

**IMAGINING A SMART CITY: A SINGULARITY BETWEEN
GOVERNMENTAL SENSING(SURVEILLANCE), ENVIRONMENTALISM
AND CITIZEN SENSING**

By

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Abstract

This capstone paper delves into the multifaceted realm of "smart cities," a paradigm that epitomizes urban development interwoven with cutting-edge technology to enhance the quality of life. Emphasizing the portrayal of technology as a facilitator of convenience, the paper looks into how these smart and sustainable urban ecosystems may inadvertently reshape the material-political landscape. The research begins by exploring the core concept of a "smart city," investigating how technology is harnessed to streamline urban living. However, the paper critically questions the implications of this convenience-centric approach, probing whether the proliferation of data-driven solutions could limit citizenship to a series of actions primarily centered on monitoring and managing information.

The research methodology incorporates a comprehensive literature review, synthesizing existing papers that expound on the implementation of technology in smart cities. Additionally, the paper delves into contrasting case studies to draw meaningful insights from the spectrum of urban development strategies. Building on this foundation, the capstone project concludes with an imaginative envisioning of a utopian sensing city, drawing inspiration from science fiction narratives. This speculative approach aims to stimulate critical discourse on the future trajectory of smart cities, contemplating the delicate balance between technological advancement, civic engagement, and urban citizenship.

Keywords: Smart city, biopolitics, governmental sensing, citizen sensing, symbiosis

Introduction

The smart city is, starting from the origin of this urban imagination, a faith in technology and innovation (Cugurullo, p. 2). From the early computing models to regulate transportation flows in the 1950s, up to today's smart city "The Heartland" in Singapore, the development of smart cities has been a choice to "use technological solutions to improve the management and efficiency of the urban environment" (European Union, n.d.). This means the implementation of digitalization in urban sensing, during which the city collects data from both citizens and the services provided for them.

Yet besides all the excitement and promises, the process of making a city "smart" is far more complex than adding a technological layer to the current society. The idea of making the city wear "a skin of sensors" raises questions about privacy. Furthermore, beneath the beautiful name of "smart city" often lies political intention. Environmental technologies as extensions of spatial governing alter material-political distribution power, putting life in a smart city under constant, omnipresent surveillance in the name of "convenience" (Gabrys, p. 32).

From another perspective, we may be able to see the vision of symbiosis between machines and nature in smart cities where the boundary between machines and nature becomes blurred. In this scenario, the city is an interface between different sensing agents: humans and other animals, plants, and machines, and a platform for interaction with nonhuman agents (Bratton). The literature review will dig deeper into the political, environmental and citizen aspects of urban sensing, which further contributes to imagining an idealized, utopian smart city.

Literature Review

In many cases, smart city plan is proposed with a focus on making the city “greener” or “more sufficient” (Gabrys, p. 30). For example, the smart city project in Singapore mainly dealt with problems of “growing population, aging population, aspirations for a better quality environment, development and management of infrastructure, and lower energy use to address climate change” (Cheong). Proponents of these smart city projects often insist on the necessity of developing a networked urban society and increased digitalization of urban services in order to achieve sustainability initiatives. Yet for Gabrys, smart city nevertheless becomes an excuse for promoting digital technology, in order to achieve a new, material-political distribution of power (32). Gabrys uses the term “biopolitics” to describe this distribution of power, a term defined by Foucault as a style of government that regulates men not as individuals, but “as an entire race, a global mess” that is affected by all kinds of biological characteristics, for example, birth, death, reproduction, illness and so on (Foucault & Macey, p. 243). Modern biopolitical practices such as China’s One Child Policy, which implements governing power on citizen birth in order to control population growth, demonstrate governing beyond the individual level, overlooking the entire human race.

Biopolitics is “new” compared to the traditional ideology of a sovereign political power, which is often known as “the Social Contract”. Thomas Hobbes argues that individual actions are shaped by personal power and conscience. He sees humans in the state of nature as both free and vulnerable, exposed to potential harm from others (p. 103). Hobbes argues that authority should be absolute sovereignty, held by one person, as he stated in his article *Leviathan*:

The only way to erect such a common power, as may be able to defend them from the invasion of foreigners, and the injuries of one another...is to confer all their power and strength upon one man, or upon one assembly of men...and every one...therein to submit their wills, everyone to his will, and their judgments, to his judgment (Hobbes, p. 132).

What Hobbes describes is a traditional system of political rights that applies to monarchies. The monarch himself has centralized, supreme ruling power. In contrast, biopolitical power is scattered in the space of the city. In addition, Biopolitics expands the possibilities of urban

pan-management. The model of centralized management based on the social contract is usually as follows: a citizen breaks the law, and the monarch sends someone to sanction him. This is one-on-one regulation. The power of biopolitics is distributed among the city's various public facilities, such as traffic lights that restrict people's mobility, and roadside sensors that sense traffic and direct better routes. Marshall McLuhan's concept of "media as an extension of man" can be applied to biopolitics by understanding how contemporary public sensing facilities act as extensions of governmental sensing. As McLuhan said "Our human senses, of which all media are extensions"(p. 22). Replace the human senses here with city senses, such as traffic sensors, which function as technological extensions of the governing body. These technologies amplify the reach and influence of governing power by constantly monitoring and collecting data on individuals and their activities. The cityscape transforms into a medium through which power is projected, shaping and regulating citizen behavior.

Thus, biopolitics is extended from closely bio-related human race management to a broader bio-related urban management, including but not limited to pollution sensing, smoking management, and others. If we look deeper into each category of urban management, we see the truth that the city data is in many cases accessible only to governing bodies, and citizens are questioning data democratization. Take air pollution sensing and management as an example, a significant challenge lies in the fact that contemporary air pollution is often invisible to the human eye. Despite registering on the body, not all issues are evident in the visible smog layers above many Chinese megacities, where less visible smog on the streets can be more harmful to citizens' health (Parikka). UK's failure to follow up on required limits of Nitrogen Dioxide (McGrath) also underpinned the fact that invisible air pollution doesn't easily appear on media reports and becomes a representation of the smog city, thus less likely to be managed by the government (Parikka). Considering this, a demand for democratizing data is called. Is there a possibility that we can speculate a smart city, where data is democratized, and decentralized for citizens? Will this be the starting point for advocating citizen sensing?

Thinking about citizen sensing, Bratton may start with, how does a citizen, a human, sense? For human, the skin is our largest sensing organ. It captures biological data from the environment for our body. We also wear technology to augment nature, The fabrics we wear help us adjust body temperature, in one way it is augmenting nature (Bratton, p. 13). This technology that we wear is "the second skin". Applying this to a smart city, the surface of the city is "the second skin" of the

planet, since it senses the urban environment and augments nature (Bratton, p. 12). Bratton's speculation that the future city is an "interface" between machines, humans, plants, and animals gives insight into the possibility of achieving a symbiosis between nature and machines. In one way, we as humans wear different kinds of machines, for example, clothes and Apple Watch, in order to capture data related to personal health. Vice versa, the machines also wear us. These are cases of various bio-sensors that measure biological data of the urban environment. To take a step further, these synthetic skins will one day become interactive interfaces, where all data is transmitted (Bratton, p. 13). This may be a possibility for democratization of data, and engaging citizen sensing in urban sensing.

Bratton and Gabrys provide two interpretations of a "smart" city. For Gabrys, the term "smart" is a justification for imposing political power on urban sensing. For Bratton, the "smart" refers to a symbiosis between machine and nature. Since these concepts are either abstract or theoretical, I would like to find real-life examples to supplement the literature review.

Methodology

The methodology employed in this study encompasses a multi-faceted approach, integrating real-life case studies, reference to the science fiction “Folding Beijing”, and a trajectory for future work. The selected case studies, Singapore's smart city "The Heartland" and Hong Kong's demolished "Kowloon Walled City," offer contrasting perspectives. The former aligns with Jennifer Gabry's definition of smartness, emphasizing surveillance and governing. In contrast, the latter allows exploration of Benjamin Bratton's speculation on a symbiosis between machine and nature. This methodology provides a comprehensive lens to scrutinize the evolving landscape of smart cities, examining both existing implementations and speculative futurism.

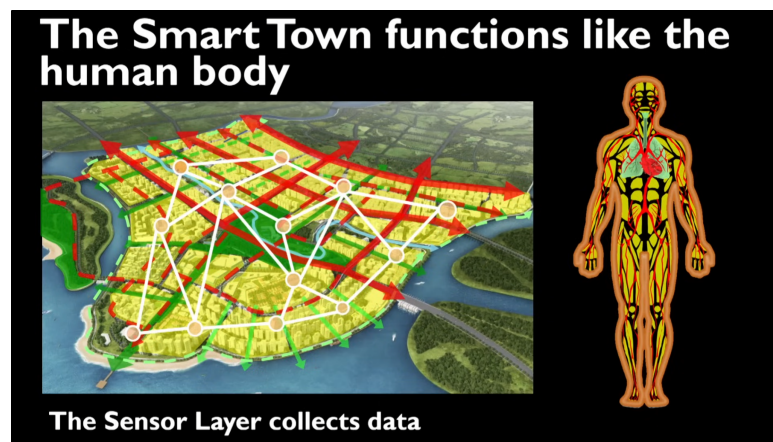


Figure 1: Singapore's “The Heartland”

In the case of Singapore's smart city project “The Heartland”, its smartness is interpreted into 4 aspects: smart planning, smart environment, smart estate services, and smart living (Cheong). Smart planning allows the urban planner to design a better living environment. The planner collects all the data about the city, for example, the building, the population, as well as energy use. Then they put the data into a computer, and with sufficient data, they can develop a 3D map of Singapore. This allows the planner to move from smart planning to redesigning the environment. With feedback from the computer of analysis on wind flow, shadow, and solar irradiance, the planner adjusts the structure of the city to improve the living experience of citizens. Corresponding to Jennifer Gabrys' explanation on Biopolitics, which I brought up in the literature review, the urban planner of “The Heartland” encourages adding layer sensors on

residential buildings to collect biological data. For example, they put sensors in solar panels that were placed on rooftops, to track the energy flow within the panel. The planner dug deeper into the lighting adjustment in the neighborhood as an example for smart estate services. Smart sensors allow a person to walk along a corridor, predict where he/she is going, and increase the light intensity of the lighting device in the predicted direction. Another example that citizens may not realize is the lift position management. Planners move lifts up and down within the runway to test their usability. Furthermore, they collect the vibration and heating conditions of those lifts to predict potential damage. These are urban managements that are more invisible. Smart living looks into the problem of elderly care. By putting smart sensors in homes that have elder residents, the sensors monitor and learn the behavioral pattern of the elder citizen, for example, one's sleeping pattern. Once this pattern becomes irregular, a signal will be sent to this elder resident's family. Proceeding to home energy management system, when it reaches certain usage, the smart controller can even switch off the devices at home and erase data in order to save energy.

The allure of smart cities comes with a potential peril—while citizens trade privacy for convenience, the expansive digital footprint becomes a vulnerable landscape. From revealed home locations through check-ins to marketers predicting preferences, the interconnected data mesh exposes personal lives. The global shift to digital transactions erodes anonymity, with each purchase linked back to individuals. Trading our privacy for convenience made possible exploitation posed to ourselves.

An opposite example is Hong Kong's demolished Kowloon Walled City, a completely not high-tech, anarchic urban environment, that emerged as a densely populated, unplanned settlement. Originally a military fort in the Song Dynasty, it evolved into a high-rise labyrinth of interconnected structures due to legal loopholes and lack of governance. Demolished in 1993, it remains a symbol of unique, anarchic urban development.

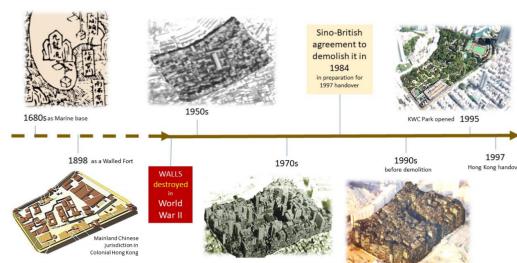


Figure 2: Simplified Timeline of KWC's history

Composite structures like Kowloon Walled City house a diverse mix of retail and services on the lower floors (podium) and guesthouses and apartments on the upper levels (tower), creating a distinctive urban fabric (Lo, p. 251). Amid the bustling density, intricate commercial and industrial relationships emerge, blurring the lines between formal and informal, legal and illegal activities. Despite appearing chaotic or unconventional, these dynamics reveal an underlying order and invisible hierarchy within the interactions of urban actors.

This microcosm of the city within composite buildings, juxtaposing residential units with various activities like guesthouses, social clubs, and commercial ventures, embodies “a dense city in a building” (Lo, p. 253). However, questions arise about the opportunities and limitations of this operational model. Composite buildings tightly weave traditionally ground-level activities into compact, adaptable, three-dimensional networks, presenting challenges in maintenance. Building owners, lacking incentives, neglect public circulation and common areas, mirroring broader issues in Hong Kong's “development-oriented urbanism and regulatory frameworks” that overlook citizens' daily complexities (Lo, p. 255).

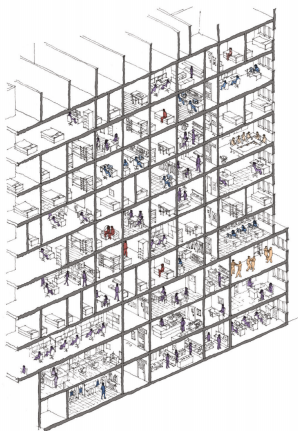


Figure 3: Conceptual composite structure

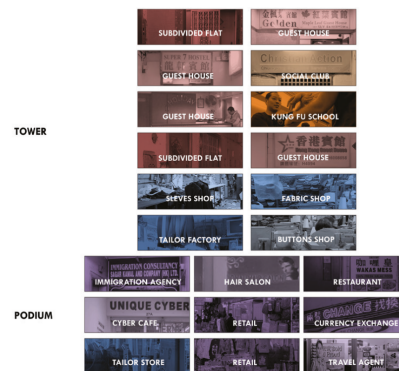


Figure 4: Conceptual sectional diagram of KWC

Despite the apparent disorder, the chaotic vitality of composite buildings reveals how stakeholders adapt, negotiate, and interact through informal practices, creating highly effective business networks within three-dimensional interiors. The overlooked spatial orders and dynamic social-spatial organizations within the informality challenge preconceptions of disorder, offering

a unique perspective on fluidity and flexibility in dense, high-speed, and high-density urban environments. The proximity of contrasting activities fosters chance encounters and unknowing social interactions, showcasing the resilience and adaptability inherent in Kowloon Walled City's unconventional urban ecology.

How does the case of Kowloon Walled City contribute to exploring Benjamin Bratton's vision of blurring the boundary between machine and nature through wearable technologies, essentially turning the city into a living, responsive organism? In Bratton's concept, “the city wears us” actually means the city wears our smart devices, from wearable technology like our clothing fabric to large-scale city sensors, as a form of the city's skin, acting as interfaces that collect and transmit data. In the context of Kowloon Walled City, the very structure of the composite buildings, with retail, services, and living spaces tightly integrated, resembles the interconnected layers of a technological skin. The informal collaborations, such as fabric and garment traders in the tower part, and cooperating with tailor storefronts on the podium part, can be seen as nodes in a network, exchanging information and resources, much like a technological interface.

While concluding the two case studies, how do I incorporate the two opposite city structures into my future work? I would like to consider science fiction as the way to build this utopian city. Science fiction sits between wild imagination and certain reality, perhaps that's why it can describe the complexity of human society. I was inspired especially by the worldbuilding of *Folding Beijing*, in which imagines:

The folding city was divided into three spaces... First Space, a population five million. Their allotted time lasted from six o'clock in the morning to six o'clock the next morning... The other side was shared by Second Space and Third Space. Twenty-five million people lived in Second Space, and their allotted time lasted from six o'clock on that second day to ten o'clock at night. Fifty million people lived in Third Space, allotted time from ten o'clock at night to six o'clock in the morning (Hao, Chapter 2).

I propose a visionary approach for my future work—a utopian city built on the interplay of governmental sensing (surveillance), environmentalism, and citizen sensing. Inspired by the imaginative worldbuilding of *Folding Beijing*, I envision a city that transcends traditional

boundaries. Building on the Folding Beijing model, I imagine a utopian city separated into two spaces, one above ground and the other below ground. The above-ground space, similar to Singapore's smart city model, can leverage natural resources and sunlight to create an environment that prioritizes sustainability and human well-being. Governing on sensing and surveillance could be reimagined as a responsible custodian of public well-being, utilizing data for efficient resource allocation and urban management. Environmentalism could be seamlessly integrated, leveraging smart technologies to minimize ecological footprints and enhance sustainability. Such a model is accepted by citizens of this space, who would like to trade privacy for convenience. On the other hand, the below-ground space, reminiscent of Kowloon Walled City, presents a unique challenge and opportunity. With limited access to sunlight, artificial nature becomes a critical component. The light source of this space becomes the interfaces——digital screens and luminous skins(from plants, animals or human fabrics). A potential medium for this project will be virtual reality. I am most likely to build a parallel world of this utopian city, which transcends current limitations on urban space imagination.

Conclusion & Future Work

To present the previous theoretical research and case studies, I proposed in the section of the case study that the outcome of this project will be a parallel universe, and the medium will be virtual reality. The city is constructed with 2 parts: the above-ground part and the below-ground part. The design of the upper ground space will focus on demonstrating urban sensing with the foundational logic of biopolitics. while sensors of the current city are still location-based, I would re-imagine the sensors of a future city to be interfaces, since they are larger in scale, and cover a wider sensing area. The below-ground city will be more densely populated. Between the residential structures will be interfaces providing light sources. Yet in this space, the interface transcends as light sources and regular sensors. The interfaces become a platform for data exchange between plants, animals, humans, and machines, in such a way presenting the possibility of a symbiotic city.

Beyond the speculative imagination, practicability should be considered. What's the scale of the project? what shape should the utopian city be built into? What should be considered when reimagining the future of urban living? I took the suggestion from Professor Andy Garcia and checked critics on Saudi Arabia's project "The Line".



Figure 5: "The Line" from NEOM's official webpage

Criticism focused on the mobility within the linear urban structure. The average distance between two random locations in this linear city is 57km apart, which is very inconvenient for traveling. The critics suggested a circle to be a better shape than a line for a city, since "If you

take The Line and make it The Circle, with a radius of 3.3km, the distance between any two people would be only 2.9km, and 24% of the population would be within walking distance of each other.” Reflecting on this, I’m most likely my project into a round-shape city.

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