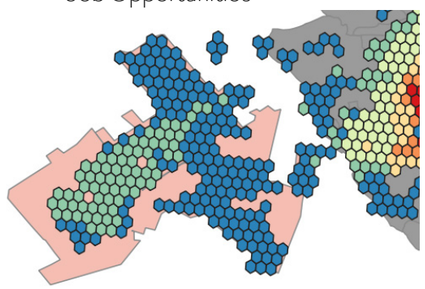
Centres of IT Service



Job Opportunities

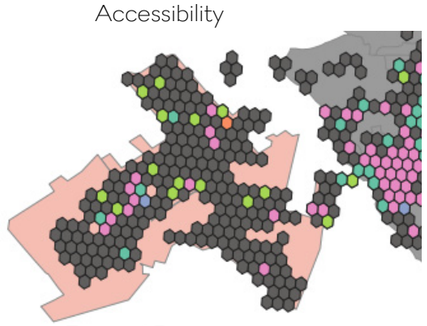


Population Density

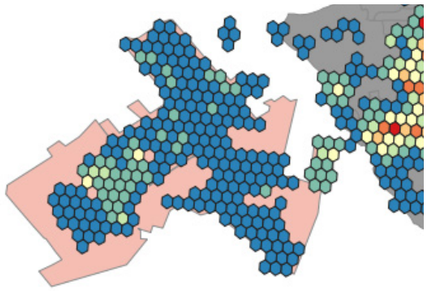


Accessibility

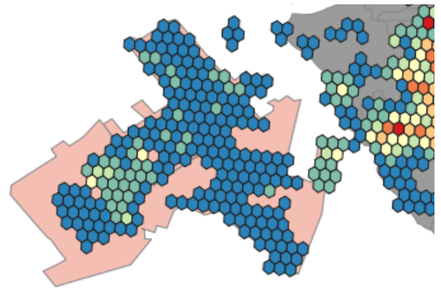
Basic Education



Typre of Education



Supermarkets



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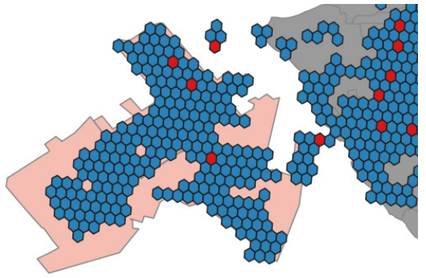

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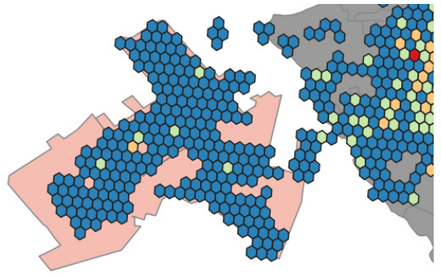
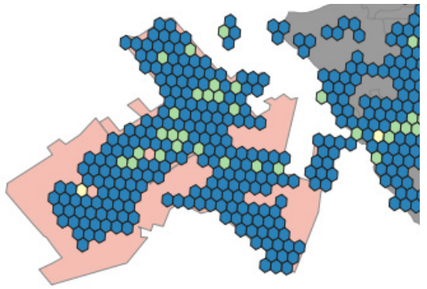
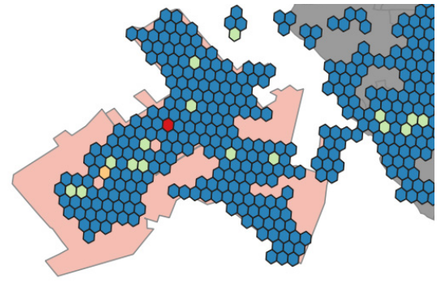


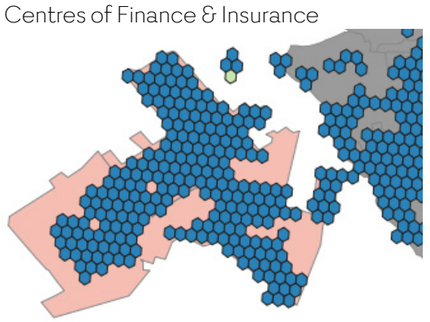
Post Offices



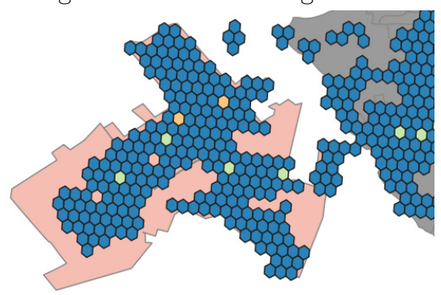
Centres of Finance & Insurance



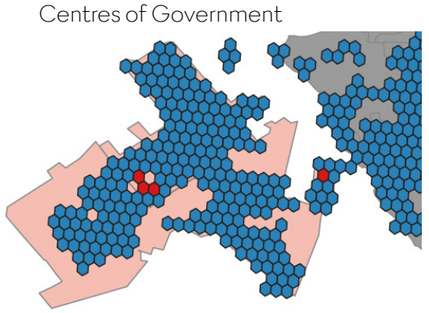
Higher Education & Training



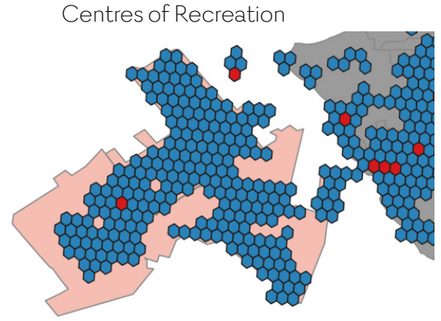
Centres of Government



Centres of Recreation

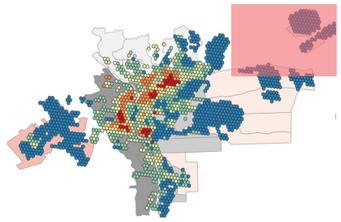


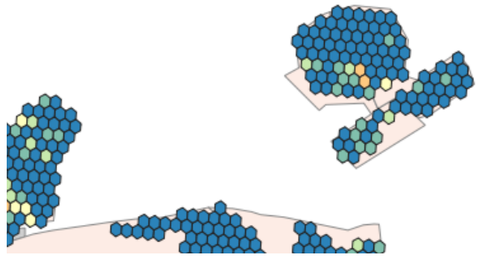
Centres of Innovation



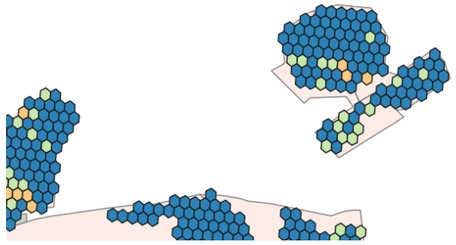
Centres of Entrepreneurship

Comparative Micro-maps; *10th of Ramadan*

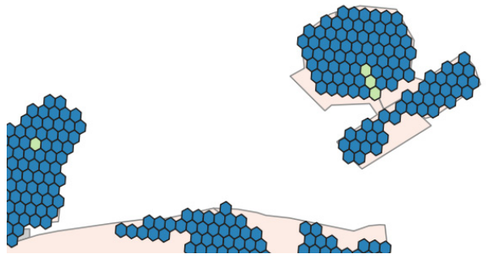




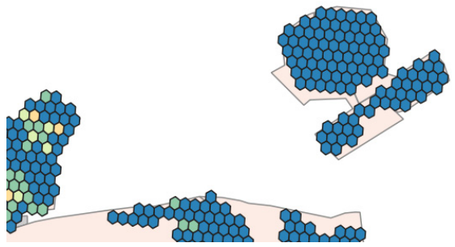
Urban Competitiveness Index



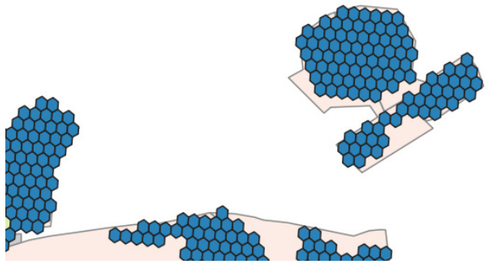
Centres of Manufacturing Production



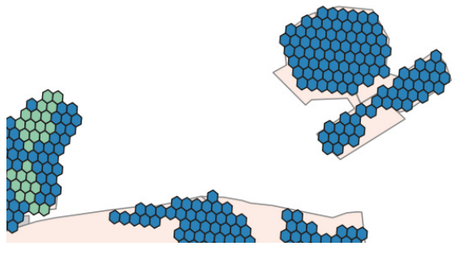
Centres of IT Service



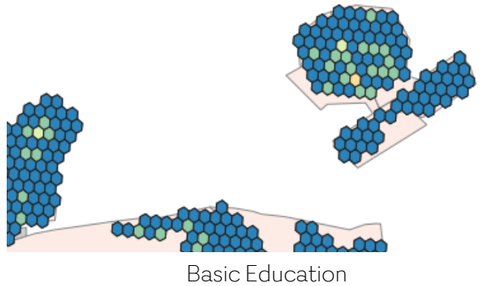
Job Opportunities



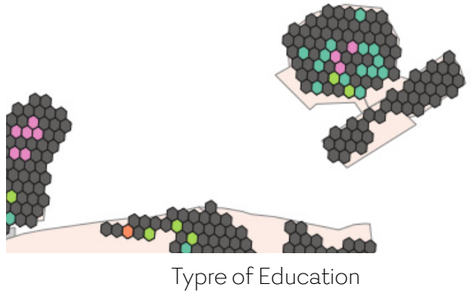
Population Density



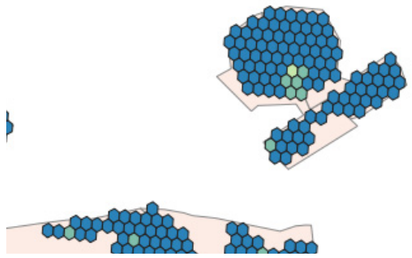
Accessibility



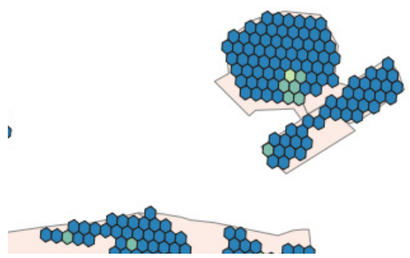
Basic Education



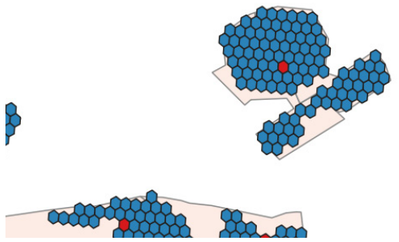
Typre of Education



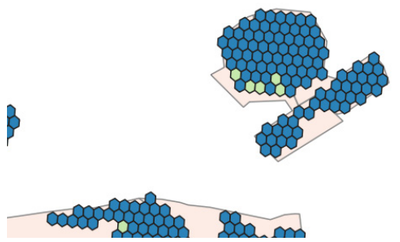
Supermarkets



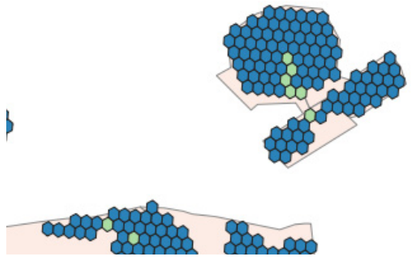
Pharmacies



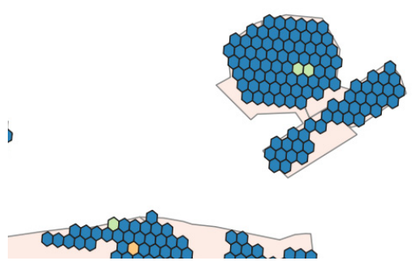
Communication Centre



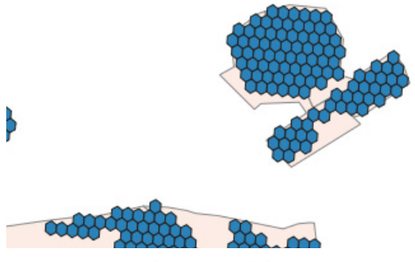
Post Offices



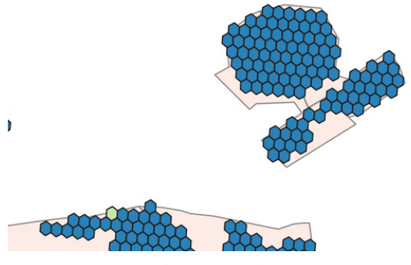
Centres of Finance & Insurance



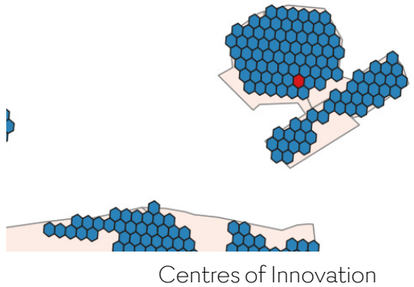
Higher Education & Training



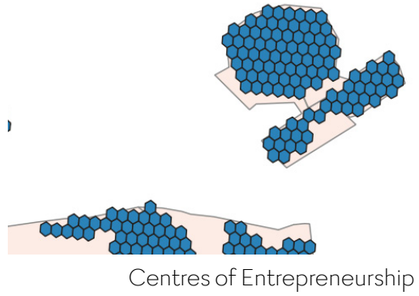
Centres of Government



Centres of Recreation



Centres of Innovation



Centres of Entrepreneurship

Forth: Conditional Mapping:

Conditional maps are a way to show interaction between multiple variables. Taking in the relationship between two variables, e.g. financial institutions and accessibility, and their relationship to economic activity. This analysis graphs the relationship between financial institutions and economic activity, and conditions them on the score of the third variable, economic activity. If a three quantile analysis is made for each of the two variables [low, medium, high]. This creates a matrix of nine micro-maps [low with low, low with medium, low with high, medium with low, medium with medium, etc.]. The observations on each graph are those satisfying the condition of the third variable. In our case, the observations on each map are the economic activity index, correlating to the three quantile analysis of financial institutions and accessibility.

The idea is that if there is no association between accessibility and financial institutions, and economic activity index, the conditional maps would be random. Figure 66 suggests an interesting correlation within the conditional map. First, the lowest quantiles of accessibility and financial institutions (Figure 66-g), show a diverse index of economic activity. This might pertain to a number of reasons, however the main observation is that using the natural breaks classification [3 quantiles] groups huge clusters of data. This is evident in the magnitude of the studied area. In other words, almost two-thirds of the metropolis lies in this classification (lightest shade of yellow).

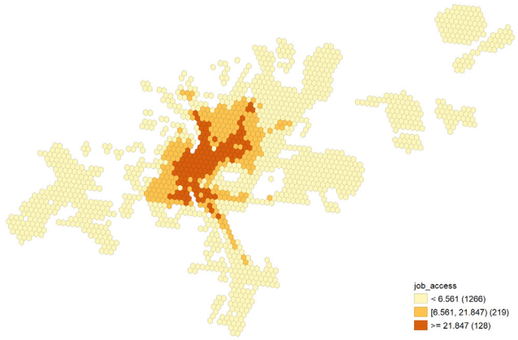


Figure 64: Three Quantile map for accesibility index (based on TfC)

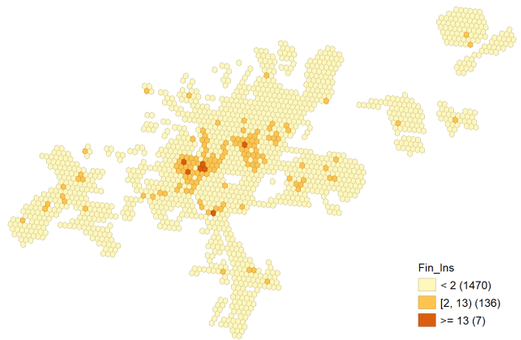


Figure 65: Three Quantile map for Centres of Finance & Insurance

The second observation related to the vertical axis (accessibility); almost all top three micro-maps show high levels of economic activity. Note that the economic index used production and population data. This extends to the medium quantile of accessibility index as well. Which shows a great relationship between accessibility and economic activity.

The reciprocal is not evident; for the three levels of financial institutions. There is a correlation between medium and high numbers of financial institutions and high economic activity index. The absence of data in the right middle and bottom maps signify that there is absence of financial institutions where there is medium to low accessibility. This combination of high-high levels (Figure 66-c) are also areas of highest economic activity, which supports the correlation between those three variables. However, it doesn't support the correlation between accessibility and financial institutions.

Hence, to create sub-centres of urban competitiveness there needs to be adequate accessibility services mobilized.

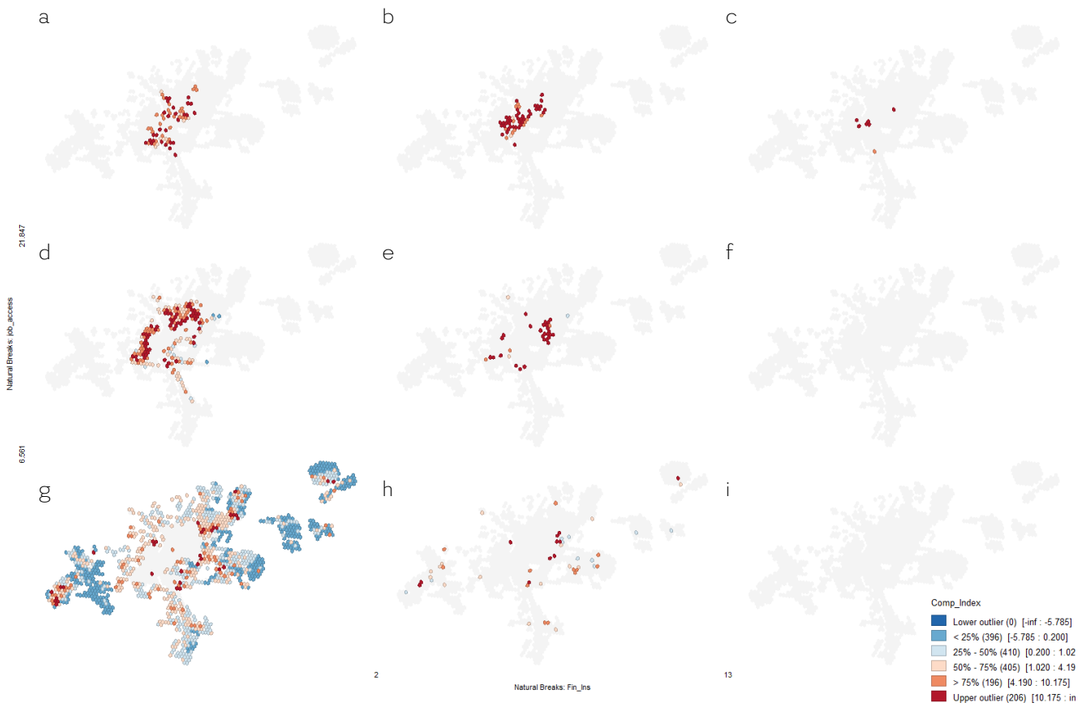


Figure 66: Conditional Maps for Economic Activity, and Accessibility (vertical axis) and Financial Institutions (Horizontal axis)

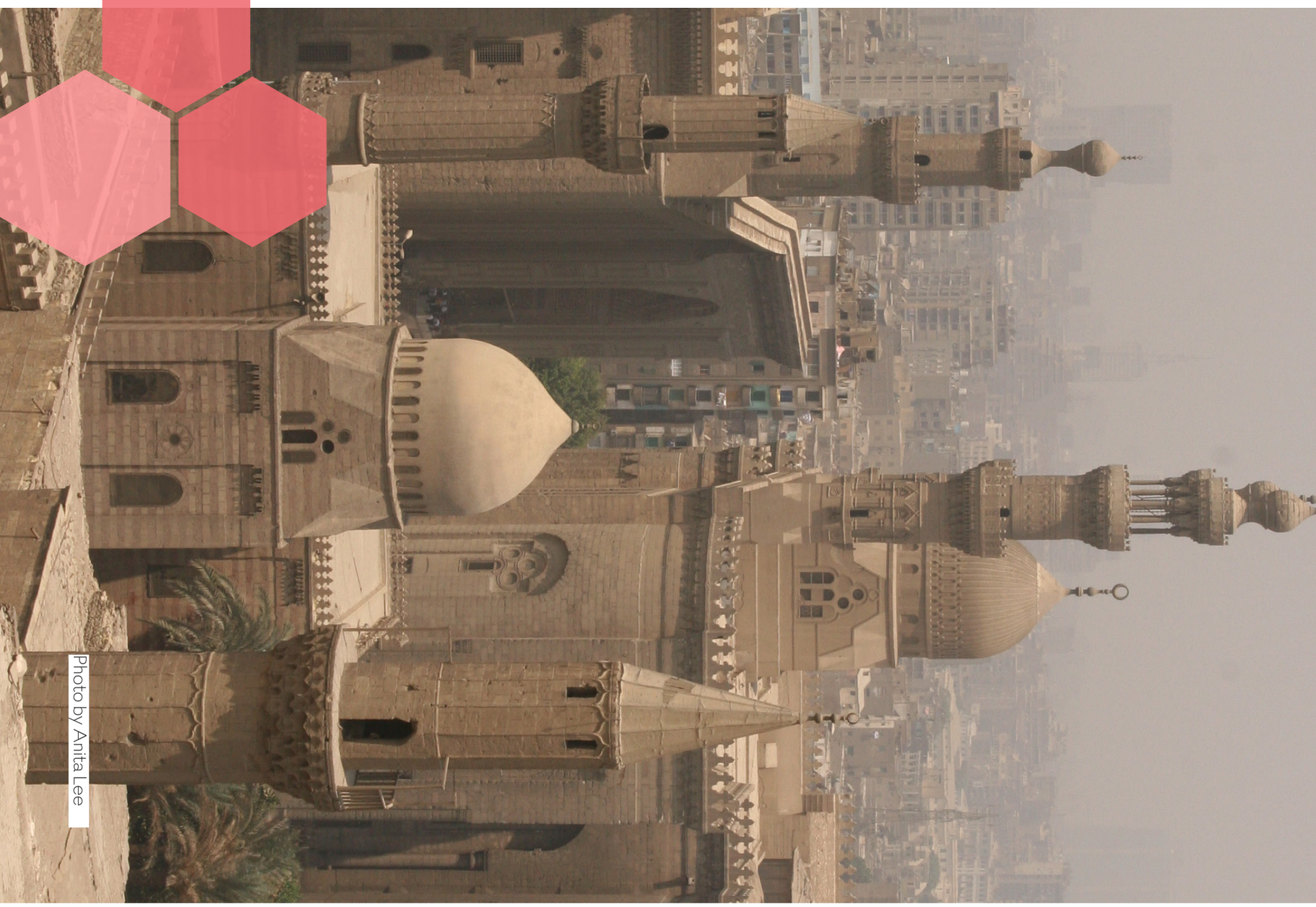


Photo by Anita Lee

Chapter SYNTHESIS

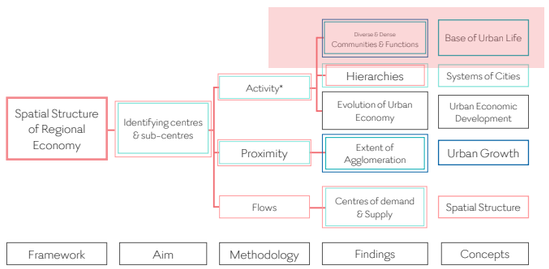
Synthesis

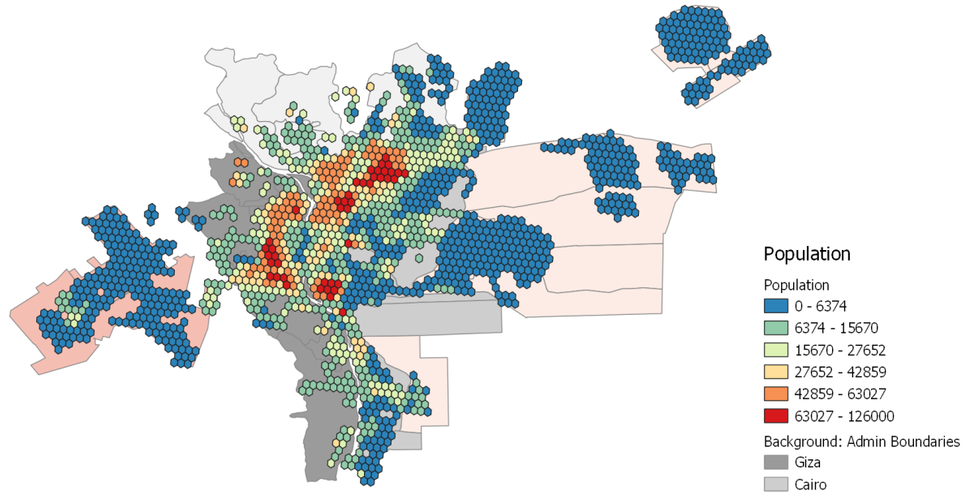
General Findings

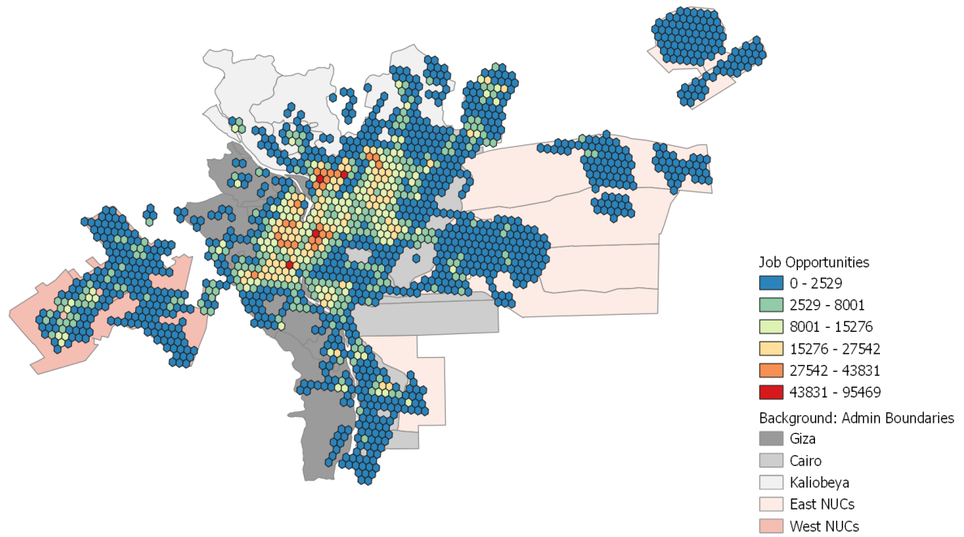
1/ Base of Urban Life

Greater Cairo Region can be classified as a 'functional urban region' (Parr, 2014), where the jobs, wages and employment decide the system of cities' centres and hinterlands. It can only be considered as a city-region controlling the sub-centres and extracting resources and employment from them. This can be seen on most levels of analysed urban attributes with the exception that the centre is highly depopulated. This signifies the development in urban economy; where the sub-regions are gaining production functions, while city centres are hollowing out of inhabitants and increasingly functioning as centres of highly skilled employment.

Furthermore, following the research definition of urban life, a comparative analysis of centres of production, employment and population is carried out. The comparative analysis shows that the centres of economic activity and population don't coincide. It is as if urban communities have been pushed away from economic functions. It is critical to re-assess how the urban centres are evolving, and how urban policies are enabling the depopulation; and how production functions are capturing these ghost regions. Or else the city will continue to grow highly segregated, dysfunctional and inefficient.



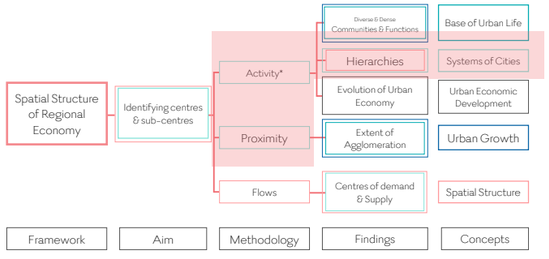


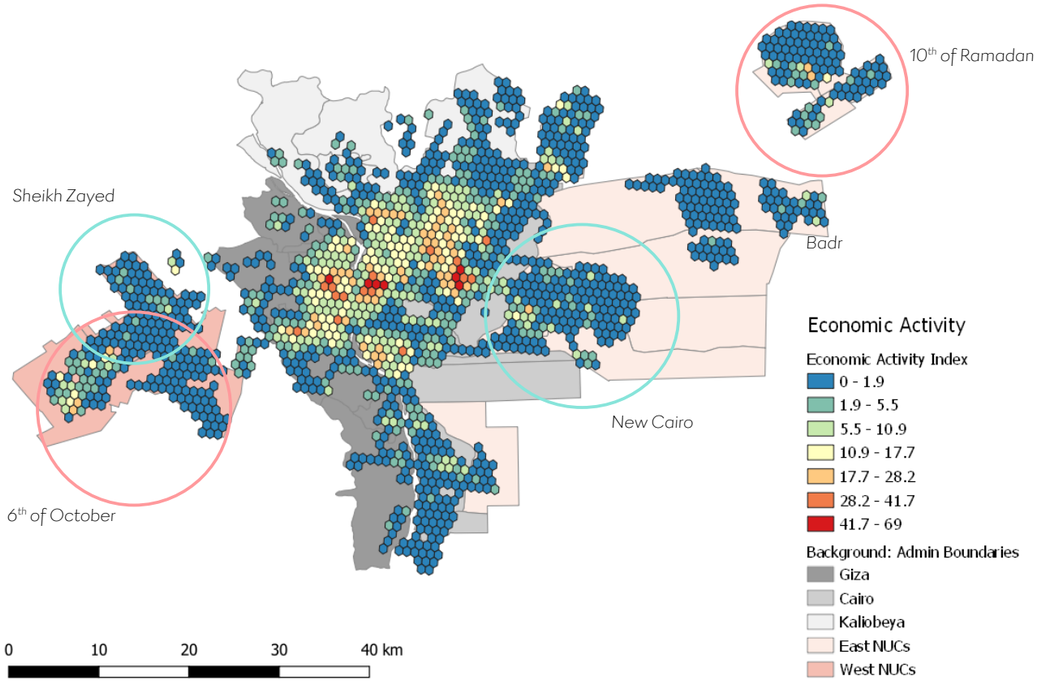


2/ System of Cities

Regarding our case study, the systems of cities evolving from the mapped urban competitiveness shows the flatness of the NUCs index, with barely any centres emerging. This suggests the competitive role these 8 NUCs played against each other. With the lack of an institutional entity that directs and manages the metropolis today, the result has been fragmented. The direct categorization and estimation of the role each sub-centre can and should play, will allow better resource allocation and lower loss of opportunity. This will prove the seriousness of the aim of these NUCs to decentralize the region. However, with the New Administrative Capital being developed swiftly, if these NUCs don't establish their autonomous competitive advantage within the metropolitan region, the aims of a polycentric urban region won't be met.

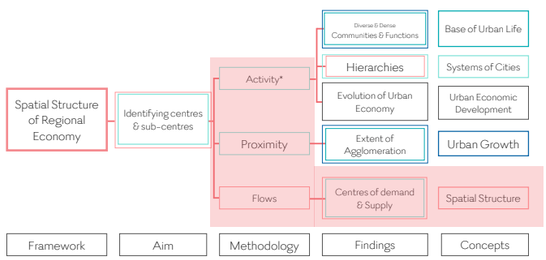
Diving further into the competitive role of the NUCs with regards to our selected case study, an analysis of the two industrial regions of the east and west, showed a coalition. 6th of October & Sheikh Zayed versus 10th of Ramadan & New Cairo. There is a complementary role that Sheikh Zayed (sleeping town) had on 6th of October, which was not the case with Badr & New Cairo or any other eastern sleeping town and 10th of Ramadan. This might be due to the distance which dilutes the effects of agglomeration and economic growth. Moreover, it demonstrates the importance of targeting diverse communities; as affluent gated communities in sleeping towns play an important role in the micro-economy of urban areas and eventually agglomeration of these NUCs, beyond their role as industrial zones.

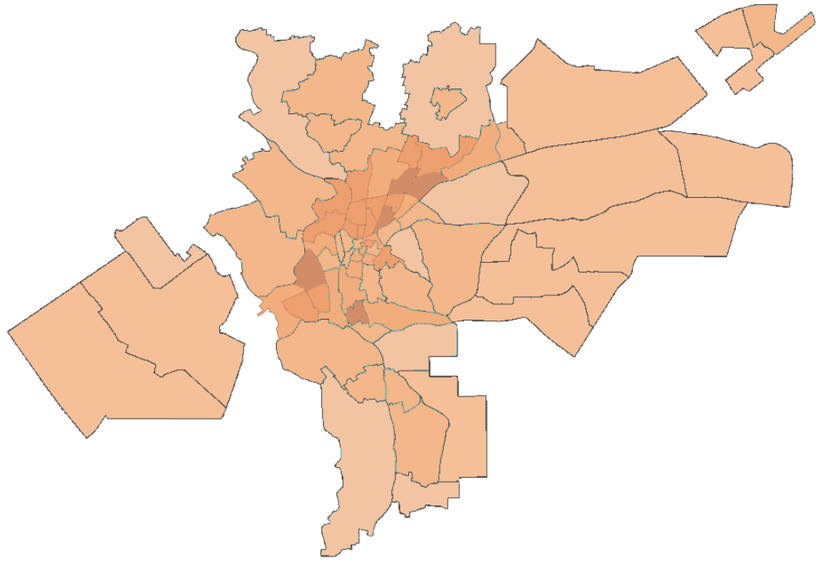


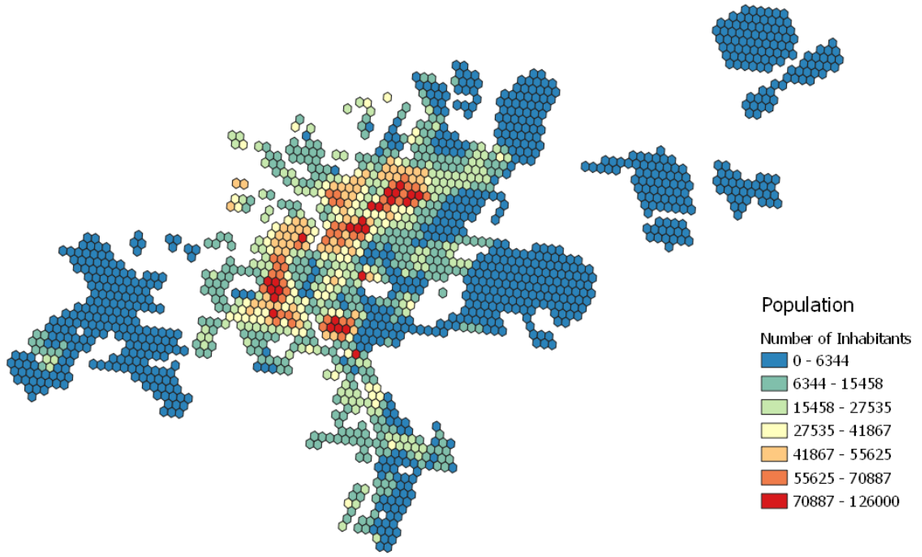


3/ Spatial Structure

The comparison between mapping attributes on district borders versus scalar geospatial polygons, show the transcendence of urban life beyond set administrative boundaries. This calls for more mitigation and collaborative governance between districts and regions. On the other hand, as mentioned in the case-study analysis: all NUCs function under the umbrella of the NUCA, which manages the development of urban communities rather than their urban development and economic growth. The analysis shows that NUCs lack many socio-economic attributes of basic, efficient and innovation development. This calls for an autonomy of management of each NUC, in order for sub-regions to grow independently, and competitively differentiate their sub-centres, while still working collaboratively to decentralize the metropolis and attract functions and communities.







4/ Reflection on Problem Analysis; Public Spending

The inadequacy of NUCs performance within the metropolitan region comes in comparison to public urban spending per capita. As mentioned in the problem analysis (chapter 1), these NUCs are a drain on public urban spending, with more than 50% of urban budget versus 2% of urban inhabitants. The public spending on urban areas is assessed as a signifier of fiscal resources mobilization, capable of enhancing agglomeration of urban areas. The research has mapped public spending against the three administrative boundaries of the GCR, in accordance with their status as existing or new urban areas [Figure 67]. There are six sectors of expenditure per the budget; urban development, social housing, mobility, electricity, sanitation and water infrastructure. Below are the former three sectors mapped for their relevance to the research [Figure 68, Figure 69 & Figure 70].

The comparison shows that NUCs have not been able to perform up to their intended role, despite depriving existing urban regions of their share of public spending. The only exception being the expenditure on transportation in existing urban regions, which is the only sector with higher spending in existing regions rather than NUCs; this is mainly due to the underground metro projects (Shawkat & Khalil, 2016). This suggests the immense deterioration taking place in central regions for the benefit of NUCs, which still continue to attain their aimed goals. Therefore, this research along others supports the re-assessment of the aimed goals of NUCs and deployed resources, given the longevity of the investment period, and the mismatch between attained goals and public investment.

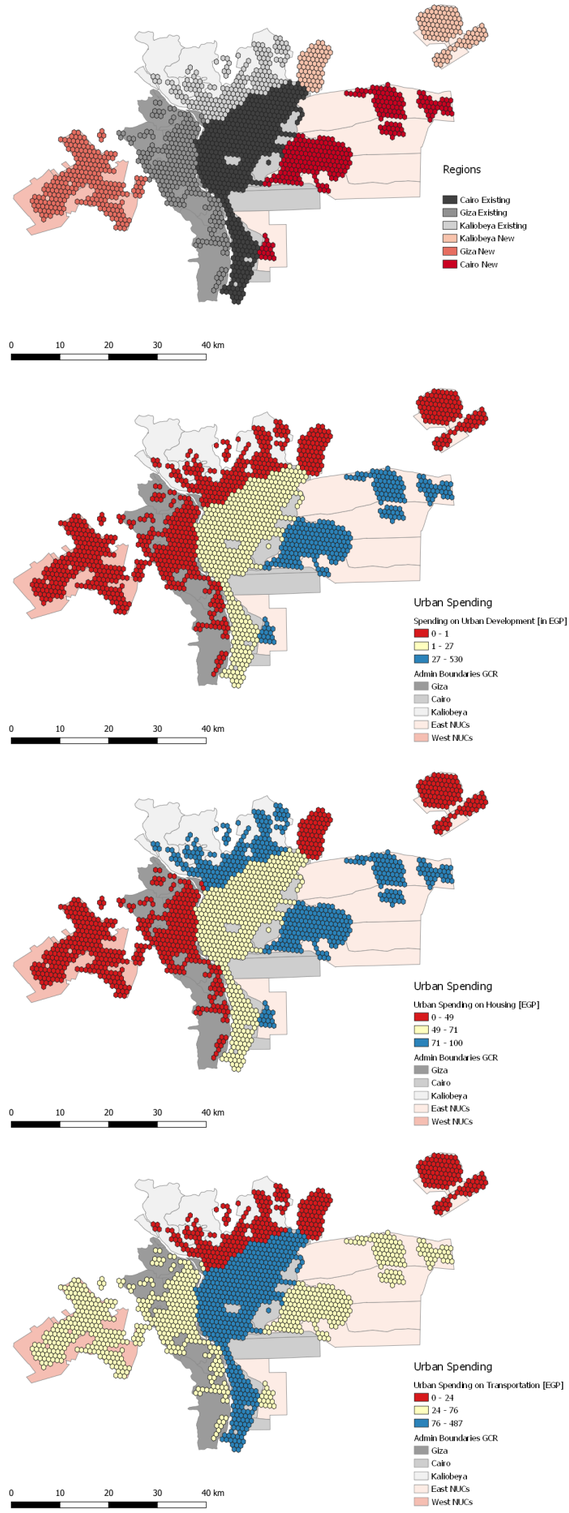


Figure 67: Existing and New Urban Administrative Boundaries [First]

Figure 68: Spending on Urban Development per Capita [EGP]. (Based on: 10tooba.org) [Second]

Figure 69: Public Spending on Houing per Capita [EGP]. (Based on: 10tooba.org) [Third]

Figure 70: Public Spending on Transportation per Capita. (Based on: 10tooba.org) [Forth]

5/ Socio-economic Activities

5.1- *Basic Attributes: Basic Education*

Moving on to specific components. If type of primary education [Figure 42] is taken as indicative of the demographics of communities, then there ought to be acknowledgment to the economic effects of more diverse communities, as per our definition of urban life. The richness of diverse and dense communities not only populate urban areas faster, they also engage in an array of diverse economic functions, leading to the agglomeration of sub-centres. Building on Porter's Diamond Model of competitiveness [Chapter 2-page 36], the government's strategy has affected the demand and factor conditions of NUCs, giving more advantage to some over others. The competitiveness of certain NUCs was capitalized on through market and public providers' strategies and enabled to grow further, while other NUCs have been curbed, or simply never capitalized on their potential.

5.2- *Basic Attributes: Accessibility*

Furthermore, high accessibility has been spatially correlated with densely populated areas and high competitiveness [Figure 81]. Within the central GCR, it is a factor of mass public transportation, which is absent in NUCs. This is compared to the public spending per capita for transportation [Figure 85] within the metropolitan region, and shows the significant low spending on transportation infrastructure, which is often directed to road networks, rather than mass mobility (Shawkat & Khalil, 2016). Thus, the potential NUCs have if sustainable mass transportation infrastructure is developed, potentially stimulates the competitiveness and agglomeration of NUCs and also ensures their population attraction and growth. This can be targeted towards areas with emerging sub-centres, as with 6th of October, 10th of Ramadan and New Cairo, to enhance their agglomeration factors and stimulate economic growth.

5.3- *Efficiency Attributes: service providers*

Service providers combine activities mapped: post offices, telecommunication centres, supermarkets and pharmacies. The former two are public services, while the latter two are supplied mostly by the market. Post offices and telecommunication centres were highly absent from NUCs, while supermarkets and pharmacies had some presence which matched the emerging sub-centres in the NUCs, often in close proximity. This shows that the private sector is more able to identify market needs, and cater for them. It also highlights the importance of coordination between public and private service providers to create vibrant sub-centres. Finally, it is a call to constantly re-evaluate the patterns emerging within urban areas to readjust occupancy plans for centres of service supply.

5.4- *Efficiency Attributes: centres of finance & insurance*

First-tire centres of finance were always correlated with high-end residential districts like Al-Aguza, Downtown Cairo & Heliopolis. This highlights the complexity with which the existing city functioned, that might be lacking in the highly-segregated low-density NUCs. Adding to that the special circumstances of their corporate real estate, which often deploy huge areas making it harder to be footloose. Finally, there was only one first-tire centre of finance and insurance combined in Downtown Cairo. This gives indication to the development in the urban economy of the GCR, attracting production function to sub-regions and maintaining highly skilled employment in the central city. While it might be hard to stimulate relocation of those centres, it might pose an even bigger urban management problem for the survival of Downtown Cairo, especially with the depopulation of its inhabitants. Therefore, centres of finance and insurance might better be maintained in the central city, while acknowledging their ties to NUCs and productive sub-regions.

5.5- *Efficiency Attributes: centres of higher education*

The analysis showed a good dispersion of higher education entities within NUCs which signifies the potential of these sub-centres. It is important to note that the success of higher education is in preparing skilled labour and professionals to join the economy, therefore the quality of professional education shall always remain part of public private partnerships.

5.6- *Efficiency Attributes: centres of government*

The analysis showed a highly centralized government, with the exception of two ministries in east and west NUCs. This is not only analogous to the centralized management of the GCR, but also to that of the entire country (Sims, 2016).

5.7- *Efficiency Attributes: centres of recreation*

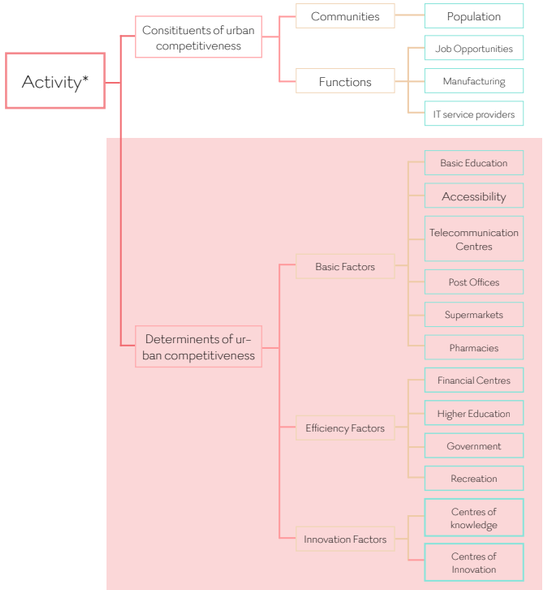
In addition, cultural and recreational facilities remain highly central. This again feeds into notions of NUC governance and the management of these cities as real estate developers rather than local districts with a need for recreation and cultural budgets. It also feeds into the lack of coordination among the various decision making institutions. Therefore, while there is high interest of some ministries to decentralize the metropolis, for the Ministry of Culture the primary aim remains central Cairo. This might change with the inauguration of the Grand Egyptian Museum, in western fringes of central Giza. Yet again, NUCs remain absent from such cultural recreational plans.

5.8- *Innovation Attributes: centres of knowledge & innovation*

In light of today's knowledge economy, mapping innovation and knowledge attributes ensures the resilient growth of the urban economy. Spatial correlation between these two attributes and higher education was found. This highlights the strength of centres of higher education in developing new innovative economic functions.

A note on research findings

Moving forward, the synthesis of geospatial data analysis with literature review highlights factors of correlation versus causation. The analysis does not prove whether these attributes and amenities are causal or simply related. The logical answer is that the lack of these attributes is probably lending urban areas a closed cycle of deprivation, which requires proactive action and resource mobilization to break.



Policy Recommendations

By overlaying the findings of the spatial structure analysis of socio-economic indicators with a preliminary survey of urban policies implemented, the research shall identify potentials and challenges in need of active public and private involvement to arrive at the research's policy proposal.

Aim

Inform better policies for agglomeration using the theoretical framework devised in the literature review

Policy Proposal

Using the literature review and the theoretical framework developed regarding agglomeration economies, and the findings of the empirical data. The research provides a list of the policy recommendations that targets the entire metropolitan region as well as specific aspects of its development.

General Recommendations

1- First and foremost, regarding urban management, NUCs management should be assigned under local urban management, rather than functioning under the NUCA. This will give rise to a management framework that is more focused on enhancing urban life, rather than developing urban areas. Furthermore, the autonomy of each NUC management should function hand-in-hand with a collaborative vision for the entire metropolitan region.

2- Second, management of urban economy within the metropolitan region should transcend the administrative boundaries of districts, as the research showed that centres of demand and supply of economic activities surpassed them.

3- With regards to communities, increasing the population density of the NUCs calls for more than zoning regulations. Policies should aim for integrating different functions and demographics within the smaller urban unit. First, through using the already identified emerging second and third level sub-centres in this research. Second, through distributing the socio-economic amenities on a multiplicity of those sub-centres, in a way that serves more than a single strata of society. Hence, capitalizing on the diversity of urban communities to enhance density.

4- With regards to production functions; the research showed that centres of production are in close proximity with centres of population density. This calls for reassessment of the qualitative nature of production functions in NUCs. Sims (2012) argues for the limitation of policies and strategies to support small and middle size enterprises [SME] to develop their entities within NUCs. Primarily because the distance to NUCs creates diseconomies that are not mitigated through active policies. The potential of SMEs lies in the role they play within the economy making more than 35% of production GDP (World Bank, 2018). Basically, NUCs can not afford to not attract these economic functions, in addition to the already present industrial zones.

5- With regards to public spending, the original problem statement called for an inspection into the discrepancy between existing urban regions and NUCs. The research has shown that these resources have not yielded saturated urban areas, but rather highly deficient fully built regions. Therefore, a rigorous analysis of aspects of the budget, coupled by the understanding of the socio-economic urban attributes, and the role NUCs are playing is crucial. Primarily, an investigation into public spending on transportation and the prospects this key infrastructure plays for competitiveness is critical.

Specific Recommendations

6- It is crucial for urban management to shadow market patterns of service provision. As seen with the comparison between basic functions, of supermarkets and pharmacies, against public service providers, the market has been able to identify centres of demand and cater better for their needs. Utilising these patterns for reassessment of zoning and urban planning procedures can enhance the quality of life of sub-centres in NUCs.

7- In addition to calling for more investment in accessibility, the research highlights the qualitative nature of modes of transportation that are present in underground metro lines in central regions. Transport for Cairo (2019) mentions extensively the money summoned for the renovation of major arteries and roads. However, a true accessibility plan shall work on providing mass transportation systems which are efficient, reliable and environmental, as well as affordable for the majority of the population.

8- Higher education and training shows signs of emerging sub-centres with regards to the two case studies researched. The importance of higher education and training springs from the industrial base of those NUCs and mapped regions of production within them. This calls for continuous public support and incentivizing the private sector to continue supporting the labour training sector.

9- It is said that societies are always united around art, sports and politics; while cultural amenities remain highly centralised, these projects are great potential for public private partnerships. Especially with NUCs abundance of big private developers and the potential to incentivise them for better cultural and recreational amenities that are publicly accessible. On the other hand, primary centres of culture available in the city centre remain of higher rank. Capitalizing on the city's identity, its heritage and the highly dense and diverse communities, central regions are more valuable providing a sense of place to the entire metropolitan region. They also ensure the restoration and revival of depopulating city centres. Therefore, a clear and differentiated plan of the hierarchies of centres and sub-centres of cultural amenities is crucial.

Photo by Kattie Mullins

Chapter CONCLUSION

Conclusion

In Cairo, eight new urban communities around the metropolitan region, stand still, fully developed, yet empty of people and economic functions. This research started with the objectives of informing policies to stimulate the economic role of sub-centres in NUCs of Greater Cairo Region. It aimed to do so through mapping the system of cities of the greater Cairo region. This led to a query into the applicability of urban economics theories on metropolitan regions of emerging economies. Additionally, it restructured the essence of those theories within their spatial context. This informed the quantitative methodology that utilized exploratory geospatial data analysis as its tool for the investigation of the role of two of the eight NUCs within the GCR.

This research arrives at a number of policy recommendations based on the mapped spatial correlation and research findings, overlaid with a theoretical framework of agglomeration, developed in the literature review. The proposals aim to increase the competitiveness of NUCs to enhance their urban growth through attracting more economic functions and inhabitants. The main challenge sparked from the inability to identify sub-centres. The levels of deficiency of socio-economic attributes in NUCs was discussed with their spatial correlation to urban competitiveness. The geospatial structure of the metropolitan region was mapped with the role of NUCs highlighted, supporting the problem definition of the research.

Additionally, a major incongruity in urban management has been identified as the possible root cause. NUCs continue to be managed under the developing authority as new urban areas rather than existing urban neighbourhoods. This has led the urban areas to be lacking very basic, efficiency and innovation factors of urban competitiveness that are key for diverse and populated sub-centres as highlighted in the research.

Limitations

There are a number of limitations, some are more generic, while others are specific. Not all limitations have affected the research negatively, although they were a challenge. Primarily, this thesis is presented in July 2020, therefore it is inevitable to mention the COVID-19 pandemic crisis which has led to major shifts in the tools and methods used in the operationalisation of this research. Coupled with the absence of official datasets and spatial surveys, this has led to a greater opportunity for developing analysis tools for similar contexts where data is unavailable.

Moreover, with regards to the research scope, this research only touched upon the factor of urban planning and design. Although the research speaks of the spatiality of economic activity, factors such as zoning have been narrower than the scale of the analysis. Similarly, qualitative analysis of indicators was lightly addressed, and could be explored more.

Finally, the main limitation that this research dealt with was the English language western literature. This has in many cases posed the question of applicability within a post-colonial emerging economy setting. It also poses the same limitation moving forward, as this research is published in English for an Arabic speaking country. Therefore, the chances of getting this research picked up, is only limited to international organizations and NGOs.

Recommendations

In order to inform better policies, we have to understand the performance of key socio-economic amenities serving our urban areas. This master's thesis calls for rigorous data-led analysis of the systems of cities of the GCR to influence urban policies and mobilize strategies. As a result, urban managers can position their urban areas within the greater region, collaboratively enabling a more interdependent rather than simply competitive position. The findings can be employed by public and private entities to identify deficiencies and enhance their urban regions.

Further work

This research provides an analysis of the spatial structure of systems of cities. Further research can look into more rigorous data of urban flows, to better understand and map centres, sub-centres and identify emerging centres. The policy recommendations can further be expanded on to inform urban economic strategies and decision makers. Over and above, the addition of inter-regional relationships will allow for a macro level analysis looking into the metropolitan region's role to the country's economy and the regional links of resources, capital and employment.

Overlaying this research with the architecture and urban analysis of NUCs can help planners integrate factors of urban growth and resilience within their designs of NUCs; as well as aid policy makers in their strategy designs for the growth of NUCs.

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