Re-Thinking Urban Retail:
The Design and Planning of "Dark Stores" and Public Spaces
Case Study: Manhattan, New York

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Bachelor of Architecture Engineering
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Abstract:

The retail industry has transformed into various formats due to the fast-paced social and sharing economy changes driven by technological advancements. The recent concept, grocery "dark stores" (retail facilities that are designed for online order fulfillment mostly located in urban areas), is expected to stay as e-commerce and omni-channel operators view them as cost-effective means of delivering quick services to customers. City officials are currently discussing the potential advantages and drawbacks of "dark stores" which could affect changes for street livability in the absence of retail storefronts. Should cities ban "dark stores" that compete with traditional brick-and-mortar retailers?

This thesis analyzes the proliferation of online grocery shopping and how "platform urbanism" (Sadowski, 2020), a novel set of digitally-enabled socio-technological assemblages rooted in the urban affects the spatial distribution of grocery "dark stores" activities by understanding their location and target customers. By using spatial analysis and interviews, this thesis tries to answer three questions: what is the role of grocery "dark stores" in cities?; where are they located?; and what are their impacts on the urban fabric? It uses NYC (Manhattan) 2021 decennial census and retail food stores data collected in 2022 and 2023 to provide some insights to these questions. The result shows that 1) The location of grocery "dark stores" are mostly located in neighborhood areas with high retail food stores and facility concentration 2) Grocery "dark stores" in Manhattan are located mostly in the Commercial and Manufacturing districts 3) Despite the rise of grocery "dark stores," high funding from Venture Capitalists, and their promise of convenience to customers, in mid-2022, grocery "dark stores" in Manhattan faced exits due to dwindling investor funding, competitive market landscape, and political environment driven by Russia-backed Venture Capitalists.

In the digital era, strategies to digitally transform the city need to consider the implications of different types of retail formats and stakeholders involved. There is a need for urban policy and regulation to address how new retail platforms can reshape the nexus between businesses location, their design and function and the public. As this thesis shows, there is more urgency to do so as new form of retail and businesses are emerging as a result the tech-enabled digital economy and urban new urban infrastructure.

Keywords: grocery dark stores, quick commerce, e-commerce, retail, location theory

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List of Abbreviations and Glossary

AI	Artificial Intelligence
BOPS/ BOPIS	Buy Online, Pick up in Store
Dark Store	A large warehouse that can either be used to facilitate a "click-and-collect" service, where a customer collects an item, they have ordered online or as an order fulfillment platform for online sales[1]
DC	Distribution Center is a warehouse or other specialized building to stock goods to be distributed to retailers, wholesalers, or directly to customers.
Dot-com Bubble	A stock market bubble in the late 1990s, coincided with massive growth in internet adoption, a proliferation of available venture capital, and the rapid growth of valuations in new dot-com startups.
E-commerce	Electronic commerce is the activity of electronically buying or selling of products on online services over the internet
FMCG	Fast Moving Consumer Goods
FRESH	Food Retail Expansion to Support Health
Ghost Kitchen	Commercial kitchen built for delivery, located within radius of a high volume of online customers.
LTV	Lifetime Value. An estimate of the average revenue that a customer will generate throughout their lifespan as customer.
MFC	Micro-fulfillment Center. Smaller spaces that have been repurposed for distribution using automated systems, such as turning an empty underground parking garage into a grocery fulfillment center (Weikal & Scott, 2020)
NTA	Neighborhood Tabulation Area
Omnichannel	A business that offers seamless shopping across all of its channels, such as physical stores, online stores, marketplaces, mobile apps, and catalogs.
Q-commerce	Type of e-commerce which emphasis on quick deliveries, typically less than an hour.
SKU	Stock Keeping Unit is the unit of measure in which the stocks of a material are managed in the form of scannable bar code to track inventory.

[1] "Supermarkets to introduce more 'dark stores'". *BBC News. 9 January 2014.* Retrieved April 18, 2023.

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Chapter 1 |
Introduction

1.1. Background

In an environment of rapid social and sharing economy driven by technological advancement, the retailing industry has evolved into various new channels and formats. The recent COVID-19 pandemic has fueled up the growth of "dark stores" which has emerged since the dotcom boom in the early 2000s when Tesco opened its online only picking facility (The Grocer, 2019). According to research by Cushman & Wakefield, demand for "dark stores" in urban neighborhood will be a trend that is not going away. E-commerce and omni-channel grocery retailers see them as a cost-effective way to get close enough to their customers to provide a quick service delivery (Kirk, 2022).

"Dark stores" are grocery or retail stores that is not open to the public and is used as a warehouse for quick-commerce deliveries (McKinsey & Company, 2022). They help retailers envision the most cost-effective system for reaching out to more customers (Pearson, 2022) by merging the concept that integrates online, offline, logistics, and data under one shopper-friendly roof. Despite not being open to the public, the interior of these stores like regular grocery stores but are more organized and optimized for online order picking (Figure 1). "Dark stores" manage their customers' orders effectively by promising a 15-minute delivery services.

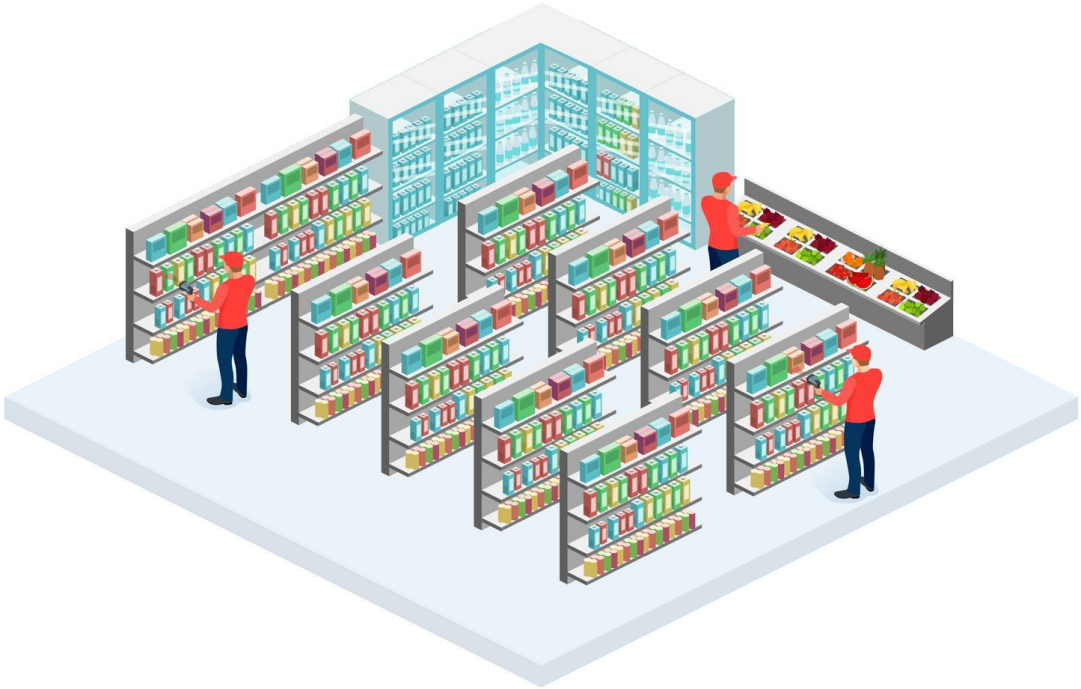


Figure 1 | Grocery Dark Store, chapmantaylor.com

Well-funded online grocery startups such as Getir, GoPuff, JOKR, Buyk, and Gorillas are transforming retail spaces into minimally staffed distribution centers near the public realm. Not only grocery stores, but this trend also affects restaurants and coffee shops known by the term "ghost kitchen" with no dining room experience or carryout (Pearson, 2022). Coffee shops such as Starbucks are changing their business model to grab and go instead of selling the experience of coffee shops (Meisenzahl, 2022). Starbucks is shutting hundreds of cafes and opening futuristic pickup-only stores in their place; Wendy's, Chick-fil-A, and other fast-food chains are also following the same footstep (Pearson, 2022).

Shopping and interacting with people in coffee shops remains a significant activity with great social and economic importance to cities and retailing could be the magnet that draws people to cities and the glue that holds it together. Mayors, redevelopment chiefs, and planners have an old tradition of using retail centers to revive ailing cities (Frieden & Sagalyn, 1991). However, these new typologies of stores are quietly taking over the city's storefronts and sidewalks. Without being well-regulated, the insatiable demand for faster delivery could hasten the erosion of community life. E-commerce and on-demand delivery will replace the need for brick-and-mortar retail, resulting in empty storefronts and less livable streets (Kushner & Lindsay, 2021).

15-Minute Delivery vs. 15-Minute City

The promise of 15-minute delivery services have so much in common with other model of urban commerce that has recently risen across the globe: the 15-minute city, where amenities and services can easily be accessible on foot or by bike within the 2 miles radius. Both visions bring goods and services closer to home, however, while one harnesses consumption to seed and bolster community, a delivery-based services devours community (Kushner & Lindsay, 2021).

The idea of a "15-minute city" is not new. Many cities such as Barcelona, Bogota, Buenos Aires, Melbourne, Milan, Paris, and Portland have been using their elements to create people-centered urban development models (Raj, 2022). In the 1920s, Clarence Perry introduced the idea of "The Neighborhood Unit" (Figure 2), offering a concept of a specified population size neighborhood with a specific prescription on the separation of land uses and the segregation of vehicular and pedestrian traffic, emphasizing boundaries and an inwardly focused core (Lloyd Lawhon, 2009).

The neighborhood unit approach was a self-conscious attempt to promote good design and incorporate the modern era's best social thought into a physical design that would promote the health, safety, and well-being of people living in urban residential areas. Perry conceived the idea of a neighborhood as a geographic unit, where he proposed that a unit should contain four basic elements:

an elementary school, small parks and playgrounds, small stores, and a configuration of buildings and streets that allowed all public facilities to be within safe pedestrian access (Banerjee & Baer, 1984). These days, the neighborhood unit idea is mainly known as a 15-minute city.

The theory of 'new urbanism,' an urban planning and design concept promoting walkable cities, gained popularity in the US in the 1980s. Similar versions of 'urban cells' or 30- and 20-minute neighborhoods have emerged globally in the past decade (Antunes et al., 2021). The "15-minute city" (Figure 3) integrate various land uses into a cohesive people-centered development trying to get away from private cars and promote walking, cycling, and public transport. This approach can boost local economies, equity, and climate benefits.

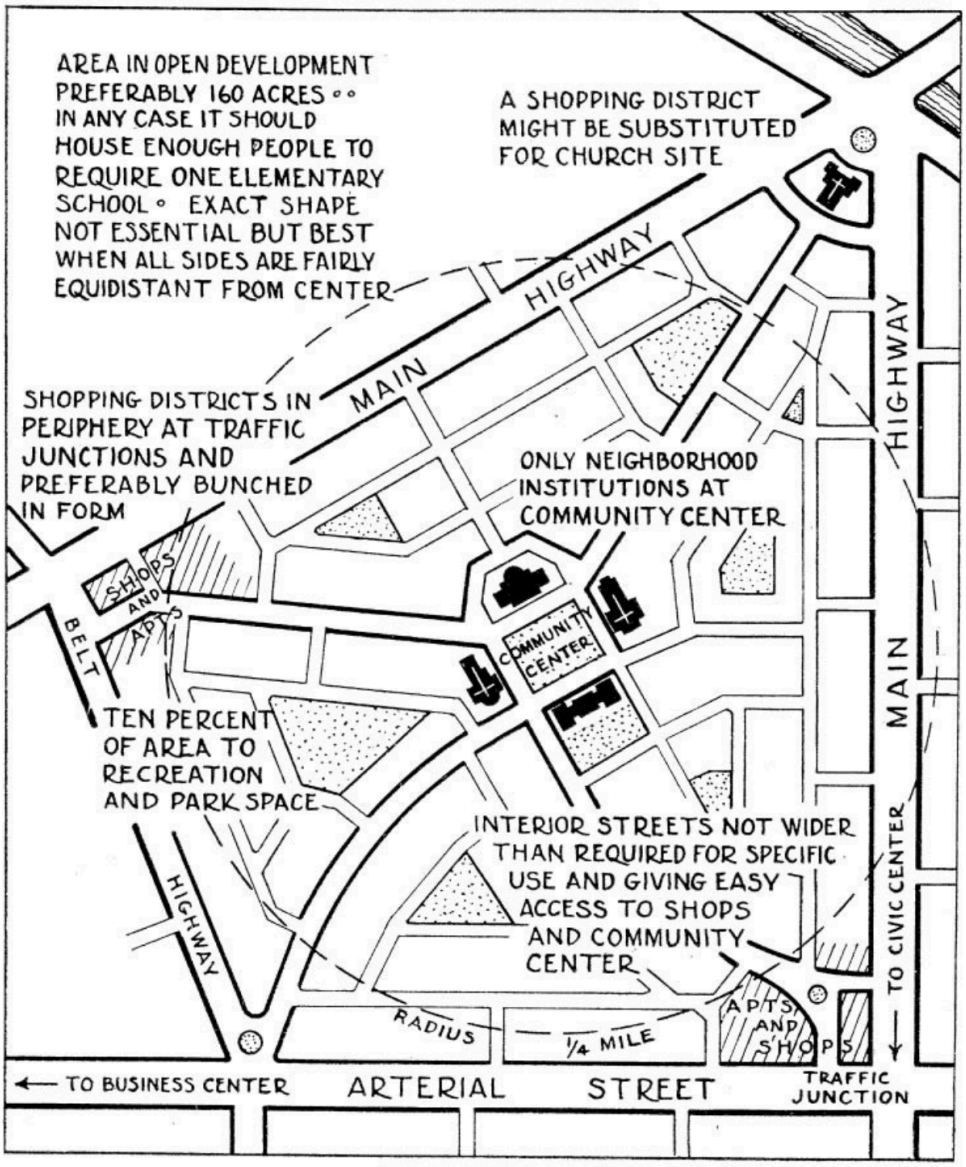


Figure 2 | Clarence Perry's Neighborhood Unit, (Perry, 1929)

Figure 3 | 15-minute city concept, Paris en Common

On the other hand, "dark stores" with their 15-minute delivery services are trying to reinvent new way of grocery shopping in cities by considering location, proximity to different land uses, density, and accessibility before selecting where they should be located. Professor Laetita Dablanc (Director of Research at the University Gustave Eiffel, Paris) talks about coexistence, in which the ultra-fast grocery delivery companies are targeting a niche population and will co-exist with traditional retail shopping (Raj, 2022). The grocery "dark" stores offer a political duality, an image of community life versus the realities of economic conflicts (Mayo, 1993).

There are pros and cons currently being debated among city officials about the growth of "dark stores" on how they could impact the presence of local retailers and the issue of no storefront, which declines the quality of livable streets. For decades, city planners have mandated street-level and mix-used retail zoning to keep more eyes on the street and make public places livelier as it enables the transfer of goods and services. Nevertheless, with the proliferation of 15-minute delivery services that rapidly increases during the COVID-19 pandemic, what defines retail spaces cannot be quickly answered. Does it require the space to be open to customers when traditionally, industrial uses such as logistics have been kept out of sight to support retail and not compete with retail? Should cities ban dark stores?

This thesis project will be grounded in chronological literature that examines the proliferation of online grocery shopping post COVID-19 pandemic and the impact of how platform urbanism (Shapiro, 2022) affects the spatial distribution of economic activity, accessibility in cities and redefine the shape of future cities. Grocery "dark stores", taking up spaces once designed to be open to the public and competing with local grocery stores, could risk entrenching the impacts that vacant real estate can have on the community (Waters, 2022). Numerous studies have focused on exploring the impacts of ridesharing service and redistribution of economic activity (Gorback, 2020), online grocery shopping and urban consumption behavior (Relihan, 2022), consumption values of cities (Glaeser, Edward L. et al., 2001), and urban retail vacancy (Talen & Park, 2021). This research seeks to further these findings, focusing on understanding the impact of online grocery "dark stores" on the urban fabric, which many have not researched.

1.2. Scope and Objective

Grocery "dark stores", through their 15-minute delivery services, change the way people grocery shop and the way economics work, influenced by urban density, proximity to order locations, and number of purchases (Wells, 2021). Arriving in every location within a city without planning or following proper zoning areas (Saltonstall, 2021), this thesis project aims to explore the impacts of online grocery shopping activities through grocery "dark stores" on the urban fabric, zoning, and land use. Therefore, relevant variables such as proximity to demographic characteristics, land use, and zoning will be analyzed to determine livable streets, neighborhoods, and communities within the presence of this new typology of retail space in cities.

1.3. Research Question and Hypothesis

This thesis project will investigate the following:

1. **What is the role of grocery "dark stores" (micro-fulfillment centers) in cities?**
    a. How has grocery activity evolved with the influence of technology?
    b. How these changes in activities produced a new form of retail space?
    c. What drives the demand rise for this new typology of store with the promise of "15-minute delivery" services?

2. **Where are grocery "dark stores" located in urban areas?**
    a. What factors are being considered in grocery "dark stores" location?
    b. What is the proximity of grocery "dark stores" location to these considered factors?
    c. Who are their target customers?

3. **What are the impacts of grocery "dark stores" to urban fabric?**
    a. How are grocery "dark stores" impacting zoning and land-use regulation?
    b. How are grocery "dark stores" impacting building façade design?
    c. Will grocery "dark stores" phenomenon stay?

4. **What should be the appropriate response for the presence of grocery "dark stores"?**
    a. How can urban planning practices enabled by technology and platform urbanism facilitate the provision of long-term planning of grocery stores in cities?
    b. What strategies can be employed to maximize the benefit of these grocery "dark stores" and minimize their impacts?
    c. What can we learn from this case to inform cities facing the presence of new type of intervention in store spaces enabled by technology and platform urbanism?

I hypothesize that grocery "dark stores" will become permanent fixtures of the post-pandemic economic landscape, sacrificing consumer-facing real estate and impact changes to urban public places. By addressing these questions, this thesis project seeks to establish the effects of digital sharing economy to the transformation of future cities and communities through the recent phenomenon of grocery "dark stores".

1.4. Structure

The organization of the following chapters will be broadly structured into two parts: theoretical investigation and empirical study. The first part will cover the growth of cities and the evolution of American grocery activities (Chapter 2) and digital transformation and the evolution of grocery store space (Chapter 3) to answer research question number 1. The second part will cover the presence and impact of grocery "dark stores" in NYC (Chapter 4 and Chapter 5) to answer research question number 2 and 3 (Chapter 5). Finally, the thesis will be closed with conclusions to synthesize the findings to the future planning of grocery "dark stores" in cities and the rise of platform urbanism.

1.5. Implications and Limitations

Implications

The implication of this thesis project is to understand the nature of the grocery "dark stores" phenomenon and their impacts on urban fabric – significantly as they are understudied. The presence of grocery "dark stores" is currently unregulated and arrives in every location within a city without planning or following proper zoning areas (Saltonstall, 2021). This could affect the small businesses and the local community in the long run. In New York, bodegas, convenience stores, and local

groceries have been representing the frontline of New Yorkers' food supply chain in the community throughout the city, providing affordable, fresh, and healthy food – quick service grocery delivery apps question their resilience and survival (O'Connell-Domenech, 2021).

By identifying proximity to urban density, land use, and zoning, this project hopes to determine the tools needed and some guidelines to ensure livable streets, neighborhoods, and communities with this new typology of retail spaces in the cities.

Limitations

Limitations of this study should be acknowledged to provide a clear understanding of its scope and applicability. Firstly, the study focuses exclusively on New York City, specifically within the borough of Manhattan. Therefore, the findings may not fully represent other regions or cities.

Secondly, the study is based on limited data availability, which may have restricted the depth and comprehensiveness of the analysis. The sample size used in the study was relatively small, which may limit the generalizability of the findings to a larger population. Additionally, the inability to obtain full access to information and interviews may have affected the completeness of the research.

Furthermore, it is crucial to note that this study only provides some of the answers to the questions at hand, and it claims to be a definitive source of information on the topic. Instead, it serves as an initial exploration, providing glimpses and insights into the subject matter that are currently still limited.

Despite these limitations, this study offers valuable preliminary information and is a fixed point for future research. It highlights the need for further investigation and can contribute to ongoing discussions and initiatives related to the topic.

Chapter 2 |
Growth of Cities and the Evolution of American Grocery Activities

2.1. The Definition of Grocery Store

The term grocery store changes constantly as new forms of food retailing appear and become part of people's lives. This definition suggests a general boundary for the examination of food retailing in the built environment, but it is not sufficient to explain the political, economic, and historical circumstances that give the grocery store its full meaning (Mayo, 1993). Based on North American Industry Classification System (NAICS 2012 – Code #4451), grocery stores comprise of establishments primarily engaged in retailing a general line of food products. Grocery stores are divided into two categories:

44511 - Supermarkets and Other Grocery (Except Convenience)

This industry comprises establishments, known as supermarkets and grocery stores, primarily engaged in retailing a general line of food, such as canned, dry, and frozen foods; fresh fruits and vegetables; fresh and prepared meats, fish, poultry, dairy products, baked products and snack foods. These establishments also typically retail a range of non-food household products, such as household paper products, toiletries, and non-prescription drugs.

44512 - Convenience Store

This industry comprises establishments, known as convenience stores, primarily engaged in retailing a limited line of convenience items that generally includes milk, bread, soft drinks, snacks, tobacco products, newspapers, and magazines. These establishments may retail a limited line of canned goods, dairy products, household paper and cleaning products, as well as alcoholic beverages, and provide related services, such as lottery ticket sales and video rental.

2.2. The Origins of Modern-Day Food Shopping: Public Market and The City

During the last century, technological innovations and societal changes were among the main drivers of how people accessed, obtained, and consumed food, causing the grocery space to evolve (Trigo, 2021) as seen on Figure 4. The US's first grocery activities and markets were transplanted from England and the continent during the colonial era. From the period mid-17th century's public market to 21st century's Q-commerce, the idea of grocery activities and space has evolved through time, population growth, urban and societal transformation, economic opportunity and challenges, and technological innovation.

Modern-day food shopping originated from the idea of public markets from the long urban tradition in Europe. The local government established market laws and constructed special buildings and spaces that demonstrated its commitment to protecting citizens from spoiled food, high food prices, food shortages, and merchandise that did not meet certain standard. The public markets were places where people of varying societal status could find fresh and healthy food at affordable prices while simultaneously enabling farmers to sell their harvest or handmade food merchandise (Albright, 2020). The market was orchestrated by local officials and the city's food purveyors, who were eager to achieve their mutual goal of provisioning the city (Tangires, 2008), serving daily shopper and travelers.

The close relationship between cities and the public market shaped the combined market and town hall spaces that still exist throughout Europe and the United States, such as Boston Faneuil Hall, which was built in 1742[2]. These spaces economized construction costs while keeping market activities off the streets. Market halls have the power to transform civic engagement while helping to create community and anchor development. However, despite its success in transforming city life, most of these relationships existed until the 19th century in the United States. In the 20th century, the private sector began to own, plan, and maintain public markets due to the growth of the free enterprise system (Mayo, 1993).

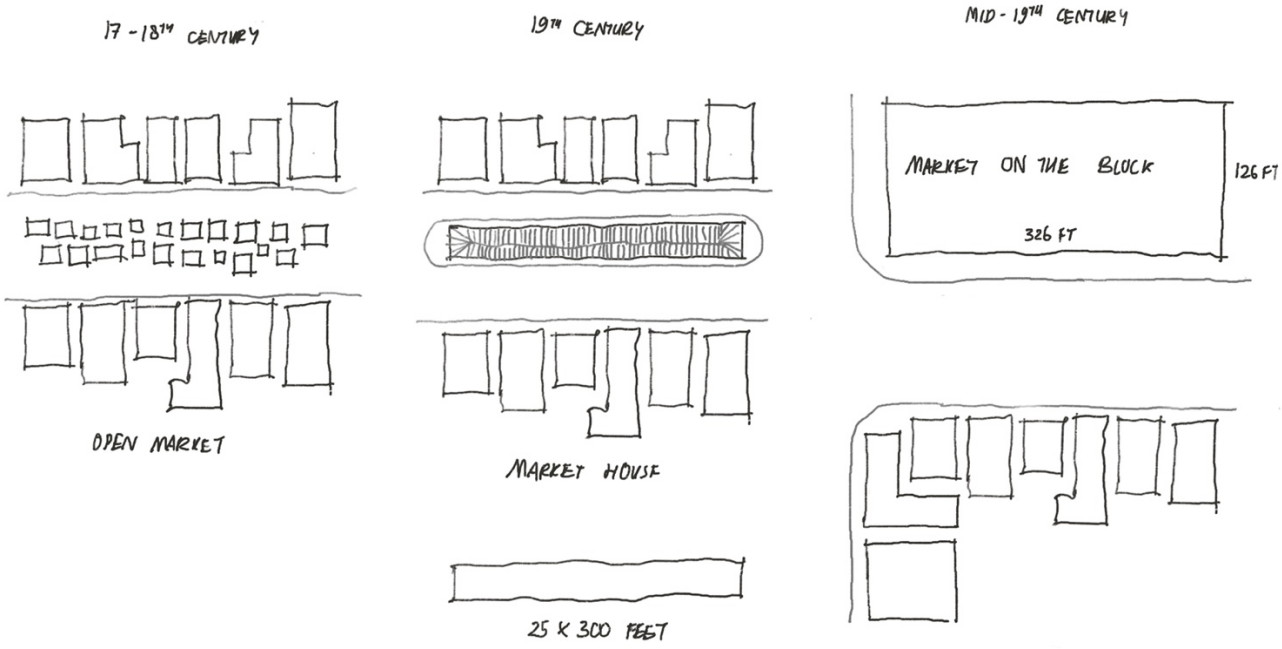


Figure 4 | Public Market and the City, Illustration by Author

[2] History of Faneuil Hall Marketplace, Faneuil Hall Marketplace, https://faneuilhallmarketplace.com/the-history-of-faneuil-hall/

2.2.1. The Open Market

The open market was a public facility without buildings or coverings in early colonial cities. The ideal condition to consider open market was that the size of the city should be sufficient, and the location must be convenient between buyers and sellers. Cities and public officials were the ones who controlled time and place to provide control over transportation and goods while also levying taxes and maintaining sanitation.

For most colonial cities, the best location for the open market was near the town's business center and town wharves, showing the importance of water transportation to a flourishing public market. The first marketplace in English colonies was in Boston in the mid 17th century. The now State Street was widened to 113 feet to allow for an open market in its center (Figure 5 and Figure 6). On other cities where there is no direct access of navigable water source, for example in San Antonio, the adaptation of grid layout was adopted according to the Laws of the Indies, influenced different best location for open market, which is more dispersed along the grid than being centralized in its downtown area. The grid plan was meant to meet the demand for speed, simplicity, and maximum economic return (Crouch & Mundigo, 1977).

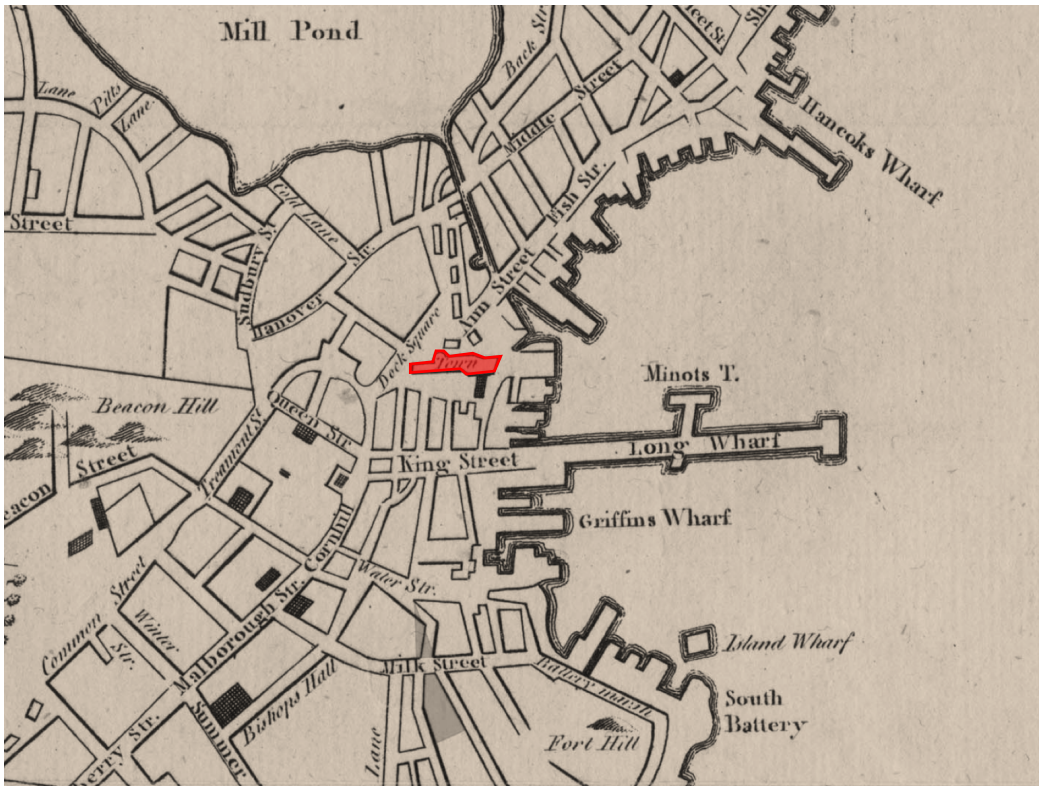


Figure 5 | 1775 Plan of Boston showing the proximity of open market location in now State Street (formerly King Street) to open water, Norman B. Leventhal Park, accessed February 6, 2023

Figure 6 | Open Market in Boston in the 17th century, The Boston Globe, accessed February 6, 2023

The open markets represented changes and stabilization of growth in the cities; it was valued as good governance and a way to protect the market from private enterprises. They were critical to the economic survival of a city because waste due to excessive competition could mean poverty and starvation for the community (Teaford, 1975). Following this tradition, the municipality in eighteenth-century America set aside public space and extra-wide streets for markets, built market houses as a shed for the protection of buyers and sellers, and established precise rules of commercial conduct in the form of market laws (Tangires, 1997). Since then, butchers, farmers, and customers shifted grocery activities in market houses than in the open market because they offered a more permanent structure to do business regularly and face any weather situation.

2.2.2. Market House

Market house were mostly built during an era of progressive regulations and new construction of municipally inspired and regulated food markets in the United States (Albright, 2020). In the 19th century, butchers, farmers, and customers wanted a permanent arrangement that enabled them to do business regularly in any weather situation. City leaders saw this situation as an opportunity to create a spatial economic system to profit from the food trade. City councils converted the vacant public property into an open market to generate tax revenues. They could put markets in locations

with no practical use, such as some Y-street intersections, which often resulted in street space not being used for traffic circulation.

The market house was the first significant design type to house public markets. It was located in the layout of communities with at least one wide street and built in the middle of the streets. The street market house was built in this location because the roads were public property, and by doing this, the city officials could avoid buying building sites on a city block. However, there were some limitations; the local market committee needed to ensure that the streets were wide enough to allow traffic to pass on both sides of the market structure.

This market typology was usually located on a major street that had been designated for public markets – 25 to 30 feet wide and 300 feet length (Figure 7). The interiors were arranged into functional areas, and sections were divided by meats, fish, vegetables, and other produces. Exterior unloading area were sometimes coordinated by food types and were adjacent to the interior retail stalls that sold the same type of food. Street market houses also served community building – local fire station or police stations were sometimes housed in these buildings. First floors were used as a market while second floor was often used as a community meeting place or other usage as (Figure 8).

Figure 7| Market Terminus, Market Street, Philadelphia, 1859, Free Library of Philadelphia

Figure 8 | Market Square Providence, Rhode Island, Providence Public Library Digital Collections, accessed February 6, 2023

Market houses in America followed the European public market model, particularly concerning their situation within a municipality as an essential part of cities and public life. They were centrally located within a downtown area or surrounding neighborhood with easy access to primary roads and waterways. These buildings were hubs for the town's social interactions and commercial transactions. The decision to build market houses demanded careful deliberation on the part of local government because the resulting building would be a city landmark mean to exemplify civic pride and validate a community's view of itself (Barnes, 2011). The decision-making process was complex and required government leaders to consider different factors: site, financing, public support, simplicity and flexibility in design, and a location convenient to buyers and sellers (Tangires, 2008).

The government paid for the market house and rented the stalls to food merchants in this market typology. The city provided the facilities as demanded and collected considerable revenue once the market house loans had been paid. By building this, city officials also improve the health standards for the city in case the butchered meat process in the open air creates a problem that causes dysentery. As cities acted as landowners and operators, they needed to manage the market houses. They started hiring market masters or clerks, responsible for seeing if public rules and regulations were obeyed and collecting the merchants' rents. The market committees established the rent

prices, which also reviewed and decided on complaints made by market occupants. The committee assessed fines and reassigned empty stalls as they became available.

2.2.3. Market on Block

In the mid-19th century, American cities became more extensive and industrialized. In addition, there were substantial population increases in American cities due to immigration and population movement from the rural areas. At this time, the attractions of city life, particularly employment opportunities, grew exponentially due to rapid changes in industrialization. However, despite the growth, cities suffered from the universal problems that rapid expansion brought, including concerns over housing, living conditions, transportation, and communication (Corbett et al., 2014).

Figure 9 | Gansevoort Market, New York, foodandcity.org, accessed February 6, 2023

Market houses created street congestion (Figure 9), and a few cities found it necessary to make some adjustments. Indeed, from the 1830s, the system showed signs of malfunction. Demographic growth, a rising free-market ideology, and weakened municipal commitment resulted in the inadequate infrastructural expansion (Baics, 2017). City officials began to build new market houses on city blocks to eliminate many market houses. Not only business interests saw these markets occupy valuable space in the city that could be used for more profitable purposes, but also, with the invention of streetcars, city officials removed market houses located on the streets to install streetcar tracks. Moreover, as cities grew larger, bigger market houses started offering a wider

variety of goods under one roof. However, the expansion makes people walk longer. Therefore, the typology of market houses needed to be more rectangular than one long linear building (Figure 10 and 11), such as 50 x 290 feet in Baltimore and 126 x 324 feet in DC (Mayo, 1993). The size of market houses on city blocks varies depending on the geographical location and space availability.

The placement of the market house on the block resulted in two basic approaches: keep the same basic plan as street market houses, but with modifications and a completely different plan and structure, as the linear design plan was abandoned by building an almost square structure with a covered quadrangular court in the center (Mayo, 1991). The main advantages of these design approaches are economic benefits and flexibility in the design of the floor plans. However, the new markets were mainly privately owned. In this era, people started caring more about good design, especially architectural components such as façade design and ornaments.

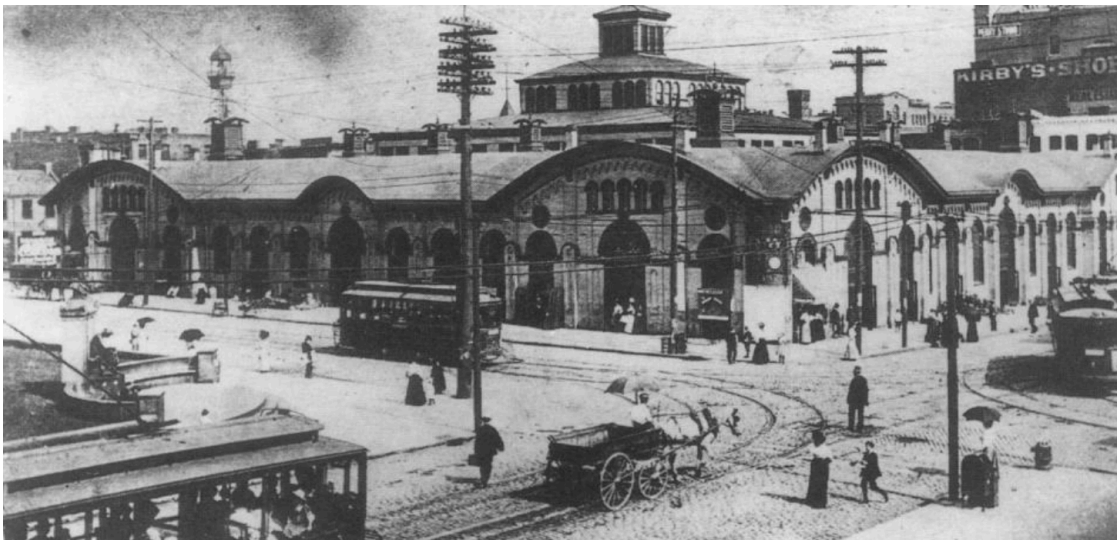


Figure 10 | Allegheny Market, Pittsburgh, Early 1900s, Carnegie Library, Pittsburg

Figure 11 | Lexington Market in the 1920s, Baltimore

2.2.4. Social Life and Public Market Politics

The social life of public markets has always been colorful, active, and a political reflection of American's economic life (Mayo, 1991). Social class forces and economic influences were interwoven in the creation of the public market as a political place in the city. Not only social class forces but the political-economic forces of municipal control and private enterprise also shaped the design of public markets in the United States. As cities developed, open markets were replaced by architectural structures located in the street. In addition, population growth leading to traffic congestion resulted in architectural changes and market standardization.

The public market was also shaped internally by the business activities of stall merchants. Determining which merchants could use which space influenced how market life was economically and politically reproduced. The primary public market space players were street vendors, butchers, hucksters, and farmers. Butchers and hucksters were the leading players for space on the market and depended on daily trade sales in a fixed space for their profits. On the other hand, street vendors were unable to maintain their food trade and the merchants inside. Therefore, they rented food-stand space along the market houses outside walls that faced the street.

The street was prolific with human activity. The amount of business conducted within the market houses was enormous, however, it was surpassed by the aggregate transactions of the street stands and retail stores in the immediate vicinity, which to a stranger appear as a continuation of the market itself (McCabe & Wolfe, 1984). Market house merchants considered street vendors to be a nuisance as they made the streets more crowded and promoted loudly to potential customers the quality of their produce. However, they generated foot traffic for the merchants inside, and the market house merchants benefited from the chaos of street vendors.

2.2.5. New Trends and Modern Dilemmas

In the early part of the 20th century, the design of public markets was responding to new technologies that influenced how American buildings were built. These changes in approach to designing space and buildings influenced general changes in market operation that were paralleled by new management methods and problems in public market management. More public markets were privately owned rather than built and controlled by local governments – running a market became more competitive. As a result, market owners needed to adopt a more effective business strategy to keep low overhead costs, high volume turnover in market stalls, effective sales promotion, and well-planned building improvements, to meet the needs of stall merchants and to satisfy customers.

With property, fixed structure, and expensive mechanical equipment having to be bought, market locations for public markets became a necessity and market owners became more aware of site location (Mayo, 1991). Market experts recommended that the public market would be best located near department stores because the people who shopped at department stores were often the same people who visited the market (Kerbey, 1921). Locating a public market meant to decide on how to optimize private enterprise opportunities within a network of public city space.

However, despite population growth, economic development, modernization, and improvement in market management, the public market began to face difficult times caused by its system and changes in American businesses. After the suburbanization era, public markets started to have problems with the other food retailing businesses, such as the grocery store. Although customers had always depended upon the principle of getting a large variety of fresh goods through the public market, at the same time, grocery stores offered home delivery services and decentralized locations nearer residential areas.

Moreover, as American cities grew in population and became more suburban, land use issues created another dilemma for public market location and land use arrangements. The city center became more commercial with lesser residential use, and the competition for urban land increased. The high land prices in the city center made it more difficult for the public market to maintain profit margins. In the end, neither municipalities nor private investors in the public market were willing to enter a fierce bidding war for urban land. The rise and fall of public markets reflected the transition of the American economy from local mercantilism to national corporatism (Mayo, 1993).

2.3. Evolution of American Grocery Activities & Space

The history of grocery activities is a history of economic competition over space and is historically inseparable from its growth as a retail industry, transportation, and cities. Although the public market was the main source of retail food trade from the colonial period to the early 19th century, grocery stores had always been an influential food source and evolves in space throughout times (Figure 12). In the early 19th century, grocery stores offered convenience and specialty products as they were located more sporadically than in the public market. In rural areas, as public markets were temporary, people commonly got things from general and country stores for primary food sources. Until the 20th century, the retail food system in the city was a dual system of the public market and small grocery stores (Mayo, 1993).

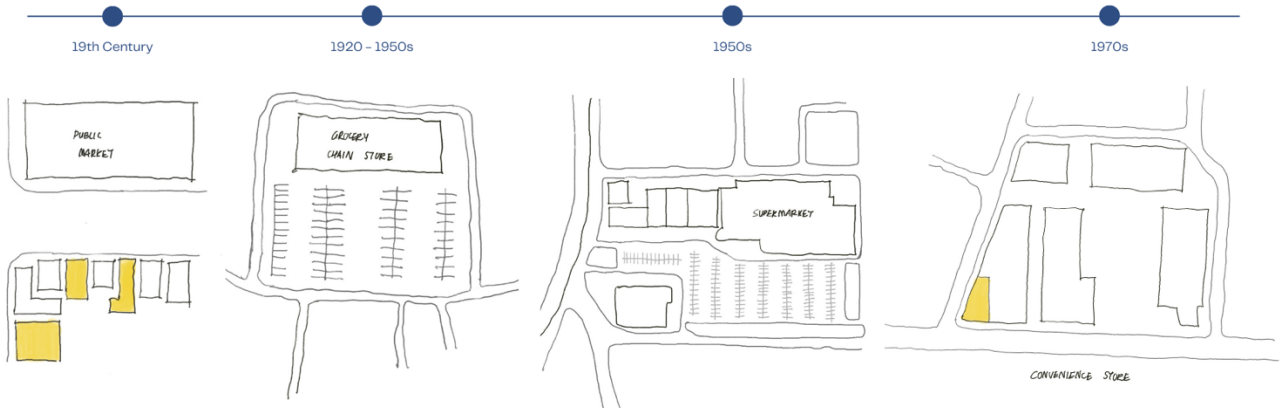


Figure 12 | Evolution of Grocery Activities and Space, Illustration by Author

2.3.1. From General to Grocery Store

America's first grocery store was the general store that appeared in a larger city during the 17th century. A grocery store was called a "general store" until the mid-19th century (Mayo, 1993). General store dominated grocery trade in small towns and in the hinterlands, serving the surrounding communities and farmers from the neighboring countryside and carried a wide variety of goods, including food, clothing, housewares, and farm equipment (The Editors of Encyclopaedia Britannica, 2002). In larger cities, grocery stores complemented the role of the public market as a go to place for finding groceries every day instead of only two or three days a week in the case of the public market.

Grocery stores were located adjacent to public markets. While public markets sold perishable goods such as fresh meat, fruits, and vegetables, grocery stores typically offered specialty items such as sugar, chocolate, cheese, oatmeal, coffee, tea, fruit, olive, and wine – some non-perishable goods. These items were primarily imported and served the needs of the upper classes, who wanted specialty items. (Mayo, 1993). However, there were some small stores serving the hand-to-mouth trade of lower classes who could neither afford to buy groceries in quantities nor pay for the best quality (Bridenbaugh, 1971).

The growing number of United States population provided the increasing number of customers for grocery stores resulting in lower retail prices. Some grocery owners keep their general store by selling daily grocery and household items, while some other store owners expanded their business into different business interests in other trades and financial ventures such as selling liquor and spirits, to expand opportunities, diversify their capital, and be more profitable.

Store Location

In the early 19th century, some metropolises in American cities were 5 to 10 times larger. Grocery stores were located among continuous rows of offices, businesses, and tenements. As urban land became most valuable due to limited land, grocery storekeepers needed help to sustain their profitability. As a result, it made more sense for them to locate near a suburban residential area where land cost was cheaper, shifting customer demand into the area (Klein & Kantor, 1976). Store architecture and site planning were reflection of store requirements and local building practices for mixed use development. Upper floor space in a building was used by storekeepers as a home or leased as a housing quarters (Atherton, 1971).

Grocery stores in the suburban area gained benefit from this, and there was a density to attract these customers in the suburban area to buy at their stores. Besides, at the end of the 19th century, mail-order grocery shopping was becoming a trend. Mail order companies supported a congressional bill[3] for rural free delivery parcel post. Home deliveries in the suburban area were faster from the city due to congestion and transportation problems. However, suburban locations meant higher costs for grocers because jobbers had to travel farther to deliver goods to the stores. During mid 19th century, chain stores began to reduce wholesale costs and organize shipping trips for multiple store destinations rather than making a single trip. By doing this, a company could purchase in volume to balance the cost for grocers.

Store Design

The store architecture was designed to match different economic and spatial limitations in the city, small towns, and rural crossroads affected by population growth and technological developments such as railroad transportation and mass production of food. As cities grew, dense development forced city officials to be more aware of coordinating the configuration of streets and blocks. People preferred to make shorter trips to buy their goods. The spatial barrier of city size were minimized by townspeople using land use density as an economic means to reduce travel time within the city (Mayo, 1993). These challenges of growth combined with increasing business competition helped to shape the architectural spaces that enabled grocery stores to sustain a sustainable business. Glass window invention in that era transformed how food products can be displayed. The impulse to decorate extended outward through the large, plate-glass windows fronting stores, transforming what had been a practical way to illuminate shops into a selling technology (Spellman, 2016).

[3] Rural Free Delivery, Wikipedia, https://en.wikipedia.org/wiki/Rural_Free_Delivery

2.3.2. Grocery Chain Store

Chain stores were seen to maximize dollars with a given building space. This type of store relied on bulk buying to reduce costs. With several stores, chain store owners could oversee many stores and maintain organizational economies. Home delivery in the city now became a necessity, and each independent store needed to have a delivery wagon, a horse, and a driver. By having chain stores, these resources could be shared between stores. As a result, delivery requirements could be lesser because people could decide to go to the store with the same quality of goods somewhere nearer where they live. On the other hand, food stock items in one store could also be shifted to another in cases where temporary shortages of goods existed. The big advantage of a chain store was the ability for the store owners to plan efficiently for unified system of bookkeeping, system evaluations in different stores, and creating consistent image of "brand awareness".

Store Location

During the early 20th century, grocery chain stores were proven to be more resistant to economic depression. This was the era of suburbanization of chain stores where the number of chain stores in the 1930s in the suburbs grew 4 times bigger than in the 1920s for about 30,453 stores (Mayo, 1993). These stores considered the ability to do bulk buying and started analyzing good locations to be located in. American strip development began after trolleys extended into the countryside, and commercial development in the suburbs followed the presence of rail lines. Real estate investors saw that these locations could generate profit because of their density. To exploit the new market opportunities, grocery chain store was better prepared than their competitors to select the best locations with the lowest rental rates along or near suburban trolley routes.

Store Design

Corporate chain stores began to modify store design and manage standardization. The store's economy was designed as a factory assembly line for consumption. Store owners chose the lower-rent side street location over higher-rent locations on the main street and picked locations based on foot traffic. The economy store has no place attachment to the local community as mom-and-pop stores did. The chain store floor plan was not designed to handle lots of customers. The layout was modified as a counter-and-wall system where the packaged goods lined the walls and were stacked almost to the ceiling on the extended shelves. The display was put behind a counter where customers could view the wall displays and request a clerk to help with their selections. This type of layout's downside was labor intensive as a clerk was assigned to serve individual customers.

Home Delivery

As the chain grocery stores were expanding into rural America, a new form of chain retailing was also moving into suburbia: home delivery, as there were no sufficient means of transportation for carrying groceries. The traditional home delivery practice was for a homemaker to personally place an order with an independent shopkeeper for staples such as flour, butter, salt, sugar, coffee, tea, bacon, or lard. As a convenience and sign of personalized service, he would then select her items and have the large bundles of provisions delivered to her home later in the day by a delivery boy (Muller, 2015).

Home delivery companies exploited the last geographic gap of suburban retail grocery trade. They carried food goods by wagon and eventually trucks to suburban neighborhood. However, delivery wagons and trucks were designed to offer only a few select goods that salesmen could sell competitively against nearby grocery stores. Most home-delivery companies limited sales to fewer than two hundred items and some companies regularly sold less than 100 types of goods (Mayo, 1993). With this opportunity, larger home delivery companies started to sell their own food brands to create brand loyalty and entice customer to depend on home delivery due to some specific products. The chain store system started to become a serious threat to the independent system of grocery retailing and wholesaling which were relying on a multi-tiered system of self-employed business.

However, home delivery in the suburbs has its own difficulties. The general delivery life cycle should be thought of as "pickup – transport – drop off". In suburban areas, the "transport" segment is most of this process. This is because areas are spread out over greater distances and traffic patterns can dramatically impact transit times. Optimization of suburban logistics is a two-dimensional problem in the sense that retailers have to worry about the flow of goods in a flat plane: north-south and east-west.

In urban areas, such as Manhattan, small neighborhood grocery chains served as community hubs and offered delivery services to nearby residents. Customers would provide their grocery lists and the store employees would pack the items and deliver them to customers' home (Ruhlman, 2017),

Store Warehouses

Due to bulk buying, it was important for chain store owners to have their warehouses to manage their inventory. Chain store warehouses were often located as a hub for the stores in the chain to help minimize time and transport costs between stores and warehouses, contradictory to the

tradition of locating warehouses in the warehouse district. The hub approach is also used to serve geographic regions to reduce costs. The chain store warehouse was designed to be smaller than the facilities in the 19th century.

2.3.3. Supermarket Evolution

A supermarket was defined as a highly decentralized retail establishment wholly owned or concessions operated with adequate parking space and doing a minimum of $250k annually and must be on a self-service basis (Zimmerman, 1955). Between the 1920s to 1930s, the term supermarket came as developers started building malls that included grocery stores as their tenants, and grocery chain stores in the 1920s made way for the supermarket in the 1930s. Most independent grocers organized affiliated independents to compete economically against corporate chains. They informally joined together to do cooperative buying and selling to reach their quantities for bulk buying. The supermarket was 5,200 - 6,400 sq. ft big compared to chain stores that were only 500 - 600 sq. ft (Mayo, 1993).

During the World War II, supermarkets were expanding, and grocers were converting to a high-volume level of trade by increasing store size – stores were more distant than others, independent stores were closing, and supermarkets emphasized providing large parking lots. In addition, labor shortage after the war pushed the direction for self-service grocery buying. In the postwar boom era, suburban movement flourished and the supermarket flourished with it. Many small stores were eliminated. By 1988, the largest chain supermarket had amassed enough real estate to build out even bigger "supercenters" (Trinidad, 2020). These supercenters offered a wide array of services, including banking, photo development, pharmacy needs, and floral arrangement.

Self-Service Food Shopping

Piggly Wiggly was the first chain store to come up with the self-service system and opened on September 6, 1916, in Memphis (Belasco & Horowitz, 2009) due to the innovation in individual packaging and mass-marketing of food products. Customers were attracted to the clean and orderly environment of the self-service grocery. Historian Tracey Deutsch argued that self-service chain stores were popular among Chicago consumers, particularly women because they can have lesser interaction between grocer and customer, especially based on disagreements over the price or quality of goods or the stress of hassles over credit (Belasco & Horowitz, 2009).

Figure 13 | Piggly Wiggly Store, Wikimedia Commons

The concept of self-service established a blueprint for the price-oriented, multi-department supermarkets that gave birth to modern supermarket retailing. Any of these early supermarkets were built inside buildings that had previously served some other purpose. Failed bank buildings were abundant in the years after the Depression, and other buildings, including former garages and roller rinks, also were well-suited to these cost-cutting entrepreneurs. By the late 1930s, large grocery-store chains, which included Kroger, Safeway, and others, in addition to A&P, began rolling out large, multi-department supermarkets of their own (Boss, 2022).

In 1937, the shopping cart was invented to create a solution that would encourage customers to keep shopping. Before this solution, grocery stores provided customers with a small wire or wooden basket to carry their items while shopping; however, the number of items was minimal. Grocery chain owner Sylvan Goldman noticed that at his Humpty Dumpty supermarkets, customers would start to head for the registers once these hand-held baskets got too heavy (Trinidad, 2020).

Real Estate Investment

By the 1950s, grocery management started to develop a real estate investment plan to buy, build, sell, and lease back policy because owning and leasing their own space worked best when retail trade areas for their supermarket remained fixed than changing with the booming suburban expansion (Cramer, 1973). Grocery management bought the land and built a store building to meet market needs and plan an exit strategy to sell the property to large banks and insurance companies from whom they leased the property (Mayo, 1993).

The reasons for this sequential strategy were twofold. Firstly, the grocery management was able to design a store to meet their needs and maximize profits, which took much work to do when working with a shopping center developer. Secondly, corporate management was able to free up investment capital and remain flexible with their store locations. Corporate management could secure new building loans with their freed-up capital by having an exit strategy and leasing the properties. Thus, their capital was permanently resolving from one store to the next. Corporate management gained mobility as they could discontinue the building lease and locate their store somewhere more profitable.

Store Locating Trend

As suburban expansion occurred, methods of locating new supermarkets became important. Some store owners were pragmatic in selecting locations, such as Kroger, which was looking for the concept of the similarity of experience. As a result, corporate management chose locations similar to the other Kroger store sites that have been proven profitable (Markin, 1968). George Jenkins, the owner of Publix chain in Florida, mentioned that they have an instinct for going into an area and getting a feeling of whether certain areas have growth potential (Mayo, 1993). Part of the instinct was observing the housing pattern near the sites and the roads and highways leading to it from the helicopter. These pragmatic approaches were based on successes and aggressive acquisition of the sites that fitted the chain's site location criteria.

Some stores began to emerge systematic model as analytic techniques to forecast new site locations by analyzing population trends, income patterns, transportation networks, city planning requirements, and store saturation. Store saturation was calculated through quantifying the amount of total food sales divided by the square footage of retail grocery space available. Corporate management chose the area with the highest index of supermarket saturation while food sales per square feet had to be profitable (Markin, 1968).

Total food sales

$$number\ of\ consumers\ in\ an\ area$$
$$\times\ average\ food\ expenditure\ per\ customer\ in\ the\ area$$

Store Saturation

$$total\ food\ sales\ \div\ sq.footage\ of\ retail\ grocery\ space$$

These locational techniques enabled grocery management to assess store location opportunities in a unified manner than through ad hoc expansion. In addition, by reanalyzing the location of older stores, management could estimate the continued viability of a location.

Store Design

Due to the highly competitive landscape, storefront design has become more fundamental. Storefront enabled people to sense the variety of gods and the store's quality. Storage in the stockroom had to be reduced significantly to put into open displays exposing more items to customers to see and touch the items. Hence, product organization and store layout became major concerns – merchandise was now more systematically organized, price tag became an important element, and store owners adopted a strategic design for customer movements. Some grocery chains and affiliated independents attempted to relate the design of supermarkets to the surrounding areas and starting to reconsider the interior design.

Self-service shopping transformed the interior of a store through a complete reorganization of goods and an investment in new fixtures and finishes in stark contrast to the disorganized sights and smelled of old-fashioned grocery interiors (Belasco & Horowitz, 2009). The interior emphasized cleanliness and visual order, which echoed the advice of popular magazines and domestic scientists that promoted new standards of cleanliness and sanitation in the Progressive Era. Besides, grocers also started to think about how to make self-service work in some narrow store interiors of existing commercial blocks and how to prevent shoplifting. They were concerned about the interior design for creating pathways through stores that were small and narrow, mostly on downtown lots.

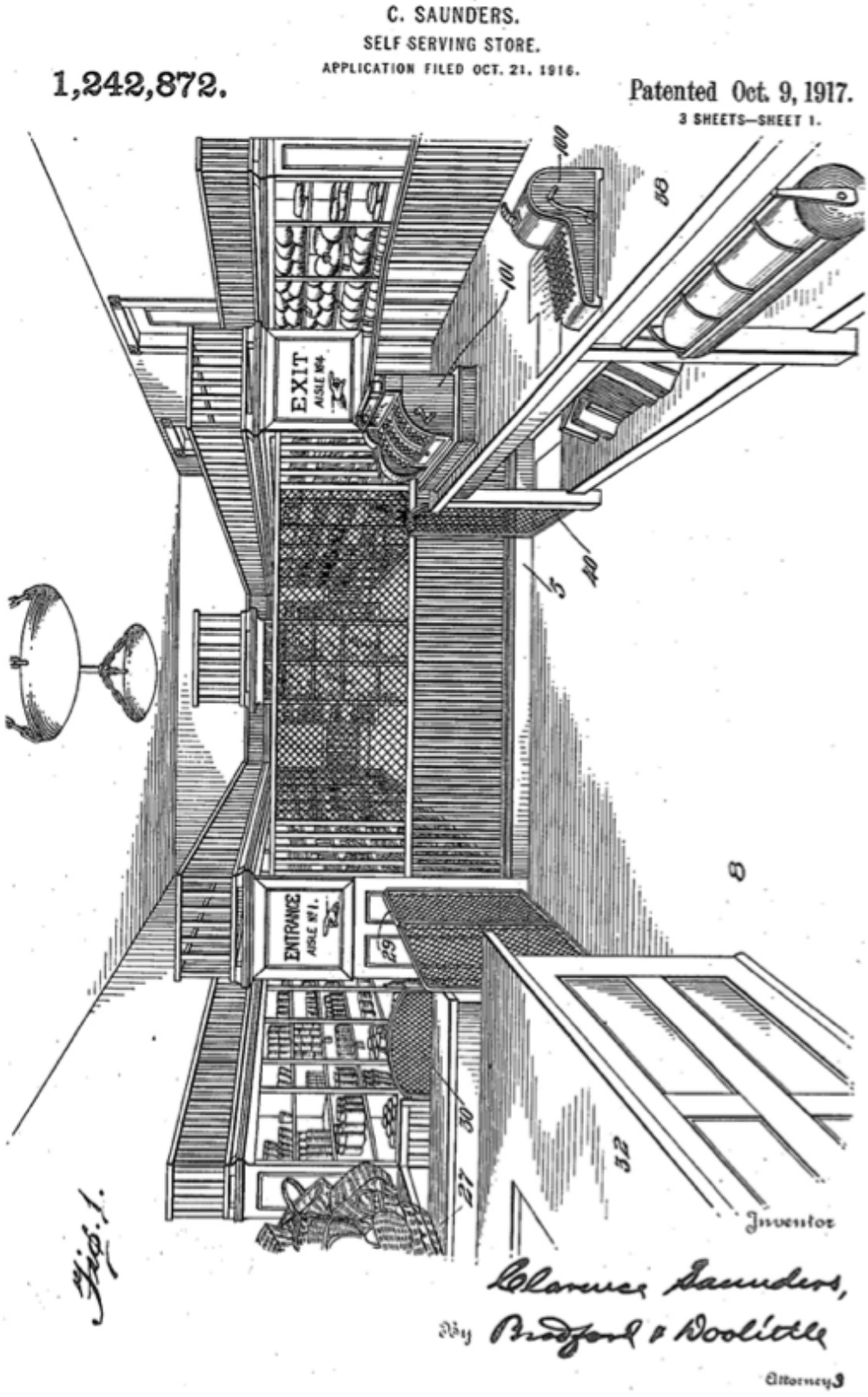


Figure 14 | Early Piggly Wiggly Store Concept, Patent No. 1242879, United States Patent and Trademark Office

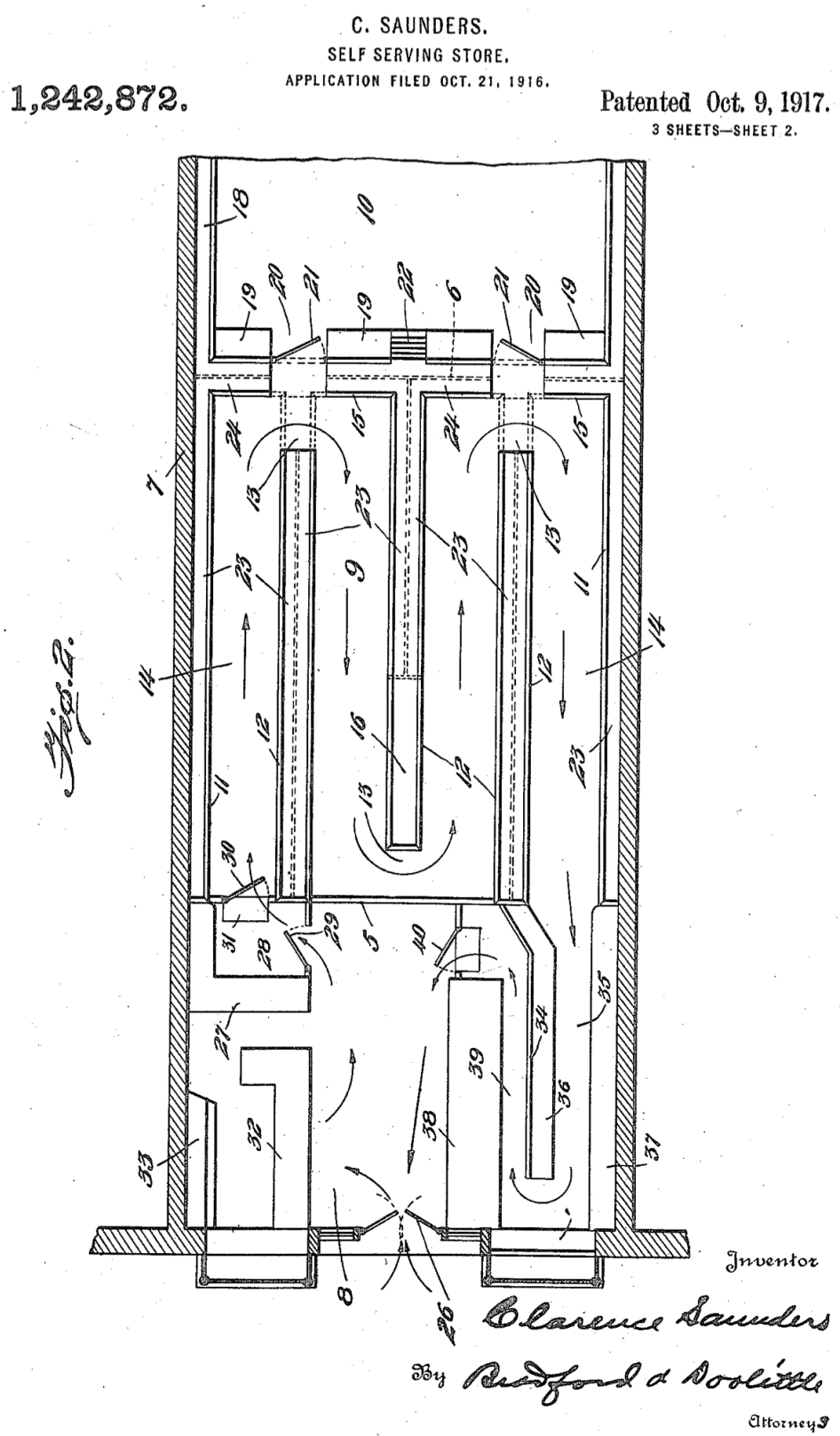


Figure 15 | Saunders's first patent regulated the one-way path with a series of swinging doors, Patent No. 1242872, United States Patent and Trademark Office

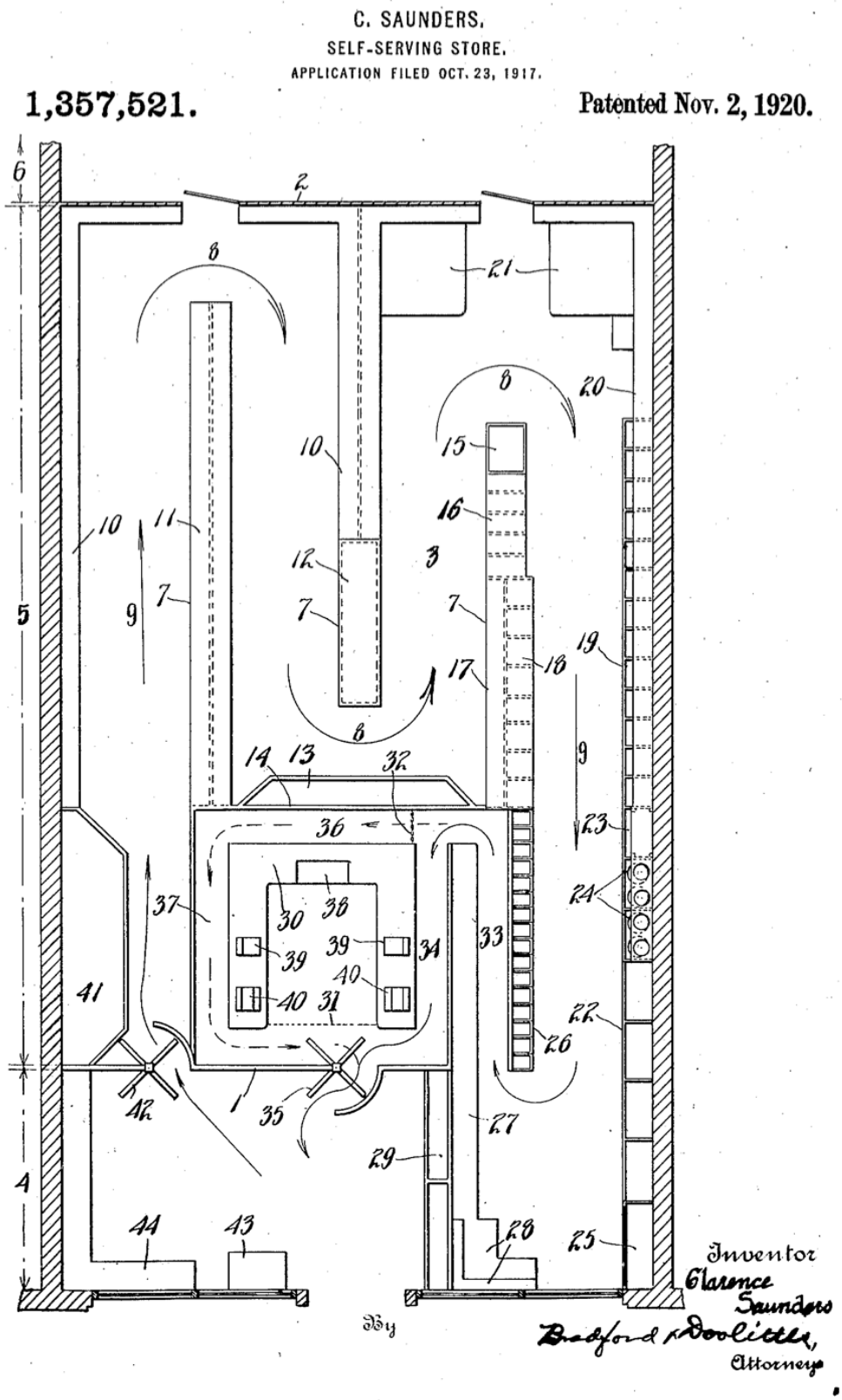


Figure 16 | Saunders's first patent regulated the one-way path with a series of swinging doors, Patent No. 1357521, United States Patent and Trademark Office

2.3.4. Convenience Store

Until the 1970s, Americans were accustomed to the supermarket operating only until 8 pm and being closed on Sunday. Although the supermarket was a retail powerhouse, business interests realized that its spatial and time gaps could be exploited. The convenience store emerged as the solution of the space-time limitation of supermarket. The growth of the convenience store became evident after the World War II when automobile ownership began to increase significantly. At the same time, suburbanization of America and the supermarkets' displacement of small grocery stores created the opportunities for convenience store owners to identify spatial gaps for their market niche. They managed the time gap with longer store hours.

During this period, some companies attempted the idea of an automated grocery store. However, this was a short-lived phenomenon because customers wanted to be served. At the same time, these stores did not carry goods as diverse as the typical convenience store. Convenience store was designed to look after moms and pops stores in the 1920s. The size ranged from less than 1,000 to 4,000 square feet with parking spot for 5 to 15 cars (Mayo, 1993). Convenience store emphasizes self-service, high turnover of a limited assortment of food items and convenient location.

Figure 17 | The Southland Ice Company, one of the early convenience stores in the US, National Association of Convenience Store

2.3.5. The 21st Century Trend: Grocery Delivery, Curated Store, and Quick Commerce

In 1989, brothers Andrew and Thomas Parkinson founded Peapod, the first online grocery delivery service (Trinidad, 2020). The concept was to let customers to install software from CD-ROMs onto their computers to place orders. The brothers would hand-pick the desired items at a local grocery store, allowing customers shop remotely and get their groceries delivered to their doors.

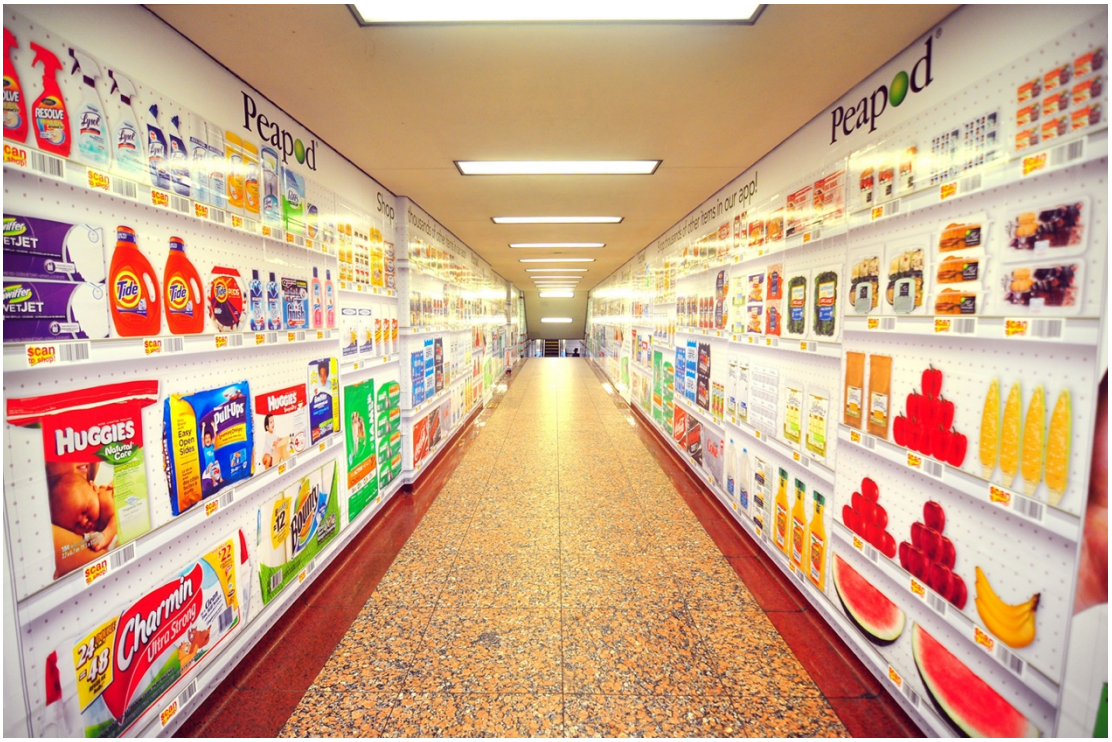


Figure 18 | Peapod, US first online virtual grocery store, New Hope

In 2007, Amazon adding an online grocery delivery service in selected cities under the name Amazon Fresh. The tech giant offered convenience and value in which the online store could draw from its thousands of products outside of just grocery products, but also household goods (Trinidad, 2020). As retail trends moved toward automating, the cashier-less store concept started to pop up. As a result, Amazon took on the task of implementing an automated customer experience in brick-and-mortar storefronts.

As grocers look to step up product discovery and make their aisles of packaged goods less drab, a pop-up retailer is showcasing a few ways to shake up the grocery shopping experience. In 2019, Emily Schildt came up with a concept of a curated shopping experience for consumers seeking

on-trend food products without having to wade through traditional grocery items to find them[4]. Each pop-up location has between 120-150 brands, which are essentially food and beverage but also include pet, body care, and sometimes home care in spaces that are roughly 1,000 square feet (Moran, 2022).

Figure 19 | Customer shopping at Pop Up Grocer in Washington D.C., Grocery Dive

The awareness of curated products, convenience, and on-demand delivery services has allowed the concept of quick commerce and "dark stores" to emerge. "Dark stores" are in retail storefronts on main streets, near the heart of busy neighborhoods, but they serve only e-commerce customers. And they have gone from a niche phenomenon discussed broadly in retail industry circles to a feature of major American cities (Waters, 2022). The rise of "dark stores" directly parallels the acceleration of e-commerce, especially in the grocery industry. Online sales represented 13% of all grocery spending in 2021, and dark stores are designed to make the delivery process smoother in 15 to 30 minutes delivery.

[4] 12 Under 35: Emily Schildt, Founder, Pop Up Grocer, Mark Hamstra, September 1, 2019, https://www.specialtyfood.com/news/article/12-under-35-emily-schildt-founder-pop-grocer/

Chapter 3 |
Digital Transformation and the Reshaping of Grocery Retail Value Chain

3.1. The Internet and The Reshaping of Retail Value Chain

The retail economy has undergone massive changes in the last decade. Digital transformation is real and widely pervasive, and its implications are obvious in the retail industry, which has traditionally been known for retail competition and narrow profit margins (McKinsey & Company, 2020). This transformation started in 1995 when the "dotcom" bubble started to burst out until 2001 when internet-related technology companies attracted massive attention from venture capitalists and traditional investors alike (Salvucci, 2022).

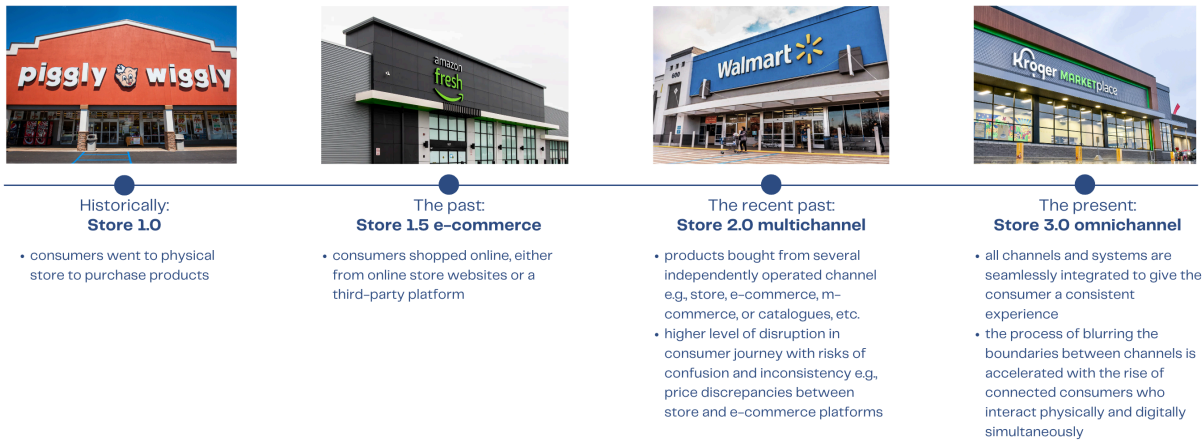


Figure 20 | Digital Disruption and the Growth of Omnichannel, Deloitte Consumer Review, Digital Predictions 2014

The Internet emerged from the interweaving of computer and telecommunication technologies and, in less than four decades, has been transformed from an obscure piece of technology of interest for defense into a communication and network used by businesses and consumers around the globe (Stobart & Howard, 2019). The web, web browsers, and search engines, with their free access to anyone with a dial-up Internet connection, were fundamental to the growth of online retailing and online shopping. By 1995, this new set of infrastructure attracted global attention from businesses and shoppers, and so did the number of commercial websites offering a range of information-based and interactive services (Pyle, 1996). More severe attempts to buy and sell things online emerged near the end of the 1990s when technically savvy companies responded to the opportunities and challenges posed by the internet to develop sophisticated websites serving customers in their homes (Stobart & Howard, 2019).

For the past two decades, the rise of online and catalogue purchases have begun to cut significantly into sales by many forms of brick-and-mortar retail stores (Stobart & Howard, 2019). Both data analytics, digital marketing tools, and technologies enable retailers to target individual consumers in contrast to mass marketing and foster more innovations (Strycharz et al., 2019), while from an operation perspectives, retailers are now able to fulfill order and deliver to customer faster and more flexibly (Marchet et al., 2018). Digital transformation has transformed retail value chain from store operations, manufacturing to supply chain activities and identify the critical drivers for these changes (MacCarthy & Ivanov, 2022).

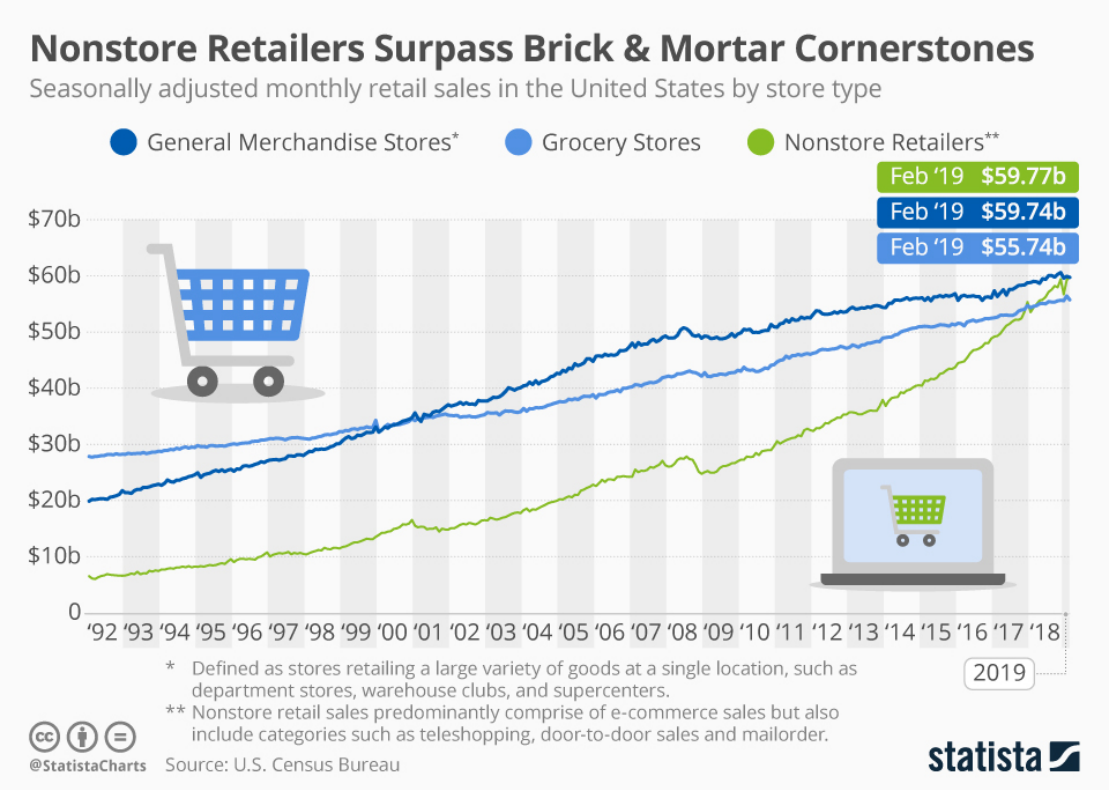


Figure 21 | E-commerce versus In-store Sales, Statista

3.1.1. Technological Innovation and Digitalization in the Retail Value Chain

During the last three decades of the 19th century, several factors contributed to the transformation of the American history of food supply from originating in regionally based economies to being mass-produced on a national scale[5]. The new transportation network of railroads throughout the country, communication structure, and population growth had increased consumer demands and opportunities. In addition, the growth of chain store retail formats after World War II also led to

[5] Big Business: Food Production, Processing & Distribution in the North 1850-1900, American Antiquarian Society, https://www.americanantiquarian.org/Exhibitions/Food/manufacturing.htm

the decentralization of many manufacturing activities as chain stores dealt directly with food manufacturers and efficiently designed their stores for volume business, as did the manufacturer's factories (Mayo, 1993). Manufacturing and technological innovation helped shaped the evolution of grocery business.

The transformation began in the 1920s when the innovation of tin and refrigeration changed the world of food processing and evolved grocery stores (Ruhlman, 2017). Electric refrigeration, which did not become commercially viable until the 1920s, allowed the creation of the supermarket. This single store sold groceries, meat, seafood, dairy, and products. In the 1930-the 40s, supermarkets went big, and grocery stores were primarily filled with food that could sit on a shelf for a long time. After World War II, America entered its economic boom years when supermarkets grew between 3,000 to 30,000 square feet. In the 1960-the 1970s, supermarket size increased by three times, up to 90,000 square feet. As a consequence of this increase in size, supermarket owners were trying to save money and work more efficiently through such expansion by building a central warehouse and production facility (Ruhlman, 2017).

Warehouse proved to be the company's saving grace when many family-owned supermarkets could not efficiently distribute goods to their far-flung stores as they could no longer compete on price and were bought up by multinational food retailing companies. In the late 1990s, the emergence of the large retail chains such as Walmart prompted many large manufacturers to develop closer relationships with retailers, enabling FMCG (Fast Moving Consumer Goods) players to thrive and become increasingly integrated with retail activities. For example, by sharing demand and supply data, both retailers and manufacturers could develop win-win value propositions and maximize their business efficiencies (MacCarthy & Ivanov, 2022).

Data and IT started to play significant role in the digital transformation of manufacturing (Hänninen et al., 2021) and the increased digitalization of retail has enabled retailers to aggregate data form across the retail value chain to better and more efficiently customer needs, wants, and expectation (Evans & Kitchin, 2018). The first barcode standards introduced in the 1970s enabled more sophisticated product identification and provided the foundations for automatic replenishment and more efficient inventory management practices (Hänninen et al., 2021). This enabled retailers to coordinate production and distribution activities between manufacturers, wholesalers, and other retailers more efficiently, at the right quantities to the right locations at the right time, and for the right price (J. R. Brown et al., 2005).

In the last two decades, digital technology has changed the structure between manufacturers and retailers through advances in communication and computing technologies (MacCarthy & Ivanov, 2022). Digital technologies, systems, platforms, and algorithms affect how we collaborate, exchange, integrate, manage, and control the supply chain. Firstly, it eliminated the wholesalers as the middlemen who bridge the information between the manufacturers and the retailers. Secondly, retailers play a reduced role as manufacturers with the available data could take more control over the customer relationship through D2C (Direct to Consumer) businesses. On the other hand, manufacturers also face increasing competition from retailers' private or own labels.

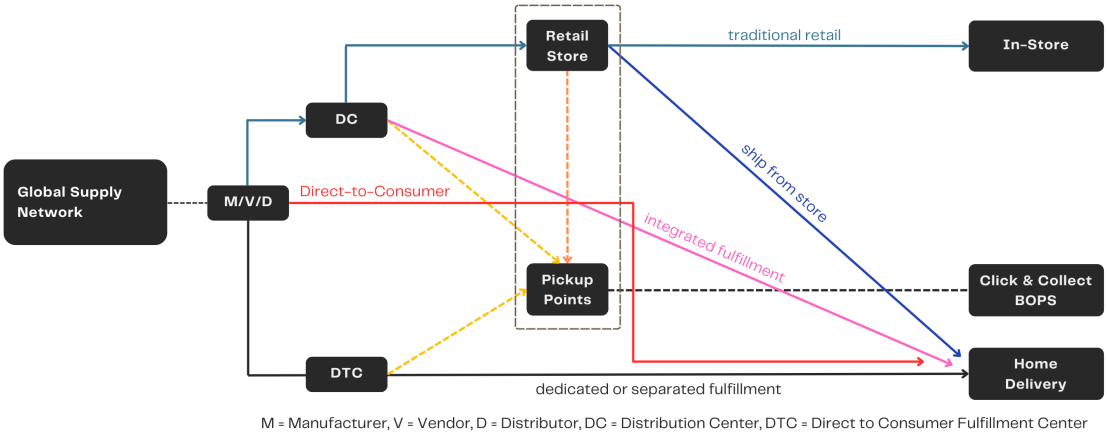


Figure 22 | Multitude of digitally enabled omnichannel retail fulfillment options, (Ishfaq & Raja, 2018)

3.1.2. The Emergence of the Platform Model in Retail Industries

The digitalization of the retail sector, for the last two decades, has been affected by the growth of the internet since the 1990s. Many traditional retailers introduced multichannel marketplaces enabling offline and online shopping experiences, while other retailers innovated the type of pure platform channel, such as Amazon. Retailers seek flexibility in distribution and supply networks to satisfy a broader and more heterogeneous customer base with diverse fulfillment options. These include in-store fulfillment, click-and-collect services, and home delivery (Ishfaq & Raja, 2018).

In the early 2000s, the increasing digitalization in marketing and retailing enabled new technologies such as smartphones and mobile devices. (Fuentes et al., 2017). Through omnichannel retailing and the platform model, new technologies enable customers to have better access to certain types of goods and the ability to buy anything, anytime, and anywhere from their mobile devices, and transform the role of food retailers in the retail value chain. Many food retailers have owned the warehousing, distribution, and storefronts since the era of Chain Stores, and they coordinated most associated retail activities. They have the role are wholesalers who manage merchandise procurement and distribution within their distributed grocery store networks.

By doing the platform model, retailers have more intermediaries role than having tight vertical control for the transaction between buyers and sellers (Hänninen et al., 2019). They primarily intermediate products between customers and sellers, thereby reducing the costs of retail space and inventory (MacCarthy & Ivanov, 2022). The use of algorithms to match supply and demand data through inventory management and supply chain coordination software has played a significant role in the visibility of the flow of goods for retailers and created more effective sales and management. With the advancement and proliferation of digital technologies, the platform model is evolving to emphasize creating a network of different stakeholders involved and orchestrating their resources to enable smooth interaction and value co-creation between platform participants (Libert et al., 2014).

The Retail Challenge

The implications of changing consumer shopping habits, despite creating efficiency for retailers, also create significant problems for retailers. The changes in behavior require retailers to innovate in three key dimensions: location, immediacy, and cost, all of which can, in part, be addressed by real estate solutions (Matthews & Dawson, 2014).

Location	Immediacy	Cost
Proximity of retailers' real estate to customer base	Reducing the lead time between capturing and delivering an order	Understanding fulfillment costs; store vs. e-commerce
Accessibility of warehouse for deliveries and staff pool	Flexibility of delivery options – convenience, choice, and precise timing	Ensure supply chain does not impact profitability
Closer collaboration with all supply chain partners from start to finish	Provision of click and collect as part of retail offering	Timey stock knowledge – understanding product movements and ensuring returned stock becomes available
Ensuring that "last-mile" delivery solution is in place		Moving from traditional logistics model to an omni-channel environment
Using "big data" to understand customers		

Table 1 | Retailer Challenges, Deloitte, (Matthews & Dawson, 2014)

3.1.3. Vertical Integration to Add Value

In the supply chain, manufacturing, wholesale, and retail activities are typically accomplished by different organizations. The retail service system undergoes a major transformation to compete in the new competition space by vertically integrating its backstage system to support its frontstage system. Vertical integration means that all the aspects that are in control of the platform model are now integrated seamlessly and are distinct elements that create added value propositions for the end customer (Hänninen et al., 2019). Many players are building logistics capabilities to integrate this aspect of their operations better.

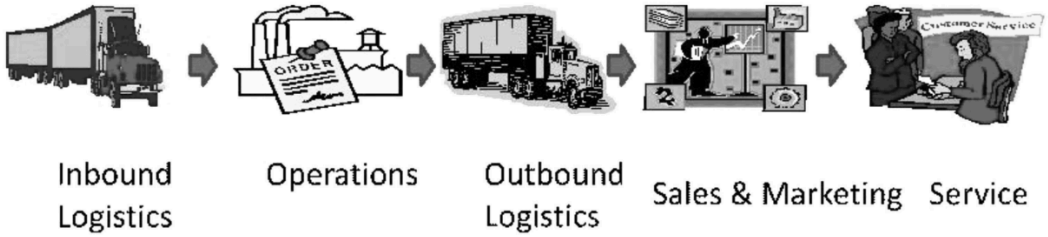


Figure 23 | Primary retail value chain activities (Myerson, 2020)

Vertical integration occurs when a business firm does something for itself that it might otherwise have obtained on the market (Ricketts, 2019), which can be an ideal way for a retailer to increase the effectiveness of its value chain. Neoclassical industrial-organization economist, Joe Bain viewed the rationales for vertical integration were driven purely by technology (Bain, 1959). In a value chain, a firm's internal activities, from inbound logistics, operations, outbound logistics, marketing, and sales to service, adds incremental value to the final product or services by transforming inputs into outputs (Myerson, 2020). By owning every chain activity and with the help of breakthrough technology such as machine learning and AI, a business firm could feed more data into the system and have better predictions for supply and demand. Vertical integration focused on production, management cost savings, and assurance of supply or outlet (Frank, 1925).

Value Chain Category	Activities
Inbound Logistics	Receiving, warehousing, and inventory control of input materials
Operations	Transforming inputs to the final product or service to create value
Outbound Logistics	Actions that get the final product to the customer including warehousing and order fulfillment
Marketing and Sales	Activities related to buyers purchasing the product, including advertising, pricing, distribution channel selection, et cetera
Service	Activities that maintain and improve a product's value and include customer support, repair, and warranty service, et cetera

Table 2 | Retail value chain activities that add value, (Myerson, 2020)

3.2. From E-Commerce to Q-Commerce

In retail, " convenience " meant a simple, efficient shopping experience that met the customers' needs. These days, it means providing the customer an easy, speedy, flexible, and save services for minimum time, cost, and effort (de Boer et al., 2022). Home delivery, beginning in the era of Chain Stores, has seen delivery times fall from two or three days to same-day, now accepted as the standard of omnichannel retail (Ecker et al., 2020). The standards have been reset by market leaders like Amazon, placing increasingly more pressure on other incumbent players.

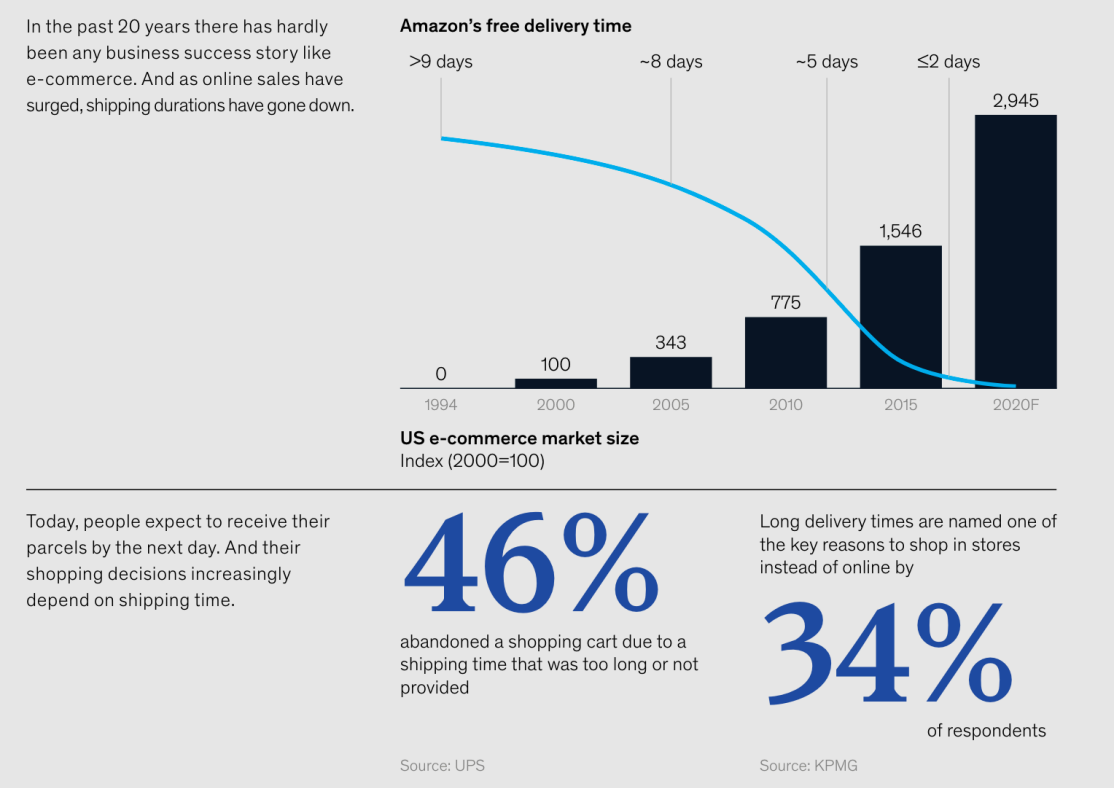


Figure 24 | Evolution of omnichannel delivery time and people's shopping decision, McKinsey & Company, 2020

The quick-commerce model began around 2011 to 2012 when Postmates (now Uber Eats) and Instacart established the quick-commerce, called the hyperlocal delivery model. Q-commerce is an emerging business model in which the timeframe between customer order and order delivery is less than e-commerce. It streamlines logistics operations and provides on-time, fast doorstep delivery within 10 minutes to half an hour of ordering (Samsukha, 2022). The model worked by intermediating third-party retailers and restaurants with customers to deliver their products, traditionally promising "same-day" delivery and, when offered at a premium service, promising 30 to 45 minutes delivery services (Weinswig et al., 2021). It mainly targets spontaneous, emergency, and emotional purchases and competes with traditional online shopping and offline convenience retail formats, such as corner shops, gas station stores,

and minimarkets. Pioneers from different industries have already jumped on this trend, either investing in their platforms or partnering with others for instant delivery (de Boer et al., 2022).

Figure 25 | Quick-commerce players in the US and percentage of online shoppers who use them, eCommerce DB, 2022

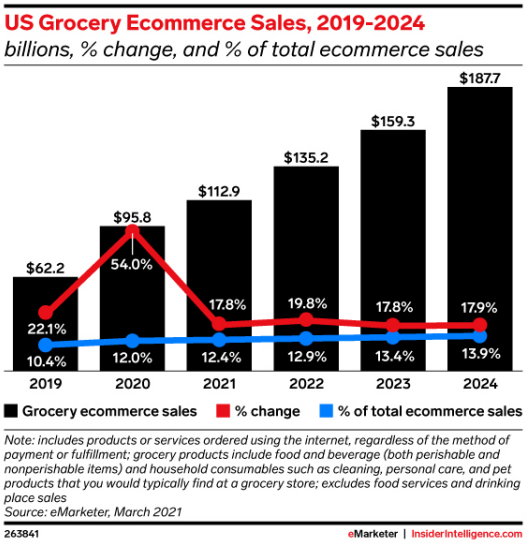
In the United States, the idea of grocery Q-commerce came in 2013, when co-founders Rafael Ilishayev and Yakir Gola, students at Drexel University in Philadelphia, encountered difficulty getting late-night snacks such as chips and candy without running to a convenience store. They then came up with the idea of delivering those goods, along with hookahs and tobacco products, in an average of 30 minutes (Repko, 2021). Following Gopuff into third-party grocery, Doordash entered the instant-needs space in August 2020 by establishing its DashMart convenience stores offering delivery of essential needs in 30 minutes or less (Weinswig et al., 2021).

	Company	Started Delivery	Operating Locations	Delivery Time	Delivery Fee per Order	No. of SKUs
Vertically Integrated	Gopuff	October 2013	1000+ US cities	30 minutes	$3.95	4,000-6,000
	Fridge No More	October 2020	New York	15 minutes	Free	2,000

Instant Needs	JOKR	March 2021 – June 2022	New York, Boston	15 minutes	Free	1,500
	Buyk	September 2021 – March 2022	Manhattan, New York	15 minutes	Free	2,000 – 3,000
	1520	January – December 2021	New York, Chicago	15 minutes	Free	1,500
	Gorillas	May 2021	New York	10 minutes	$1.80	1,500
	Getir	November 2021	New York, Boston, Chicago	10 minutes	$0.00 to $1.99	2,000
Delivery Platforms	Instacart	June 2012	Nationwide	Under 60 minutes to same-day	$3.99 + 5% service fee for same-day orders under $35 (fees vary for one-hour orders under $35)	Depends on the third-party grocery retailers they partner with
	Shipt	November 2014	Nationwide	1+ hours	$10 one-time Shipt pass; or $99 annual fee with $7 fee added for orders <$35	
	DoorDash	January 2013; moved into retail in April 2018	Nationwide	35 minutes	$3.99	
	Uber Eats	2014; added groceries in 2020	Nationwide	20 – 90 minutes	Variable (15% on Cornershop; variable $ amounts by third parties)	

Table 3 | Quick-commerce key competitors, Coresight Research, 2021

The Covid-19 pandemic has accelerated demand for e-commerce and for technologies that can improve the efficiency, responsiveness, and flexibility of food retailing and logistic facilities (Weikal & Scott, 2020). Post-pandemic, 90% of e-grocery customers are expected to continue shopping online (Redman, 2020). Consumer demand for rapid delivery will continue to bring forward innovative approaches to distribution. However, in order for the players to hold their ground, reaching the necessary size to be able to tap into economies of scale, capture efficiencies, and reduce the cost of last-mile delivery are essential for long-term profitability (de Boer et al., 2022).



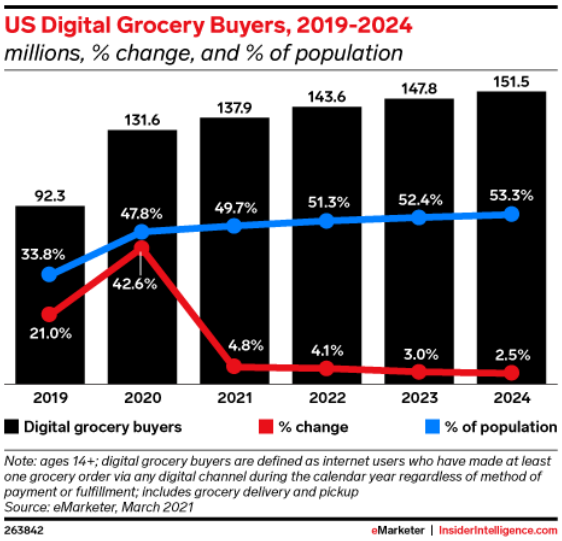


Figure 26 | US Grocery E-commerce Sales and US Digital Grocery Buyers 2019-2024, eMarketer

The online grocery boom in 2020 supported the emergence of the quick-commerce landscape. A study by Coresight Research (2021) mentioned that the explosion in industry participants is heavily concentrated on the vertically integrated segment. Players promise deliveries from their fulfillment centers to urban consumers as quickly as possible, and investors are betting on instant needs. The research found that: retail sales, predominantly grocery or essentials by significant players in the overall quick-commerce market, will total $20–25 billion in the US in 2021. The sales equate to a 10%–13% share of our estimate for US online CPG sales, which are expected to total around $191 billion in 2021 (Weinswig et al., 2021).

Operator	Headquarters	Recent Funding	Month of Recent Funding	Total Funding	Total Valuation
Buyk	United States	$46 million	June 2021	$46 million	N/A
Fridge No More	United States	$15.4 million	March 2021	$16.9 million	N/A
Getir	Turkey	$550 million	June 2021	$1 billion	$7.5 billion
Gopuff	United States	$1 billion	July 2021	$3.4 billion	$15 billion
Gorillas	Germany	$950 million	September 2021	$1.3 billion	$3 billion
JOKR	United States	$170 million	July 2021	$170 million	N/A
			Total Funding	**$5.9 billion**	

Table 4 | Recent funding raised by instant-needs companies in the US, as of September 2021, Coresight Research, 2021

Business Model and Economics

Quick-commerce players build their first-party MFCs and engage employees and couriers to deliver them to customers' homes. Vertically integrated MFCs are optimized to maximize speed while picking items and are strategically located as close to customers as possible, enabling couriers to ensure short delivery

times. By owning inventory, vertically integrated players can have greater visibility on product quality, inventory supply, and pricing (Weinswig et al., 2021). They typically carry a fast-rotating and local products of assortments of 1,000 to 4,000 SKUs that are localized to the neighborhood they serve (Wells, 2021). Besides, information sharing empowered by innovations in Information Technology has allowed collaborative planning, forecasting, and replenishment, bringing benefits for all members along the retail supply chain, such as mitigating the bullwhip effect[6] and facilitating strategic supplier relationship management (Lee et al., 2004). This means that the more data they feed and have through the platform model, the better they could predict better product supply and distribution recommendations.

Scale is vital to profitability for vertically integrated quick-commerce layers to secure more advantageous prices from suppliers as they scale, and more significant volumes equal a leveraging of fixed operating cost, increasing margins for returns. Like conventional retailers, quick-commerce players primarily generate their contribution margin through product costs and sales differences. In addition, delivery times can impact the economics of Q-commerce; with extended delivery times, there is a higher ability to pool multiple orders in one delivery (Weinswig et al., 2021).

3.3. The Impact on Real Estate and the Evolution of Warehouse Space

Retail digitalization is creating a new logistic landscape. E-commerce and Q-commerce blur the role of the store, where a store can be used as a warehouse, offering BOPIS (buy online, pick up in-store) and ship-from-store services. The physical network needs to be reimagined in terms of the building footprint, use of "dark" stores, store formats, parcel locker networks, autonomous last-mile delivery, and other open-ended possibilities (de Boer et al., 2022). As a consequence, America's top supermarkets are facing a new challenge: grocery aisles in stores are not suited to meet the growing demand for online orders. For locations that no longer support human foot traffic, Walmart and Stop & Shop are testing fully automated "dark stores" for curbside pick-up and delivery fulfillment (Meyershon, 2019). The role of physical retail stores has been redefined.

Nowadays, physical store stores have been deployed as "mini" Distribution Centers (DCs) to facilitate forward order fulfillment and backward returns options for online businesses. As stores are located closer to customers compared to DCs, the store network, therefore, enables retailers to offer more flexible and faster delivery and collection options (MacCarthy et al., 2019). Matthias Winkenbach, director of MIT Megacity Logistics, said that warehouse and distribution technology is enabling a shift to more fragmented

[6] Bullwhip effects are created when supply chain members process the demand input from their immediate downstream member (customers) in producing their own forecast (Lee et al., 1997).

and dynamic inventories due to on-demand consumerism and the corresponding need for faster and more flexible delivery services (Cannon et al., 2018). Urban logistics facility are rapidly growing in importance as they have become recognized as a way to facilitate drive for convenience and faster delivery times (Matthews & Dawson, 2014).

Warehouse of the Future

The dramatic increase in e-commerce and Q-commerce significantly affect land use due to the pressure to maintain dependable and quicker delivery times. E-commerce and Q-commerce players add smaller warehouses and distribution centers closer to consumers as part of their regional network, a trend that shows no signs of changing (Matthews & Dawson, 2014). The period of large regional distribution centers will plateau. At the same time, the demand for smaller, urban warehouses close to urban density will increase – that retailers will be able to compete effectively on delivery times. As the competition for urban warehouses increases, demand for suitable sites will intensify, and so will rental and investment values. (Matthews & Dawson, 2014).

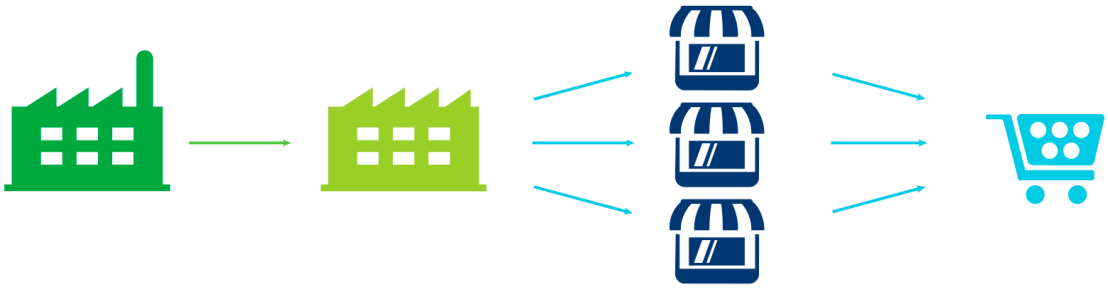


Figure 27 | Traditional Logistics Model, Deloitte, (Matthews & Dawson, 2014)

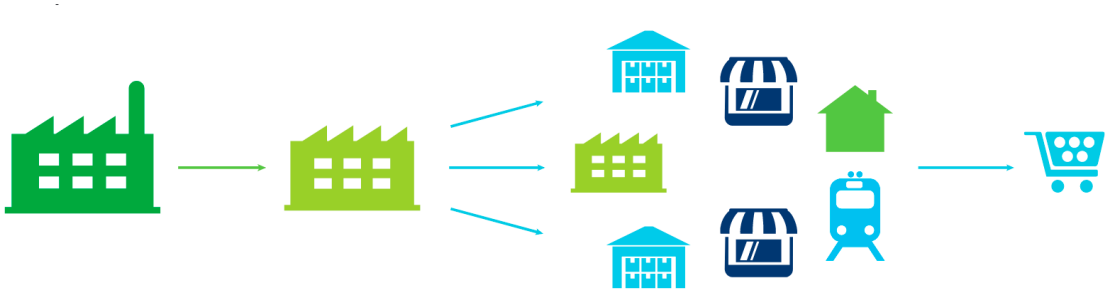


Figure 28 | New Logistics Model, Deloitte, (Matthews & Dawson, 2014)

Demand for warehouse and fulfillment space leads real estate developers, owners, and operators to rethink other real estate product types and blur traditional uses. Ed Klimek, KSS Architects Partner, observed that in the future, industrial real estate would be more agile and frictionless; not just mixed-use but

"integrated-use": the fluid blend of where we make things, where we produce things, and where we distribute things, combined with where we live (Weikal & Scott, 2020).

Micro-Fulfillment Centers

With the rise of Q-commerce, warehouses have expanded beyond storing bulk inventory to become full-service fulfillment centers. Fulfillment centers hold inventory for a shorter period; individual items are stored in smaller quantities with the expectation that inventory will be turned over quickly as orders are consistently shipped (Weikal & Scott, 2020). These changes in warehouse utilization have increased the demand for smaller warehouses close to density and primary transportation routes, accommodating fast-moving, quick-turning, and frequently ordered inventory. As a result, they are well positioned to serve as micro-distribution or micro-fulfillment centers (MDCs/ MFCs), also known as "dark stores." Instead of displaying items for passing customers, vacant storefronts are becoming storerooms and delivery depots for businesses that have moved entirely online. MFCs hold inventory for shorter periods with the expectation that inventory will be turned over quickly as orders are consistently shipped (Weikal & Scott, 2020).

Figure 29 | Dark Store (MFC) in NYC, photo by Author

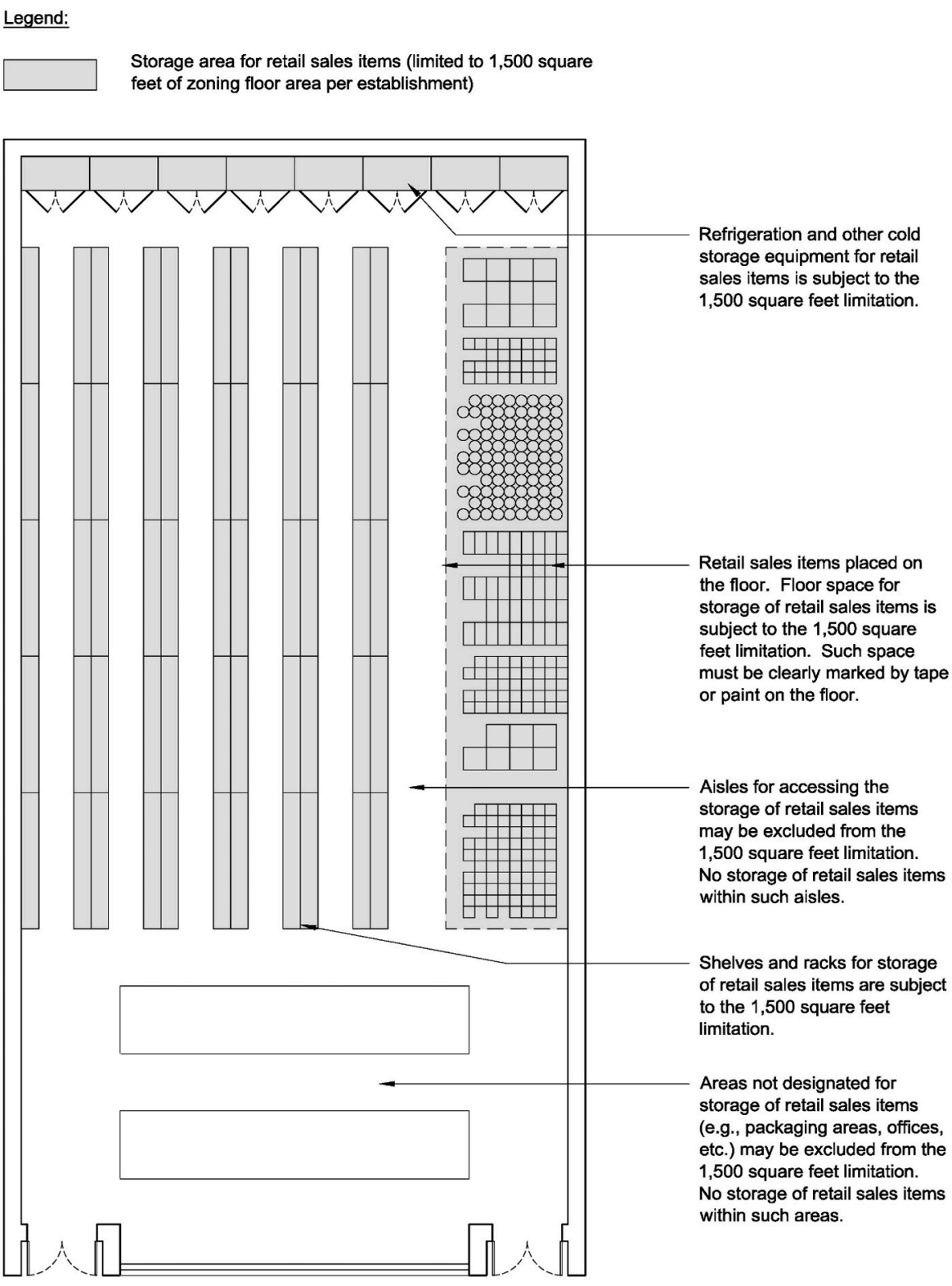


Figure 30 | Dark Store Layout, source: NYC Buildings

3.4. Platform Urbanism and How MFCs are Revolutionizing Grocery Retail Activities in Cities

Adopting new technology in cities drives new actors and new developments in cities. The intervention of new technology in cities focuses on capturing and understanding a still-evolving movement called platform urbanism. It aims to transform the operation of city services that tend to be more consumer oriented (Sadowski, 2020). Platforms are concerned with producing productive space, time, and things so that value can be extracted from unproductivity.

> "… platform urbanism is shaping up as a widely distributed, well-funded, and ambitious agenda for reconfiguring urban services and space. Cities have been picked apart by the Cerberus of austerity, entrepreneurialism, and privatization, making them prime targets for technology capital. Platforms claim they are disrupting incumbents who have stagnated, rather than innovated. But if we look past the slick marketing and subsidized prices, it's clear they are intensifying many of the worst features of capitalist urban development." (Sadowski, 2020:451)

The production of "dark" space involves two considerations – internal and locational, as retailers shift the traditional functions of commercial space into online platforms (Shapiro, 2022). "Dark stores" demand for full store conversions into fulfillment hub, impacting changes to store physical layout and logical workflows to accommodate optimal picking routes and capacity. Retail's locational virtues of consumer accessibility, density of social flows and interactions, and spatial differentiation (S. Brown, 1993) become secondary to the ultimate criterion for last-mile efficiency. Integrated into the neighborhood fabric, "dark stores" signal a new alignment between the "platformization" of urban transactions (Barns, 2019) and the "urbanization" of supply chain capitalism – a dark convergence of "cyberspace and cityscapes" (Sadowski, 2020) taking shape between consumers' awareness. Business Operations Managers of these stores explained that MFCs are revolutionizing grocery activities by promising multiple benefits for retail stores and end customers. For retailers, MFCs optimize SKU management, addressing the perishability and fulfillment window challenge (Machado, 2020). On the other hand, Customers could get faster and more convenient delivery with just a click.

Dark stores can optimize SKU management in many ways. Firstly, dark stores can predict the supply and demand for their SKUs by focusing on storage and click-and-collect functionality. Dark stores provide limited products of a particular brand that the customers mostly buy (Hoffman & Gola, 2022). Secondly, they could simultaneously cater to multiple online grocery stores to share real-estate costs, encouraging more mixed-use development. Thirdly, they are also saving retail space because they do not need to think

about the shopping experience and display in-store advertising (Machado, 2020). Thus, dark stores can accommodate much more variety per item at much less space cost.

Grocery involves items with all kinds of expiry windows. Consumers want the items delivered together in their ideal states – crackers must not crack, liquids must not spill, and what is airtight must remain so. It requires impeccable inventory management that works seamlessly so that the window between off-the-store-fridge and in-the-home-fridge is as short as possible (Machado, 2020). Dark stores could address these challenges by dedicating the time, space, and visibility for stock managers and pickers to manage order fulfillment while maintaining the desired freshness level for all items.

Chapter 4 |
Grocery "Dark Stores" in Manhattan

4.1. Case Study: Grocery "Dark Stores" in Manhattan

Ultrafast grocery delivery services, such as Gorillas, Getir, JOKR, and GoPuff, have ballooned in New York City since the start of the pandemic to offer the promise of everyday items delivered to customers' doors in minutes (Zara, 2022). However, the companies behind these services exist in a gray area of regulation, renting out storefronts zoned for traditional retail establishments that allow customers to walk into the store and buy things off the shelves.

Edward Amador, the Director of Communications from the Office of Council Member Gale Brewer, explained that their team conducted an in-person survey of all identified MFCs associated with rapid-delivery apps such as JOKR, Getir, Gorillas, GoPuff, and Door Dash in November 2021. Together with BetaNYC, a civic technology organization in New York City, and the NYC Department of Agriculture and Markets, the Office of Council Member Gale Brewer collected data to map out where MFCs are located across the city. Per March 2022, they identified 115 MFCs across New York, with 40% of their presence in Manhattan.

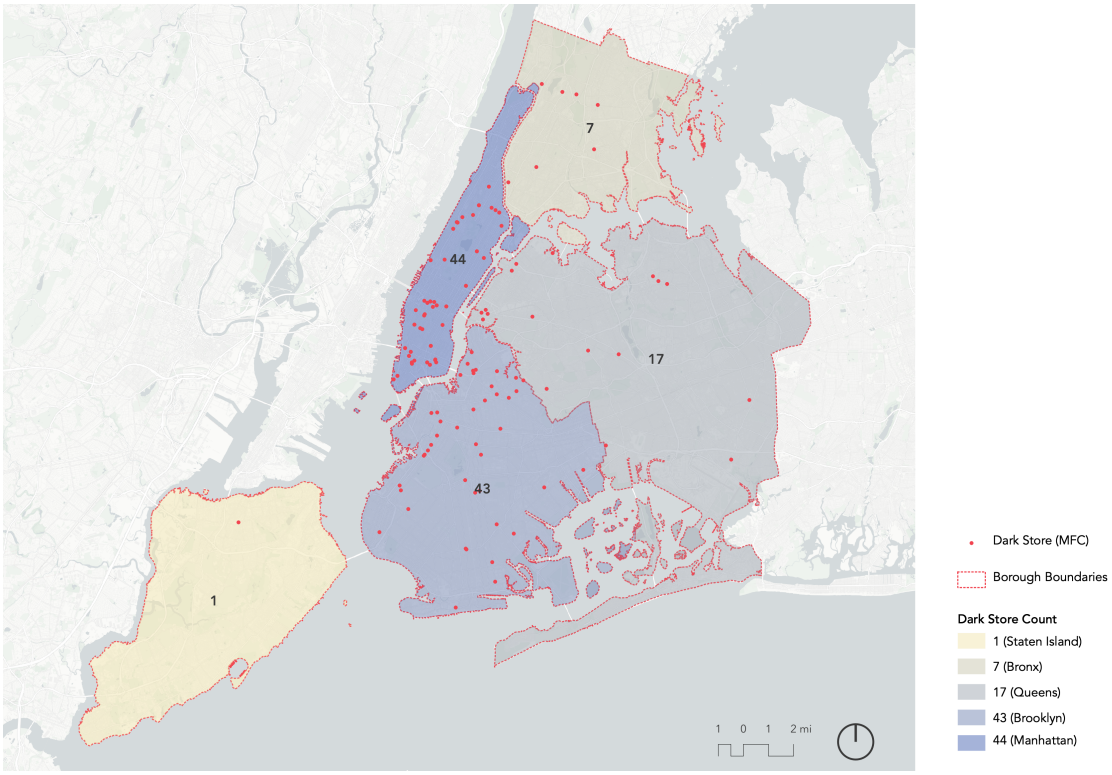


Figure 31 | Distribution of Dark Store in New York City, Map by Author, Data Source: NYC Department of Agriculture and Market

From the data collected and the survey, they observed non-compliance with relevant zoning and consumer protection regulations such as public access to space, ability to shop onsite, window transparency, acceptance of cash, shelf pricing, and zoning. In a press release, Council Member Gale Brewer called on city agencies to clarify the regulation of MFCs. Through a memo, Gale Brewer emphasized that the oversight of MFCs leads to an environment of permissiveness, creating inequity in the street retail sector because brick-and-mortar must comply with many rules and regulations. MFCs operate in a challenging economic environment and bear a heavy regulatory burden that fulfillment centers are not subject to. Furthermore, the MFCs are backed by venture capitalists with deep pockets who can wait years for a return. They have been present in New York City since the summer of 2021 and are not being held accountable to the same rules as other commercial establishments.

> "Despite months of calls for action, there appears to be little or no further action to determine the legal status and compliance of micro fulfillment centers. Most of these warehouses do not allow members of the public to enter, limit visibility into the space, refuse cash payments, deaden the streetscape, and do not belong in our commercial storefronts," said Council Member Gale A. Brewer (D-06).

> "The City and State must adapt as new industries emerge in this rapidly changing economy. We cannot allow MFCs to go unchecked and without oversight. I applaud my colleague Council Member Gale Brewer for her work in holding these new centers accountable to the same standards we hold other businesses," said State Senator Brad Hoylman (D-27)

> "Manhattan Community Board 7 applauds Council Member Brewer on her unwavering efforts to seek recourse for MFCs that violate the City's zoning legislation. The Council Member's commitment will help provide the opportunity for small businesses and increase vitality at the neighborhood level," said Max Vandervliet, District Manager, Community Board 7

4.2. Grocery Shopping in Manhattan: Bodega, Deli, and Corner Store

A bodega is a small corner store that sells snacks, lottery tickets, cigarettes, and toiletries along with other basic food and household items, located at street level amidst most New York City neighborhoods. Most New Yorkers are loyal to their neighborhood bodega. Bodegas often stay open until 4am, serving both daytime and nighttime crowds. Bodegas first appeared during the 1920s and 1930s and sold comfort food to Puerto Ricans working in New York factories. It was not until after World War II that bodegas became the citywide icons, stretching through all neighborhoods in New York City. The word "bodega" originates in Spain and translates to "storeroom". The early bodegas specialized in Caribbean culinary staples such

as cilantro, recao, yucca, and other herbs. Families could find everything they needed to make the beloved recipes along with necessary household items such as toilet paper, cigarettes and batteries.

Bodega owners often held leadership roles within their communities and were familiar with the issues and needs of their local community (Gjording, 2022). They tend to have lower price range for basic items like milk, eggs, and fruits, making it more economically advantageous for inner city dwellers to shop at the bodega instead of grocery chain stores.

4.3. Vacant Storefronts, "Dark Stores", and the Dilemma of Urban Landscape

Between 2007 and 2017, the number of small retailers in the United States fell by 65,000 (Taparia, 2022). In New York City, the number of retail vacancies during that decade doubled, reaching a vacancy rate of about 7.4% citywide average, 5.8% in Brooklyn, and 5.2% in Manhattan (ABS Partners LLC, 2019). Vacancy conditions are influenced not only by high rents but also by many other factors, such as retail industry shifts, underperforming corridors characterized by long-term historic disinvestments, the rise of internet shopping, and the increased minimum wage. Many individual storefront businesses have conveyed concerns about a changing retail environment and about challenges of uncertainty they face, including factors such as shifting consumer habits, taxes, rents, and complex business and land use regulations (NYC DCP, 2019).

Borough	2007	2017	% Increase
Manhattan	2,100,000 sq. feet	4,300,000 sq. feet	105%
Brooklyn	1,000,000 sq. feet	2,100,000 sq. feet	110%
Queens	1,200,000 sq. feet	2,700,000 sq. feet	125%
Bronx	830,000 sq. feet	1,600,000 sq. feet	93%
Staten Island	350,000 sq. feet	1,100,000 sq. feet	214%

Table 5 | Vacant Retail Space, ABS Partners Real Estate, LLC, 2019

New York City can be a challenging place for small business to operate. They must navigate complex regulatory schemes enforced by multiple city agencies, contend with rising rents, taxes, competition from chain stores, and e-commerce retailers, and face various zoning restrictions. Local Law 157 of 2019 was enacted to gather data on vacant storefronts and facilitate the necessary studies to comprehensively understand storefront vacancies in New York City (2020). Leveraging this data, the New York City

Council Data Team has conducted an analysis to identify vacant storefront rates (Figure 32) and hotspots of storefront vacancies (Figure 33).

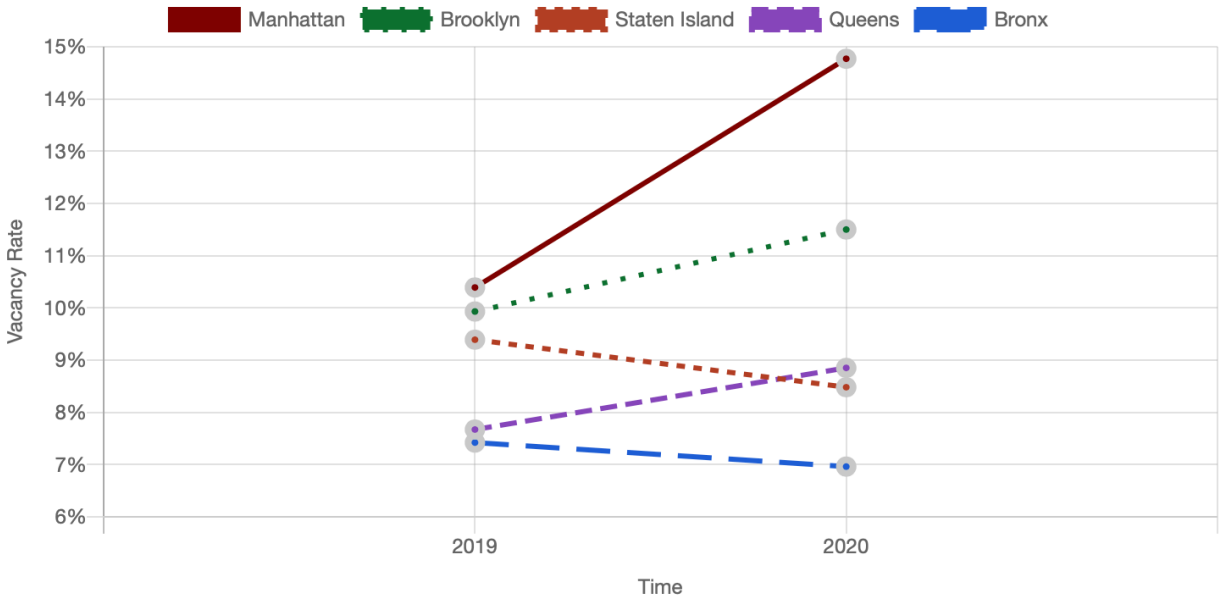


Figure 32 | Vacant Storefront Rates 2019-2020 by Borough, New York City Council

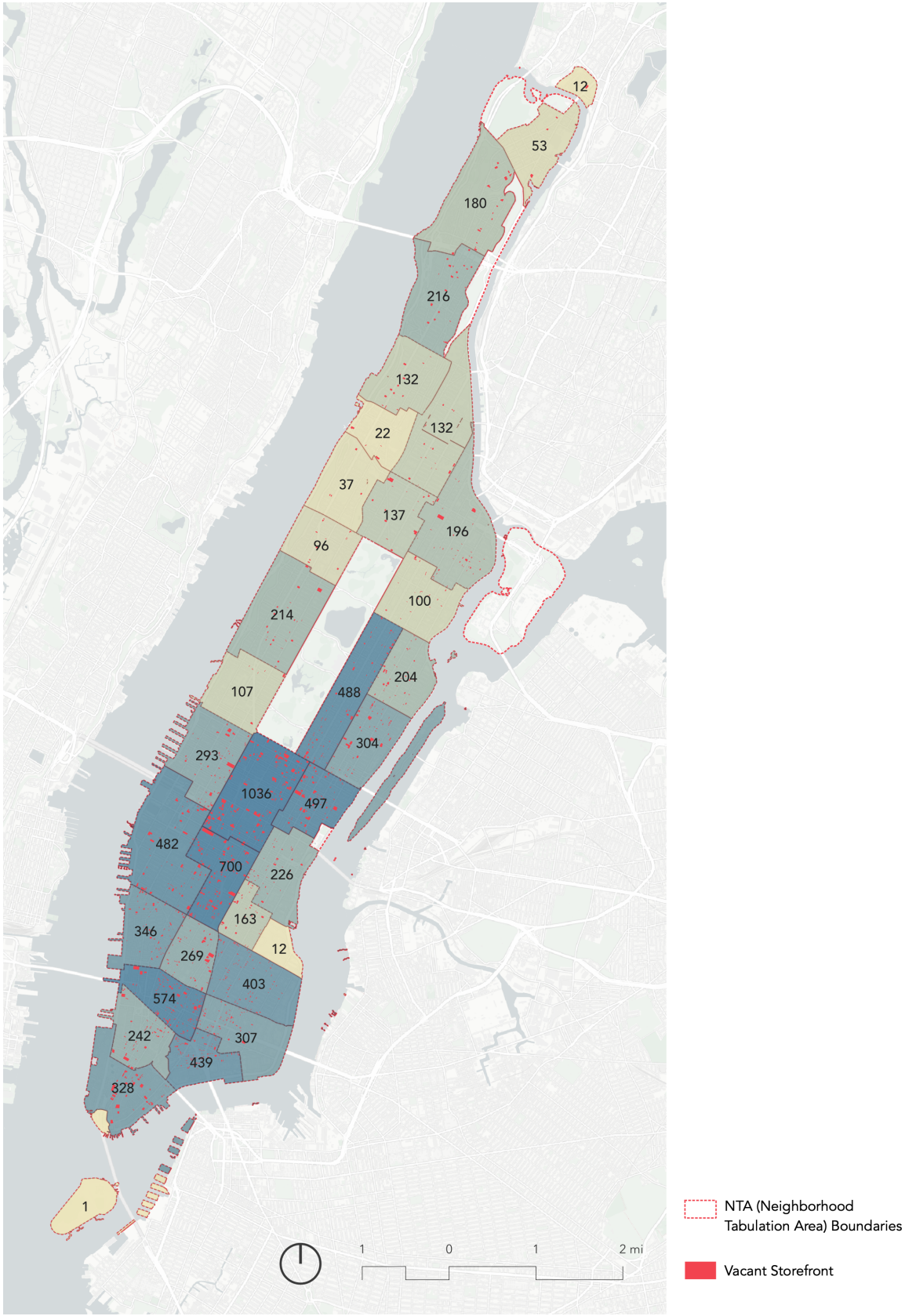


Figure 33 | Number of Vacant Storefronts in Manhattan, Map by Author, Data Source: NYC Open Data, 2022

"Dark Stores", FRESH Program, and the Dilemma of the City

Accelerated by the Covid-19 pandemic, the industry of hyper-convenience is just getting started. The biggest delivery platforms, such as DoorDash and Instacart, have announced plans to open their own "dark" kitchens and stores (Taparia, 2022). Unlike e-commerce warehouses such as Amazon's warehouses which are large and located outside city centers, "dark stores" are not bigger than a pharmacy and tend to be located within neighborhoods to reach customers in minutes. Vacant retail spaces across the city are being turned into warehouses in zoning specifically purposed for retail use.

"Dark stores," theoretically can provide better access to goods and greater food security to neighborhoods historically underserved by bricks-and-mortar retailers (Bitterman & Hess, 2021), which goes along with the Food Retail Expansion to Support Health (FRESH) Zoning Program. The FRESH program brings healthy and affordable food options to communities by lowering the costs of owning, leasing, developing, and renovating supermarket retail space through an incentive program promoting the development of Fresh Food Stores in some regions of New York City, where an applicable floor area bonus can be applied to the residential portion of a mixed-use building (Figure 34). A store that benefits from the program must be located in an eligible area and provide[7]:

- A minimum of 5,000 square feet of retail space for a general line of food and nonfood grocery products intended for home preparation, consumption, and utilization.
- A minimum of 30 percent of retail space dedicated to perishable goods that may include dairy, fresh produce, fresh meats, poultry, fish, and frozen foods.
- At least 500 square feet of retail space for fresh produce.

More "dark stores" would mean street corridors and neighborhoods will also go dark – no shopkeepers, patrons, fewer people, and less street activity. In *The Death and Life of Great American Cities*, published in 1961, Jane Jacobs argues that public safety will never come just from police supervision. Instead, public safety came from having the "eyes on the streets," such as storekeepers, steady customers, doormen, and neighbors of varying ages and interests. As neighborhoods go dark, inequality will also rise (Jacobs, 1992). The "dark store" phenomenon created an opportunity for vacant retail spaces to fill in while creating new challenges on neighborhood look and city attractiveness. The character of smaller neighborhood shopping districts will change as shopping behavior change (Bitterman & Hess, 2021).

[7] https://edc.nyc/program/food-retail-expansion-support-health-fresh

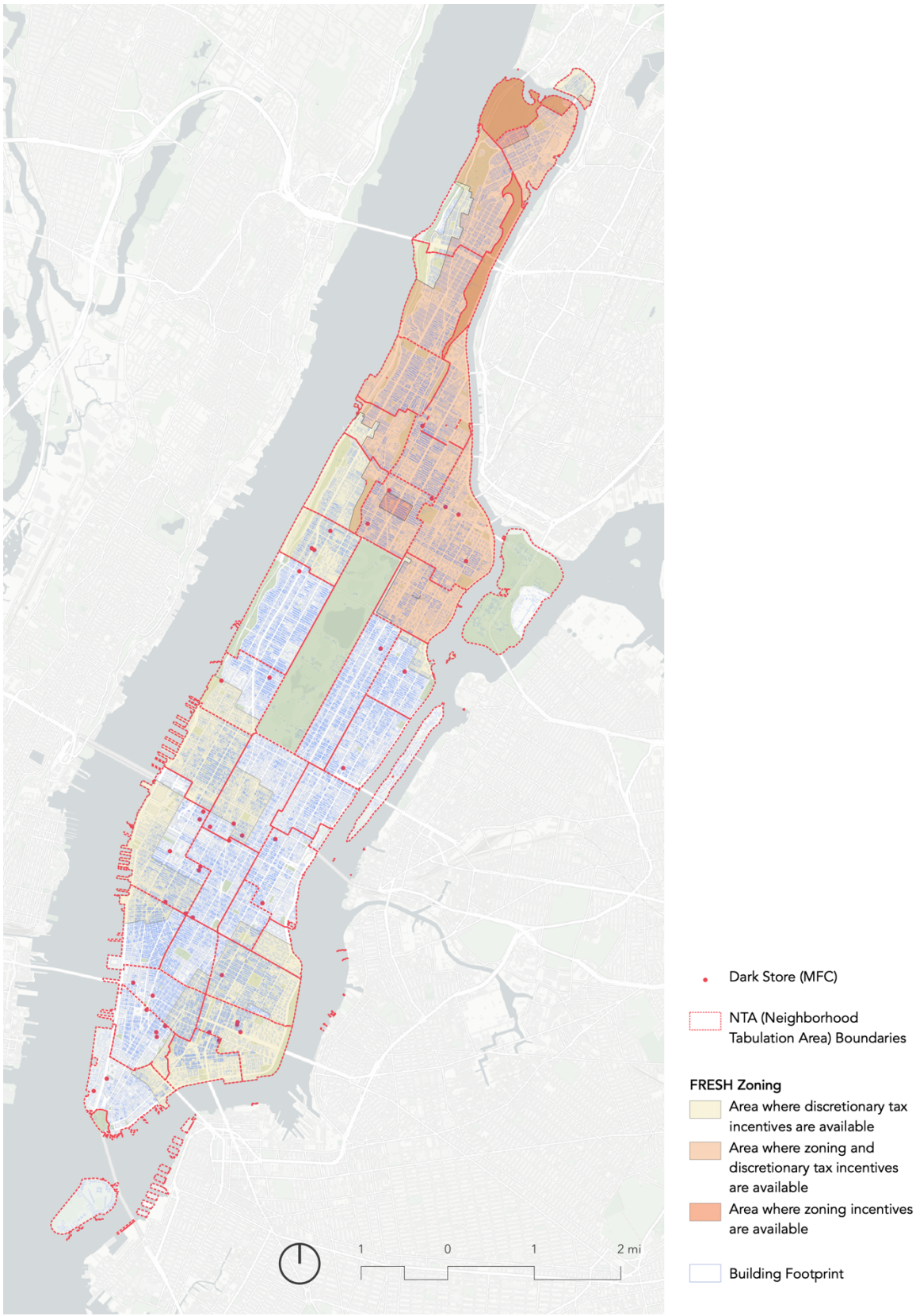


Figure 34 | Distribution of Dark Store and FRESH Zoning Eligibility Areas in Manhattan, Map by Author, Data Source: NYC Department of Agriculture and Market, 2022

4.4. Storefront Retail and the Role of Perceived City Attractiveness

Storefront retail is highly valued because of its contribution to street life, its pedestrian-oriented urban design quality, and its ability to foster social connection. Despite this valuation, in many areas main street retails struggles and storefront vacancies are common. The rise of e-commerce can be seen as the most recent structural change in a centuries-long battle for mass-market dominance (Talen & Park, 2021). The story of retailing over the last century or more has been a story of myriad forces working against the small main street retailer: the rise of the department store, mail-based (and now e-commerce) consumerism, new methods of distribution and merchandizing, and chain stores with their low prices and high sales volumes (Kickert, 2021) between the rise of income and improving transport technologies for people, goods, and ideas.

Several key urban commercial trends are harder to predict. Self-driving technology is likely to profoundly influence public spaces and the distribution of land uses, but it may either fuel re-urbanization or further deurbanization of population and retail (Chase, 2014). Finally, citywide, state, and federal regulations have significantly shaped urban retail in the past (mostly to its detriment), and future regulatory trends depend on unpredictable political and institutional climates. Among the permanence of our urban fabric, retailers will continue to adapt to changing markets and policies at breakneck speed and volatility.

> "Urban retail streets will never look the same, but urban designers have the potential to leverage retail trends to ensure vibrant urban ground floors as the cornerstone to healthy, sociable, and resilient cities. Urban retail streets will never look the same, but planners and urban designers have the potential to leverage retail trends to ensure vibrant urban ground floors as the cornerstone to healthy, sociable and resilient cities." (Kickert, 2021:11)

4.5. Data and Limitations

Location, demographic, and urban form characteristics data are keys to this research analysis. Location data of retail food stores and points of interest helps to identify the variables that determine the factors being considered in selecting "dark stores" location and long-term presence. Demographic data helps to understand the population these grocery "dark stores" serve. Lastly, street network data helps to understand the spatial accessibility to these stores.

Location Data

The location data for retail food stores establishment (including grocery "dark stores") in Manhattan was obtained from NYC Department of Agriculture and Markets. This data set contains a listing of retail food

stores that hold an Article 20-C[8] food processing establishment license or an Article 28 license in New York State with its establishment name, license number, establishment type, address, square footage, and georeferenced points. Retail food stores include establishments such as convenience stores, bodegas, grocery stores, and supermarkets. Food establishment demographic information is primarily collected from license applications submitted to the Department's Licensing Unit[9].

Demographic Data

Demographic data were obtained from US Decennial Census 2020 at the block group level for its granularity and detailed information. As this research looking at neighborhood level, the use of census blocks help represents smaller geographic units corresponding to city blocks or bounded areas with visible features. This level of data allows for in-depth analysis of population, housing, and socio-economic characteristics within localized areas. Additionally, this data could be leveraged for market research purposes, enabling to understand consumer demographics, purchasing power, and market at a hyper-local level.

This research specifically looks at population density, age, education, employment, number of households, household income, house rent prices, workers' travel mode, and housing ownership to understand the target market of these "dark stores" and their accessibility.

Urban Form Characteristic Data

The urban form characteristics data were obtained from NYC Open Data for Map PLUTO, NYC Zoning Districts, Neighborhood Tabulation Areas (NTAs), Digital City Map (DCM), FRESH Food Stores Zoning, Facilities Database, and Building Footprints. These sets of data reflect the 2022 situation.

Map PLUTO merges PLUTO (Primary Land Use Tax Lot Output) data with tax lot features from the Department of Finance's Digital Tax Map (DTM) containing extensive land use and geographic data at the tax lot level in ESRI shapefile and File Geodatabase formats. From this dataset, we are looking at land use categories to details the relationship of grocery "dark stores" to the current land use categories. Land use analysis characterizes the uses and development trends in the area that may be affected by a proposed project, and determines whether a proposed project is either compatible with those conditions or whether it may affect them (Semel et al., 2020).

[8] https://agriculture.ny.gov/food-business-licensing

[9] https://data.ny.gov/Economic-Development/Retail-Food-Stores/

NYC Zoning Districts data contains polygon features representing specific zoning over the entire city. The zoning district classification of the tax lot. Under the Zoning Resolution, the map of New York City is generally apportioned into three basic zoning district categories: Residence (R), Commercial (C) and Manufacturing (M), which are further divided into a range of individual zoning districts, denoted by different number and letter combinations. In general, the higher the number immediately following the first letter (R, C or M), the higher the density or intensity of land use permitted. Zoning designations more specifically define and regulate what kinds of uses are allowed on specific parcels and outline design and development requirements and guidelines (Semel et al., 2020).

Digital City Map (DCM) data represents street lines and other features shown on the City Map, which is the official street map of the City of New York. The City Map consists of 5 different sets of maps, one for each borough, totaling over 8000 individual paper maps. The DCM datasets were created in an ongoing effort to digitize official street records and bring them together with other street information to make them easily accessible to the public [10].

FRESH boundaries (Figure 34) show where zoning and discretionary tax incentives are available for developing, expanding, and renovating full line grocery stores and supermarkets.

The facilities database aggregates information about 30,000+ facilities and program sites owned, operated, funded, licensed, or certified by a City, State, or Federal agency in the City of New York. These facilities generally help to shape the quality of life in the city's neighborhoods. Bike Lanes includes locations of bike lanes and routes throughout Manhattan. Public Transit data contains subway stations, subway entrances, and bus stop shelter. Building footprints data is shapefile of footprint outlines of buildings in New York City.

Limitations

It is important to consider potential biases and limitations in the data used for this research analysis. These may include:

1. Sampling Bias. The data sources may not capture the entire population or geographic areas.
2. Data Collection Bias. Data collection method may have inherent biases, such as underrepresentation of certain demographic groups or locations.
3. Spatial and Temporal Biases. The data used may have spatial and temporal limitations, not capturing real-time changes or reflecting all aspect of urban dynamics.

[10] https://www.nyc.gov/site/planning/data-maps/open-data.page#digitalcitymap

4. Data Accuracy and Completeness. Data sources may vary in terms of accuracy, quality, and coverage, which can introduce errors or misrepresentations in the analysis.

4.4.1. Dependent Variable: Grocery "Dark Stores" Location

The analysis began by treating the locations of grocery "dark stores" establishments while also looking at the location preferences of each store establishment. Next, I use retail food stores' location data collected in 2022 and 2023 to measure the change in grocery "dark stores" post-pandemic. The 2022 grocery "dark stores" data comes from a field survey in collaboration between the Office of Council Member Gale Brewer and the NYC Department of Agriculture and Markets. Based on the existing data, I geocode each DBA (Doing Business As) address, also known as company names, to transfer a .csv file containing tabular formatted data into spatial formatted data.

Finally, in the absence of the updates of similar location data in 2023, I double-checked grocery "dark stores" presence using Google Maps, visited several of the locations, and manually removed closed store locations. The data consists of 44 grocery "dark stores" locations in 2022 and 22 in 2023, indicating a 50% cut in just one year (Figure 35 – Figure 37).

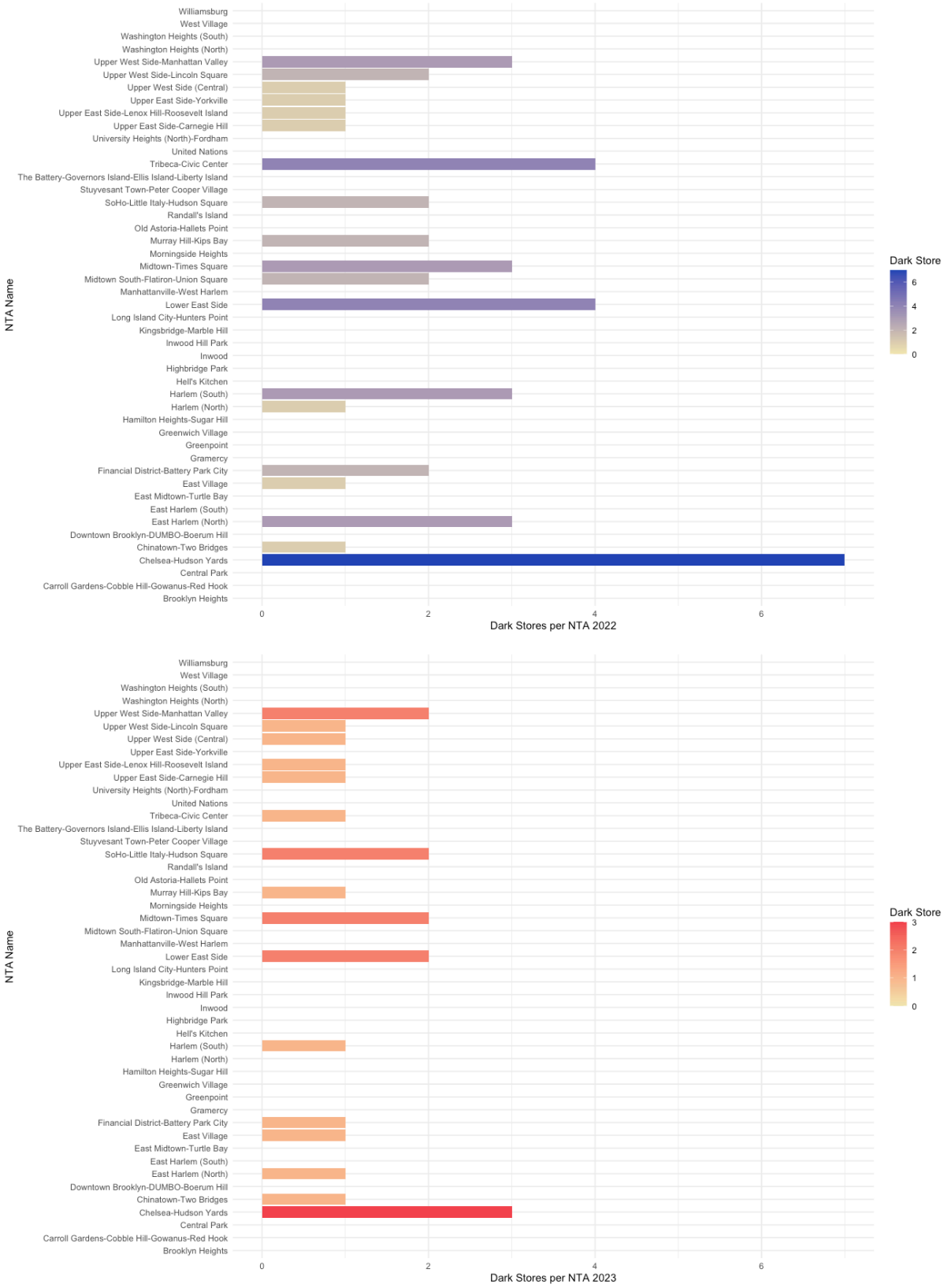


Figure 35 | Grocery "dark store" count by NTAs in 2022 (blue) and 2023 (red), Graphic by Author, Data Source: NYC Department of Agriculture and Market, 2022

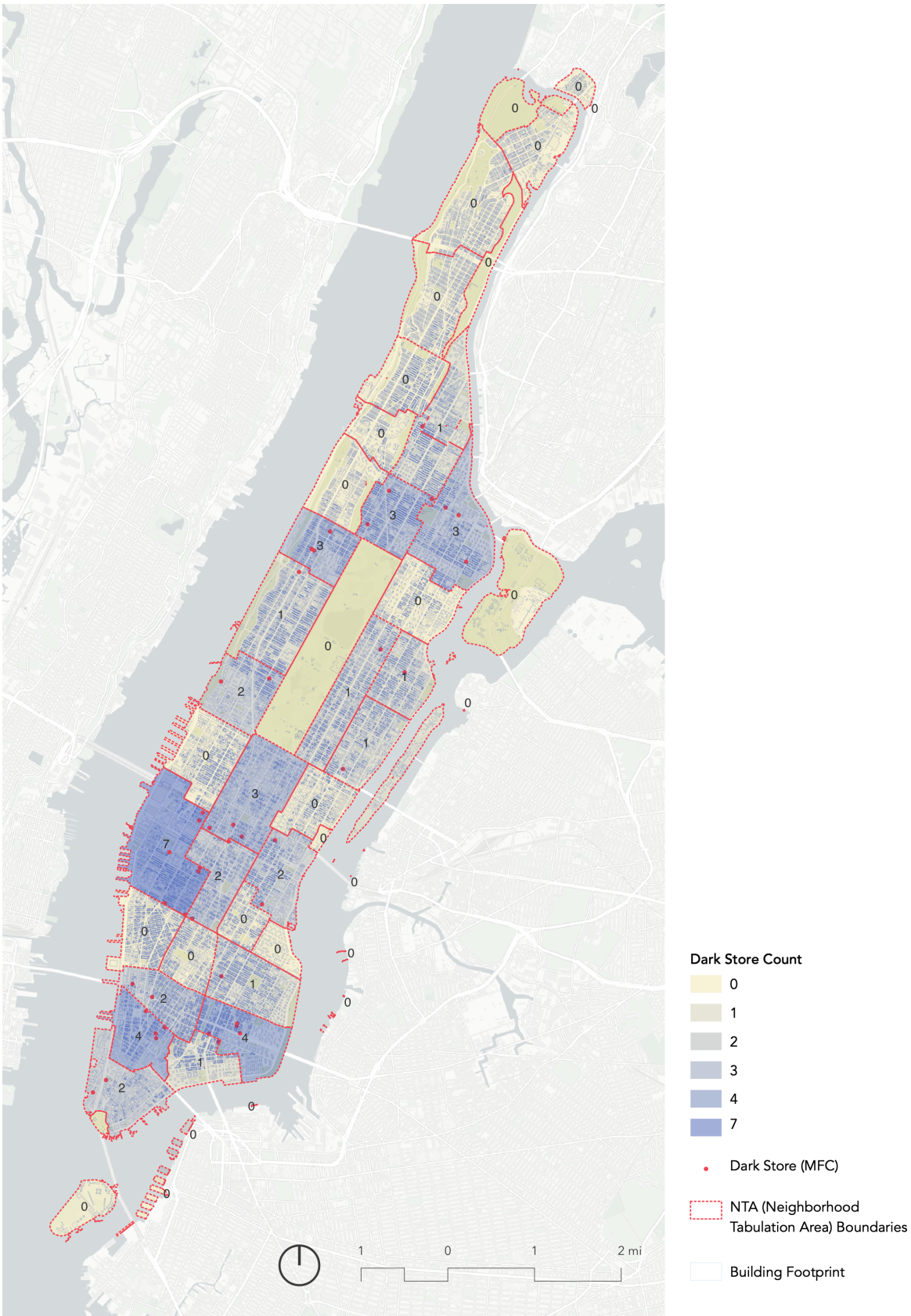


Figure 36 | Distribution of Grocery "Dark Stores" in Manhattan, Map by Author, Source: NYC Department of Agriculture and Market, 2022

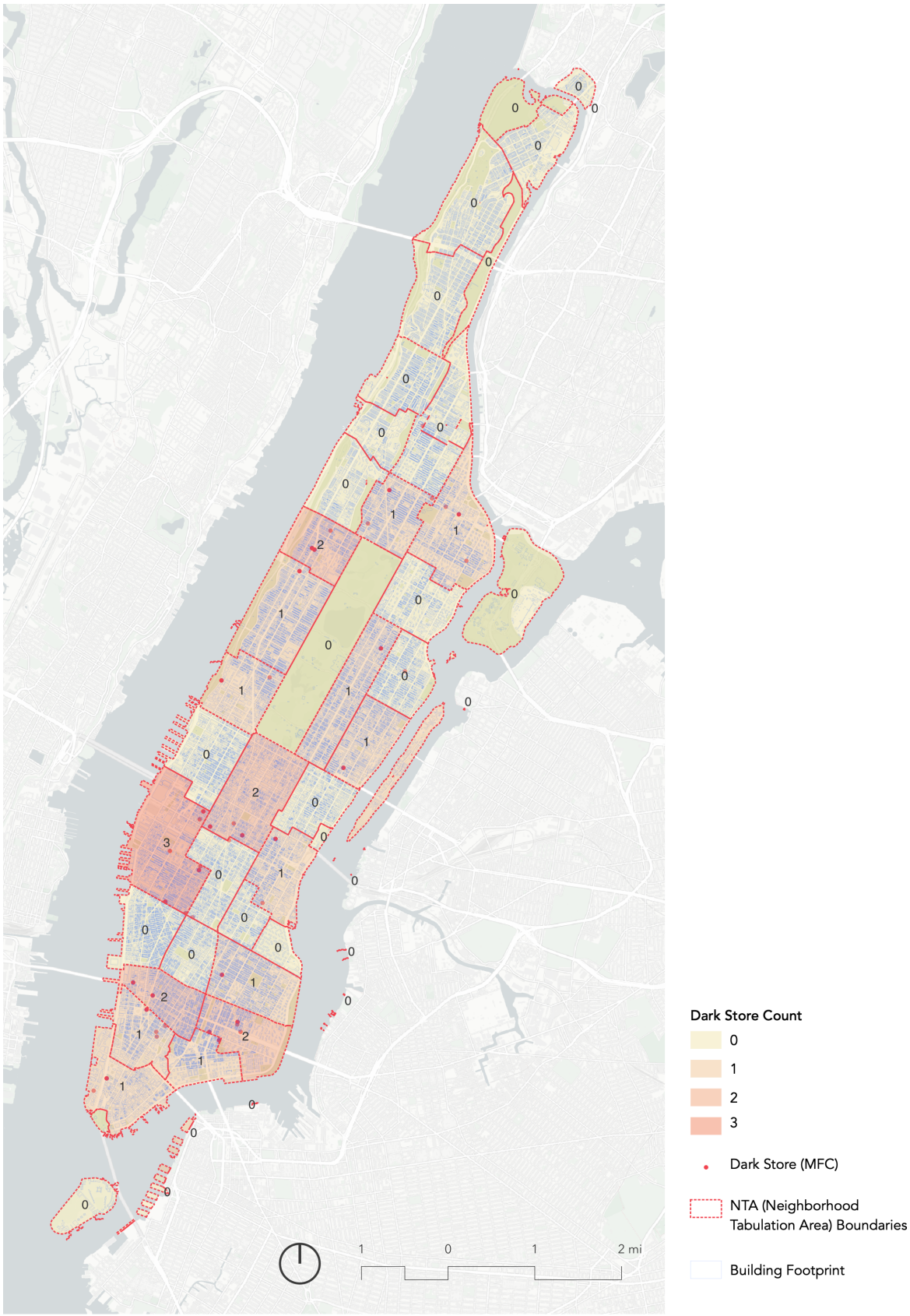


Figure 37 | Distribution of Grocery "Dark Stores" in Manhattan, Map by Author, Source: NYC Department of Agriculture and Market, 2023

4.4.2. Independent Variables

I identify several independent variables that help explain the driving factors behind location selection for grocery "dark stores." The variables are correlated with the underlying assumption based on a literature review of retail location theory and interviews with several grocery "dark stores" companies. I categorized the independent variables as 2 categories: point of interests and geodemographics. Geodemographics gives a ready-made profile of the population by age, social class, and many other dimensions. I speculate that grocery "dark stores" consider population density, median household income, household expenditure, age, education level, percentage of population working from home, median gross rent, percentage of housing vacancy, vacant storefront, the density of other food retail and service-oriented businesses, and uniquely branded assets (such as Starbucks and Blue Bottle Coffee). Percentage of population working from home could be an interesting factor as these grocery "dark stores" show up at the same time as the COVID-19 pandemic and an increase in the "working from home trend".

Category	Variable Name	n	mean	sd	median	min	max	range	SE
Location	Dark Store 2022	47	0.94	1.49	0.00	0.00	7.00	7.00	0.22
	Dark Store 2023	47	0.47	0.75	0.00	0.00	3.00	3.00	0.11
Point of Interest	Facilities	47	16.98	19.76	11.00	0.00	86.00	86.00	2.88
	Retail Food Store	47	49.85	43.01	56.00	0.00	139.00	139.00	6.27
	College and University	47	0.91	1.55	0.00	0.00	6.00	6.00	0.22
	Vacant Storefront (sqm)	1535	6,341.70	9,259.26	2,747.00	272.10	128,453.20	128,181.10	236.33
Demographics	Population Density (/km2)	1319	3,829.00	2,900.27	3,437.00	0.00	20,553.00	20,553.00	79.89
	Average Age	1319	33.31	15.33	39.60	0.00	82.50	82.50	0.42
	Percentage of Higher Educated Population	1319	0.68	0.33	0.82	0.00	1.00	1.00	0.0091
	Median Household Income (USD)	1319	87,084.00	78,018.07	76,240.00	0.00	250,001.00	250,001.00	2149.00
	Household Expenditure (USD)	1319	18,962.00	15,758.12	16,102.00	0.00	124,816.00	124,816.00	434.06
	Median Gross Rent	1319	1,676.00	1,137.72	1,774.00	0.00	3,501.00	3,501.00	31.34
	Percentage of Housing Vacancy	1319	0.13	0.14	0.11	0.00	1.00	1.00	0.004
	Percentage of Population Working from Home	1319	0.14	0.13	0.12	0.00	1.00	1.00	0.004
	Asian	1319	167.00	218.63	106.0	0.00	2,325.00	2325.0	6.02
	African American	1319	151.60	268.88	43.00	0.00	3,624.00	3,624.00	7.41

American Indian & Alaska	1319	1.44	3.75	0.00	0.00	104.00	104.00	0.10
Hispanic	1319	305.40	381.99	139.00	0.00	2,055.00	2,055.00	10.52
Native Hawaiian & Pacific Islander	1319	0.67	2.96	0.00	0.00	80.00	80.00	0.08
White	1319	602.30	477.90	598.50	0.00	3,875.00	3,875.00	13.16

Table 6 | Descriptive Statistics of Dependent and Independent Variable

I hypothesize that household expenditure, population density, percentage of the population working from home, percentage of housing vacancy, the density of other food retail, facilities, service-oriented businesses, college and universities, and vacant storefronts would be critical in selecting locations for grocery "dark stores." Grocery "dark stores" would select their location based on high-density areas with high household expenditure on food category, low percentage of housing vacancy, a higher percentage of working from home population, and point of interest. At the same time, they might want to be in areas with high vacant storefronts to cut down their operational cost on rental prices. Grocery "dark stores" will stay, however, in the end only the strong player will stay in the field.

4.6. Methodology

This research employs both quantitative and qualitative approaches. The quantitative method relies on spatial and location analysis technique to understand the spatial configuration of "dark stores" as related to urban form and activities and their market competition. The spatial and location analysis method will take place through GIS to determine existing urban forms in the form of graphics representing the area under investigation.

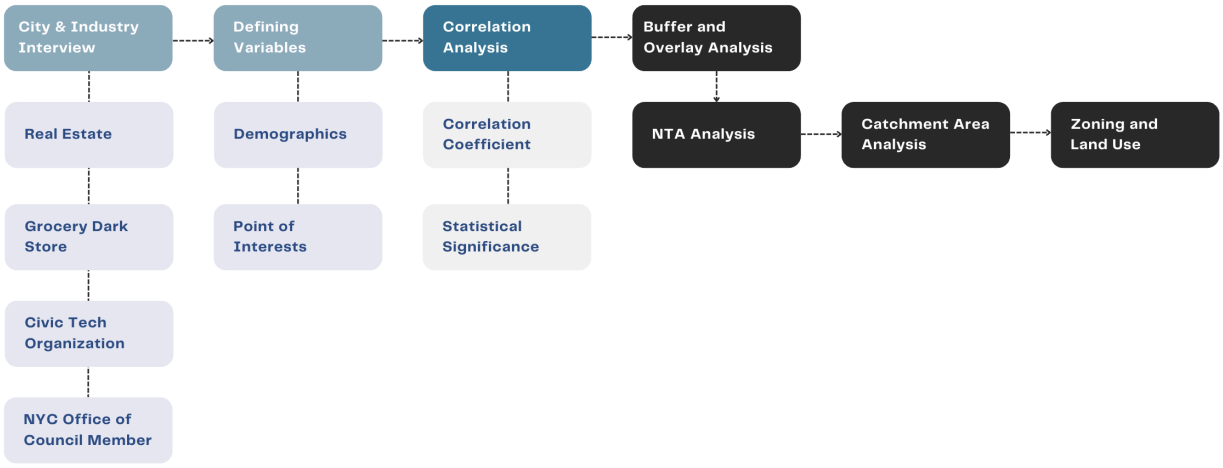


Figure 38 | Methodology, Diagram by Author

Correlation Analysis and Industry Interview

I ran correlation analysis help to examines the variable assumptions that potentially affects grocery "dark store" location preferences based on existing point of interests and demographic characteristics. I interviewed the industries, researchers, government officials, and organizations to validate the variables needed to run the analysis. In addition, I conducted semi-structured phone interviews with operation managers and real estate strategists from 2 different "dark stores" companies to understand how they operate and understand the factors of their location selection; James Robert Scott from MIT Real Estate Innovation Lab to understand how the technology and automation are fundamentally changing real estate; Ryan Monell from the Real Estate Board of New York to understand how building owners, managers and developers view and approach this phenomenon; Edward Amador from the Office of Council Member Gale Brewer to understand how the city view and respond this phenomenon; and Zhi Keng He from BetaNYC, a civic tech organization in New York City, to understand their previous research on this phenomenon and pick up where they left off to continue the research. Finally, I interviewed Frank Ruchala, the Director of Zoning from New York City Department of City Planning to understand the department's perspective on grocery "dark stores" and their future implications.

Buffer and Overlay Analysis using Geodemographics and Point of Interests

For the spatial analysis, using buffer and overlay analysis in QGIS, I demarcated the catchment area of existing grocery "dark stores" to understand these sets of questions:

<u>What are the impacts of grocery "dark stores" on urban fabric?</u>

a. How are grocery "dark stores" impacting zoning and land-use regulation?
b. How are grocery "dark stores" impacting building façade design?
c. Will "dark stores" phenomenon stay?

<u>Where are grocery "dark stores" located in urban areas?</u>

a. What factors are being considered in grocery "dark stores" location?
b. What is the proximity of grocery "dark stores" location to these considered factors?
c. Who are their target customers?

#1 Neighborhood Tabulation Area Analysis

The first step is to estimate catchment area based on Neighborhood Tabulation Areas (NTAs) to understand from a macro scale of in which neighborhood or area these stores are located – what reasons drive these grocery "dark stores" to be located in their current location and to understand potential violation of zoning regulation. NTAs were considered for the need for both geographic specificity and statistical reliability. Each NTA contains enough population to mitigate sampling error associated with the

ACS yet offers a unit of analysis smaller than the census tract level while grouping several block groups altogether for spatial analysis purposes.

#2 Thiessen Polygon (Voronoi) Analysis

Secondly, I use the Thiessen Polygon analysis to analyze each store location on a more granular level. Thiessen Polygon, also known as Voronoi analysis is a procedure for delimiting theoretical areas for a network of stores. This method assumes that the retail stores for which trade areas are being delineated are similar in size and sell similar products at similar prices; and that consumers purchase goods from their closest store to minimize travel distance or time. Voronoi models combine information on store locations and attributes with assumptions about consumer behavior to generate trade areas.

They are most useful in situations where detailed consumer patronage data is either unavailable or deemed too costly or time consuming to acquire. Moreover, they can be used in either a descriptive or a predicative way. For example, when applied to the outlets of a single retail chain, Voronoi diagrams provide a visual representation of the retail location strategy. Voronoi diagrams can also be used to identify potential sites for new facilities and indicating impact of these and other changes on the existing set of facilities.

In GIS software, this method is known as the *equal competition* method and is most suitable for delineating areas of chain stores. This method does not account for store attractiveness and works well in areas with minimal physical barriers to movement and transportation, as it does not recognize the existence of barriers and ignores their effects (Wang & Du, 2021). I use the ordinary Voronoi diagram method, which consider only the locations of facilities and assumes that customers patronize the nearest facilities considering these grocery "dark stores" are similar in size.

4.7. Limitations

Data Limitations

The data collection and methodology process for the analysis has several limitations. Firstly, the latest Census Block 2021 data has yet to be entirely out; therefore, data is limited to the Manhattan area only. Although this is concerning, 2020 data would be more relevant than 2010. The catchment area for grocery "dark stores" located nearby other boroughs, such as Brooklyn, will be limited to the Manhattan area only. However, this should make sense as I only limit my study area to understanding the impact of grocery "dark stores" in Manhattan.

Secondly, the grocery "dark store" location data was from March 2022, where after the report and location survey were out, there are several grocery "dark stores" shut down due to political and financial reasons,

while there are no more updates where new grocery "dark stores" are popping out. To overcome this limitation, I did a ground survey of some of the neighborhoods. I eliminated the name of the stores that went bankrupt or left the United States for political reasons. Moreover, the interview might not be representative of total grocery "dark stores" operations, which calls for more comprehensive future research and approach. Lastly, despite being a densely populated city, demographics characteristics in New York City tend to be homogenous and evenly distributed within areas.

Methodology Limitations

While Voronoi analysis is useful tool in retail location theory, it does have some limitations. Firstly, Voronoi analysis assumes spatial homogeneity, meaning that all areas within a Voronoi cells are considered equal in terms of population or demand. Secondly, Voronoi analysis typically considers a single factor, such as population or demand to determine optimal retail locations. Although these assumptions may not hold true in practice, as populations can vary within sells due to factor like demographics, socioeconomic conditions, or market preferences, however this can be seen as a limitation because, retail market areas will likely overlap with one another. Retail location decisions are often influenced by multiple factors, including competition, accessibility, market saturation, and customer preferences. This should be a priority for future research. Despite these limitations, Voronoi analysis remains a valuable tool in this research, especially as start of a broader study that will incorporate other factors, data sources, and methodologies to account for the complexities of retail environments.

Secondly, comparing grocery "dark stores" data from year 2022 to 2023 may not provide an accurate representation of the overall situation. Relying on data form this specific timeframe may not capture the full extent of changes and trends occurring in the industry. For future research, broader time span and deeper understanding of the topic requires a more extensive analysis. This may involve considering additional variables, examining longer time periods, and possibly exploring different geographic regions. By doing so, the research can obtain a more accurate and holistic understanding of the evolving landscape of grocery "dark stores" and their implications.

Chapter 5 |
The Design and Planning of "Dark Stores" and Public Spaces

This chapter investigates the relationship between grocery "dark stores" location and retail location planning, service area, and the association between grocery "dark stores" and city planning code. In this chapter, I will further discuss the methods and research findings for these remaining research questions.

- Where are grocery "dark stores" located in urban areas?
- What are the impacts of grocery "dark stores" on urban fabric?
- What should be the appropriate response for the presence of grocery "dark stores"?

I will cover each research question by explaining the research methods and result from the findings and incorporating the qualitative findings from industry interviews.

5.1. Part One: Design and Planning of Grocery "Dark Stores"

This part will examine grocery "dark stores" location distribution in Manhattan by understanding the factors considered in the location selection process, the proximity of grocery "dark stores" to the point of interest and demographic characteristics, and catchment area analysis.

5.1.1. Exploratory Findings

To begin, I checked the correlations between selected independent variables in the data and identified the correlation and statistical significance of the dependent variable based on each Neighborhood Tabulation Areas (NTAs). I did the former by running Spearman's correlation test for non-normal distribution data type and correlation p-value test to determine the significance of the relationships using R.

In the correlation analysis, I observed a positive correlation between grocery "dark stores," points of interest, and several demographic characteristics (Table 7 & Figure 39). This positive correlation is consistent in both 2022 and 2023, with facilities and retail food stores as "points of interest" having a higher correlation than "demographic characteristics." On the other hand, some variables, such as population density, Hispanic, African American, American Indian and Alaska population, vacant storefronts, colleges, and university have low correlation. These relationships and findings strengthen the factors mentioned in the industry interview, suggesting the importance of density towards other retail food stores and service-oriented businesses or facilities to determine location selection.

Correlation Coefficient																		
	PD	**Age**	**Ed. Higher**	**Median HH Income**	**HH Expenditure**	**Median Gross Rent**	**Housing Vacancy**	**Work From Home**	**Asian**	**African American**	**American Indian & Alaska**	**Hispanic**	**Native Hawaiian & Pacific Islander**	**White**	**Facilities**	**Retail Food Store**	**Vacant Storefront**	**College & Uni**
Dark Store 2022	0.22	0.41	0.43	0.49	0.52	0.47	0.46	0.41	0.57	0.34	0.33	0.25	0.50	0.44	0.65	0.53	0.29	0.29
Dark Store 2023	0.21	0.40	0.37	0.42	0.46	0.39	0.43	0.37	0.55	0.23	0.23	0.18	0.42	0.37	0.54	0.47	0.23	0.26
P-value																		
Dark Store 2022	0.20	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.03**	**0.02**	**0.04**	0.29	0.13	0.92	0.07	**0.03**	**0.01**	**0.00**	0.27	0.62
Dark Store 2023	0.17	**0.00**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	0.94	0.46	0.72	0.08	**0.03**	**0.01**	**0.00**	0.41	0.81

Table 7 | Correlation Coefficient and P-Value

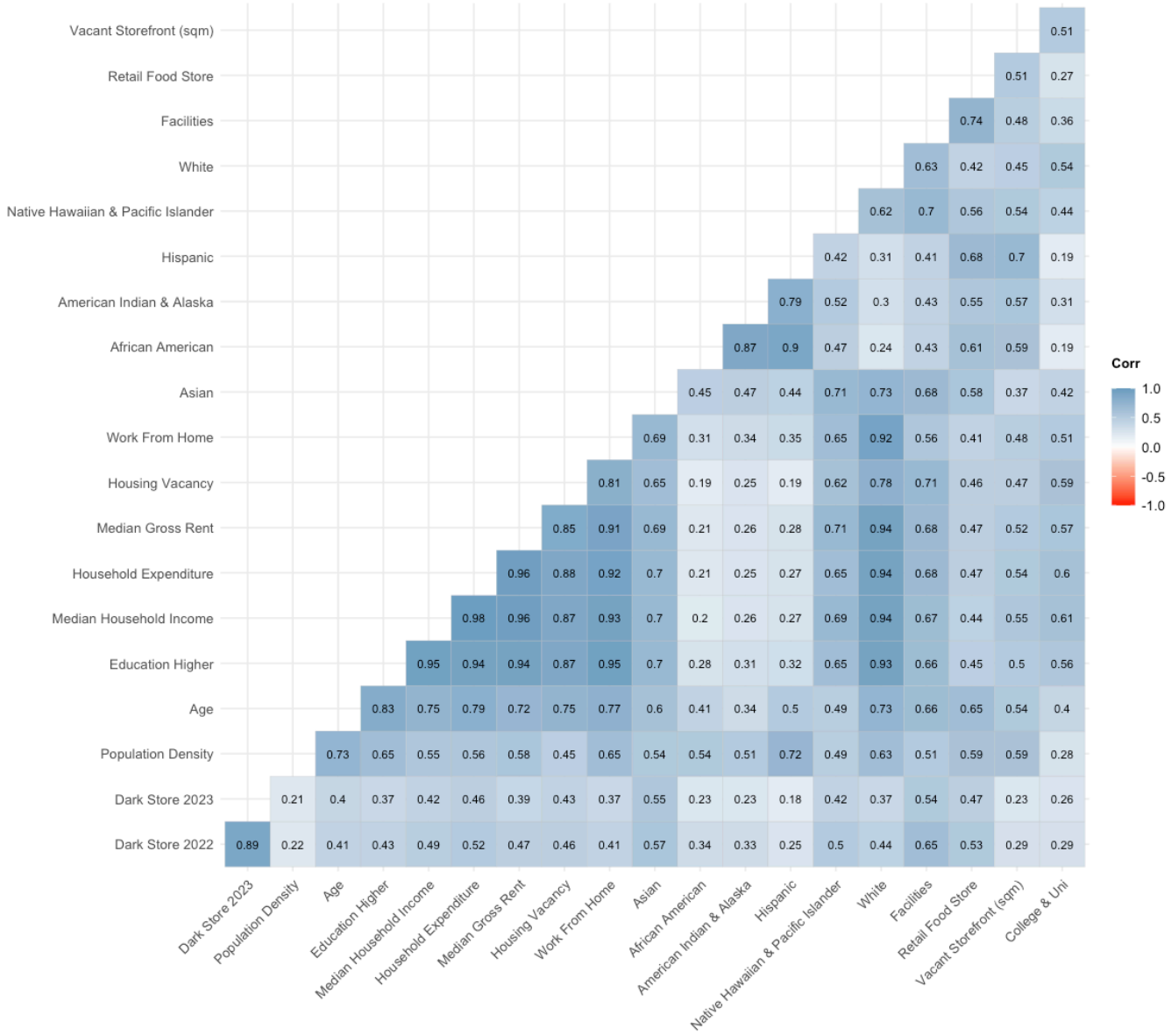


Figure 39 | Correlation Heatmap

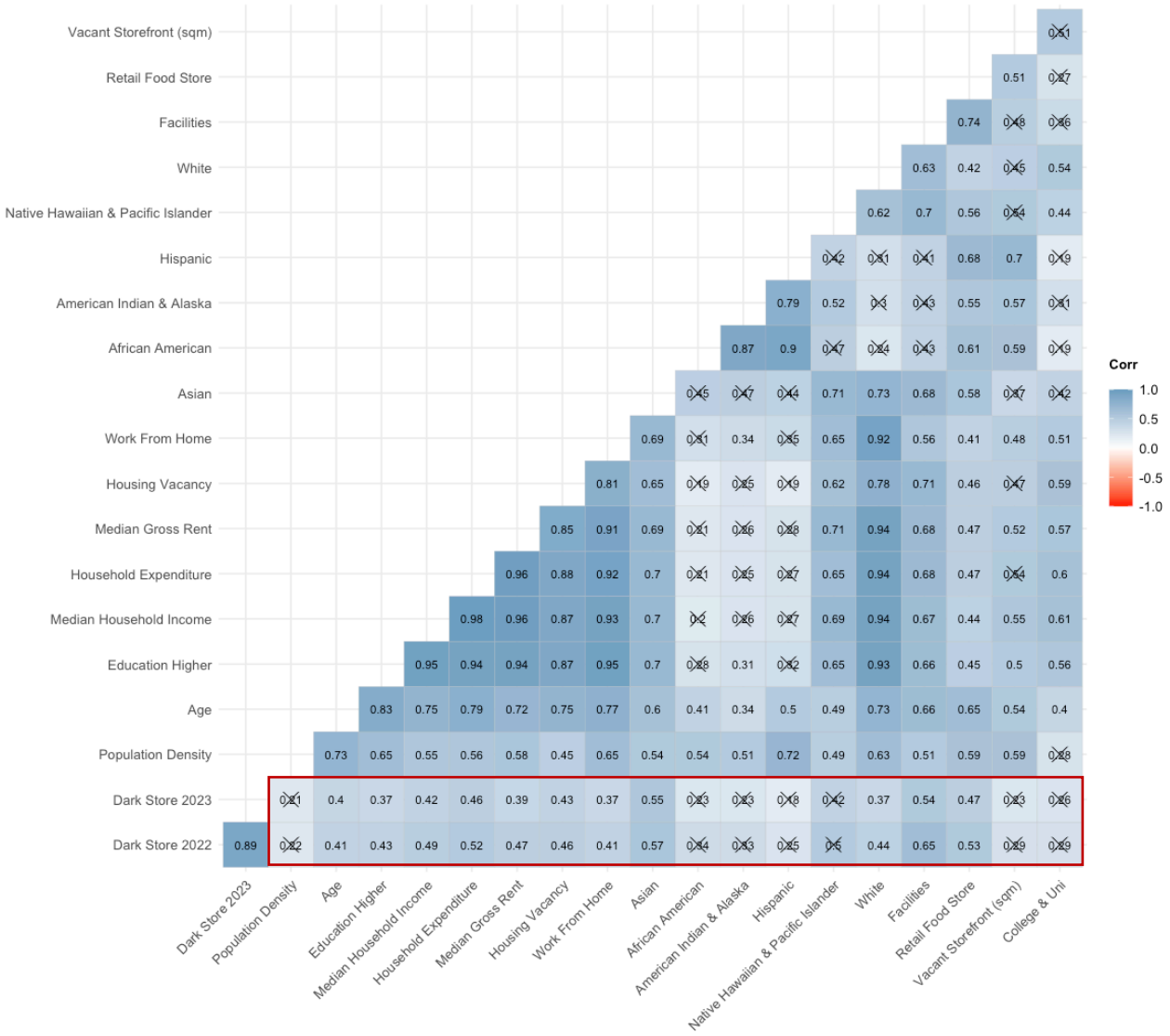


Figure 40 | Correlation Heatmap and Statistical Significance

In analyzing statistical significance, the p-values suggest that most of the correlations are significant at 0.05 level in both years. This means that the observed relationships between grocery "dark stores" and these variables are unlikely to have occurred by chance. However, it is important to note that correlation does not imply causation. While these correlation coefficients indicate the presence of relationships between grocery "dark stores" and the variable listed, they do not provide information about the direction or underlying causes of these relationships. Further analysis and research are necessary to understand the complex factors influencing grocery "dark stores" trends and their associations with the mentioned variables.

5.1.2. Location Selection Factor and Grocery "Dark Stores" Distribution in Manhattan

To gain a deeper understanding of correlation coefficients and their implications, I conducted a location selection analysis on the distribution of grocery "dark stores" in Manhattan. This analysis involved a combination of industry interviews and spatial analysis technique.

Interview Findings

The industry interviews provided valuable insights from professionals in the grocery "dark stores" retail sector regarding the factors influencing the selection of locations for "dark stores" in Manhattan. These interviews allowed me to gather firsthand information about market trends, customer preferences, competitive dynamics, and operational considerations that impact the distribution of these stores.

Location selection factor is crucial for traditional grocery retailers and even more critical for on-demand delivery with the promise of 15-minute delivery. Based on industry interviews with grocery "dark stores" companies, real estate practitioners, and existing literature on retail location planning, the factors being considered in selecting grocery "dark stores" location is population density, age, education, median household income, household expenditure, median gross rent, the density of other grocery retailers such as Wholefoods, bodegas, and service-oriented businesses and facilities such as coffee shops, restaurants, parks, and theatres. In addition, commercial real estate prices, building vacancy, foot traffic, infrastructure, and distribution network are also considered.

In a podcast with Reid Hoffman called "Master of Scale," Yakir Gola, the co-founder of GoPuff, mentioned that, on average, delivery in bigger and newer cities such as New York could be achieved in 11 minutes. The combination of MFCs infrastructure built within the cities plays a significant role. Each of the MFCs needs to have a certain radius for fast delivery, including the 2 minutes time frame to pack customers' orders. In addition, making sure that the drivers are not going too far and that the empty leg journey when they are coming back from delivering is short is also important to consider.

Grocery "dark stores" typically aim to have a leaner inventory profile by having a smaller footprint and the ability to stock inventory easier by building their distribution network. Yakir Gola mentioned they started their business by finding vacant office buildings and later owning their vertically integrated inventory management, understanding the practical operations, and running it more efficiently by operating with lower SKU. This would save real estate costs and limit the complexity of the store layout. On average, GoPuff has 4,500 SKUs. They started selling instant

needs in 2016 and now expanding into alcohol, ice cream, kitchen business, medicine, drugs, diapers, and frozen food.

To select location, some of these stores have their own optimization tool to measure their location-allocation analysis, for example GoPuff has a tool called GMO (GoPuff Market Optimization) Tools. Their tool will drop pin on locations and looking to analyze how much they will lose by not being located in a specific geographic area. The metrics they use is to look at intensive purchases from understanding number of clicks in their website and platform but do not get things delivered – their tool optimizes to increase user conversion rate from observer into buyer by establishing service in certain geographical area. The tool then will build a look alike audience in a geographical area matching with the demographic information in the area to understand what the Lifetime Value (LTV) will look like. The more data are fed in into the system, the more accurate the optimization tool prediction.

Quantitative Findings

In addition to the industry interviews, spatial analysis techniques were employed to analyzed geographic data and identify patterns or spatial relationships between the locations of "dark stores" and various variables. This analysis involved mapping the distribution of "dark stores" in Manhattan and overlaying it with datasets representing point of interests and demographic information. By examining the spatial relationships and patterns, I aimed to uncover a potential correlations or associations between the locations of grocery "dark stores" and the variables under investigation.

Facilities. 68% of NTAs of where grocery "dark stores" are located has high number of facilities for almost twice the average of Manhattan. Ranging from 19 to 86 facilities.

Retail Food Store. 90% of NTAs with grocery "dark stores" has higher number of retail food stores than the Manhattan average, for about 1.25 to 2 times higher. The presence of other retail food stores nearby is necessary to be considered to understand the customer demand and needs in a particular area. High density of retail food store shows high demand and higher income spend on groceries. Several of these grocery "dark stores" company operate with the intention to help small businesses around. Gorillas sell bodega sandwiches through their app (Nargi, 2022). In addition to that, Yakir Gola from GoPuff mentioned that their consumer insight report shows 80% of GoPuff customer like to see and buy local brands from nearby area.

Population Density. On average the population density ranges between 1,400 to 6,200 people per km2. 74% of NTAs with grocery "dark stores" have higher population density than the Manhattan's average. Putting an assortment of goods and robust logistic systems next to a high-density population of consumers creates the opportunity for a feedback loop of customers to other goods within minutes. Grocery "dark store" companies are considering population density from their potential catchment areas and city-wide regions. Alexander Angeline, Strategy and Business Operations Lead from Gorillas mentioned that currently, New York City (with a population density of 29,729 individuals per square mile) is one of the only US markets that can handle their services compared to Boston (with a population density of 14,217 individuals per square mile) that is half as dense as New York. In addition to that, Yakir Gola from GoPuff mentioned that although the suburbs are the most prominent opportunity today with higher consumer loyalty, higher retention, and larger baskets, it will take much work to keep the time window categorizing the business operation as quick-commerce with the promise of 15-minute delivery. Window delivery time in the suburbs would need a 2 to 4 hours window.

Average Age. The base customer for these grocery "dark stores" operations in the United States is 27 years old. 90% of NTAs with grocery dark stores has population with age between 30s and 40s. However, base customers are depending heavily on geography. For example, the top customers for the GoPuff operation in Phoenix are 65 to 75-year-old women who could order three times a day. In the top 10 NTAs where most grocery "dark stores" are located in New York City, the average age is 36 to 40, higher than Manhattan average.

Education. About 84% of all NTAs with grocery "dark stores" have above average percentage of population having higher education in Manhattan (50%), ranging from 54-93%.

Median Household Income. Population living in 80% of the NTAs with grocery "dark stores" earn median household income above $64,000.

Household Expenditure. Household expenditure is calculated to understand sales potential in each NTAs. Using the formula below, sales potential is each census tract is calculated first; the figures are then aggregated for each NTAs.

$$average\ household\ size \times median\ household\ income \times consumer\ expenditure$$

In the United States, people typically the portion of a New York household's budget spent on food is 12.2% on 2020-21. From the data findings, typically people in the NTAs where grocery "dark stores" are located spend more than $13,766 (Manhattan average) on food yearly, ranging from $14,000 to 46,000.

Median Gross Rent. The population living in the NTAs of where these grocery "dark stores" are located mostly spend more than $1,200 in median gross rent.

Housing Vacancy. Typically, NTAs containing grocery dark stores has a higher number of housing vacancy than Manhattan average of above 10%.

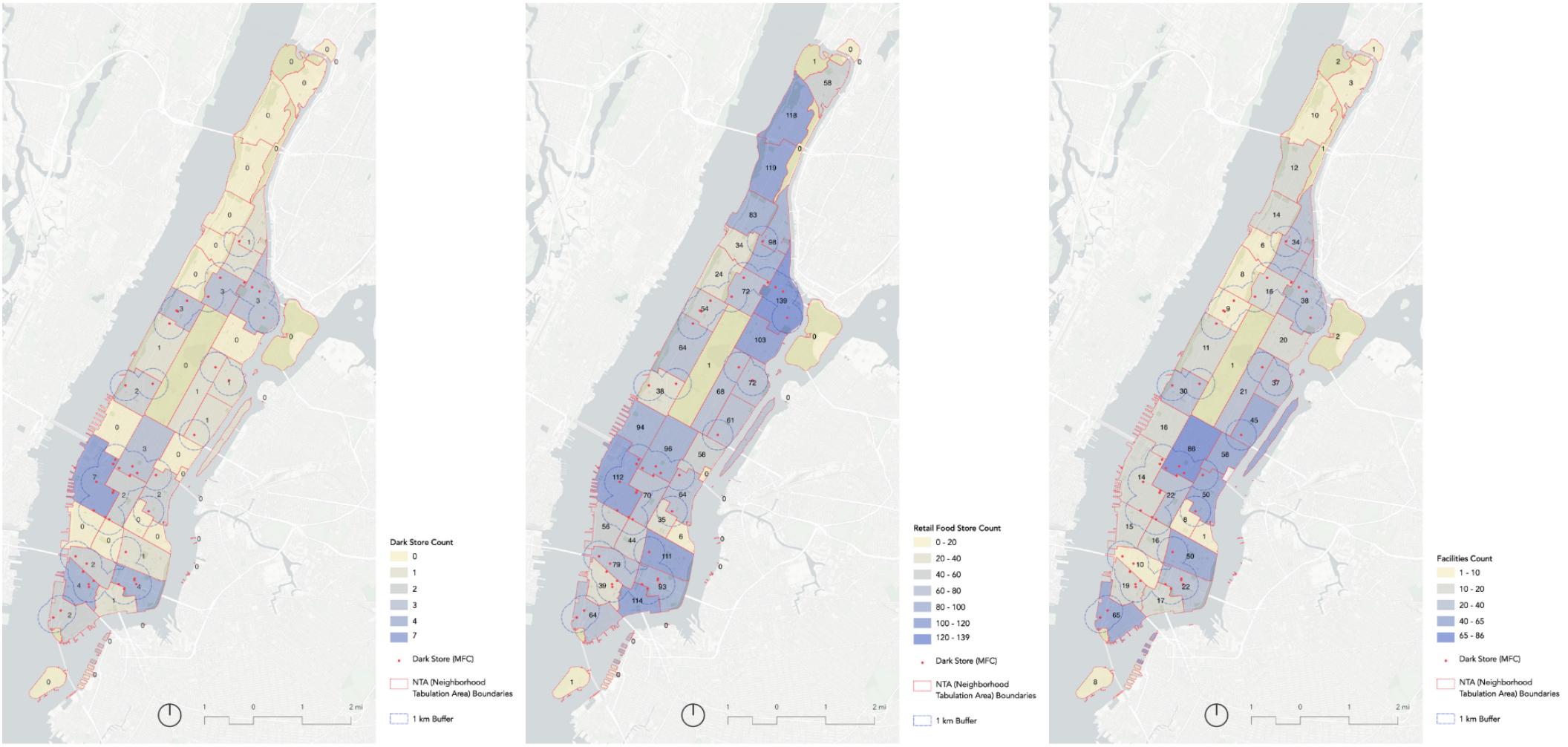
% of Employee Working from Home. Percentage of employee working from home in the NTAs with grocery "dark stores" are located are higher than the Manhattan average, more than 11%. This is most likely the changes due to the COVID-19 pandemic. Due to the pandemic, most people have attempted online grocery shopping for the first time, which forced retailers to focus on online delivery.

Quantitative findings from the spatial analysis further supported the importance of certain variables in the location selection process. The presence of a high number of facilities and retail food stores in the vicinity of grocery "dark stores" indicated customer demand and higher income spent on groceries. The analysis also showed that most of the grocery "dark stores" were located in areas with higher population density, as this creates a feedback loop of cutomers and facilitates quick delivery.

Other factors such as average age, education level, median household income, household expenditure, median gross rent, housing vacancy, and the percentage of employees working from home were also found to be higher in the areas where grocery "dark stores" were located, compared to the Manhattan average.

NTA Name	Dark Store 2022	Dark Store 2023	Pop. Density (/km2)	Age	% of Higher Educated Pop	Median Household Income	Household Expenditure	Median Gross Rent	% of Housing Vacancy	% of Employee Working from Home	Asian	African American	AIA	Hispanic	NHPI	White	Facilities	Retail Food Store
Chelsea-Hudson Yards	7	3	3168.05	34.99	0.72	$ 97,749.77	$ 19,474.04	$ 1,763.72	0.11	0.14	184	85	2	211	1	681	14	112
Tribeca-Civic Center	4	1	1958.78	31.86	0.69	$144,829.33	$ 36,395.13	$ 2,151.50	0.14	0.16	191	66	1	122	1	932	19	39
Lower East Side	4	2	2766.81	36.63	0.49	$ 48,738.88	$ 9,575.22	$ 1,013.39	0.07	0.10	299	110	1	368	0	374	22	93
Harlem (South)	3	1	3966.75	37.73	0.68	$ 66,484.55	$ 15,007.04	$ 1,424.55	0.13	0.15	87	656	3	319	1	359	16	72
East Harlem (North)	3	1	2713.48	32.43	0.41	$ 28,472.29	$ 6,682.07	$ 985.84	0.08	0.09	61	422	3	595	0	135	38	139
Upper West Side-Manhattan Valley	3	2	4777.46	43.72	0.80	$ 88,869.45	$ 20,145.23	$ 1,681.76	0.12	0.20	179	199	2	398	0	749	9	54
Midtown-Times Square	3	2	1405.15	41.25	0.81	$100,425.53	$ 25,370.12	$ 2,191.19	0.32	0.13	170	76	1	103	1	418	86	96
SoHo-Little Italy-Hudson Square	2	2	2205.43	36.04	0.70	$108,164.43	$ 23,766.76	$ 1,714.00	0.15	0.18	279	24	1	97	1	650	10	79
Murray Hill-Kips Bay	2	1	4745.01	36.10	0.83	$107,225.10	$ 20,153.09	$ 2,316.37	0.14	0.19	250	58	1	124	2	729	50	64
Midtown South-Flatiron-Union Square	2	0	2551.67	37.82	0.93	$144,888.76	$ 31,885.38	$ 2,378.52	0.17	0.19	275	97	2	197	1	931	22	70
Upper West Side-Lincoln Square	2	1	4549.94	40.87	0.83	$120,116.57	$ 24,863.54	$ 1,835.43	0.19	0.18	191	53	1	135	0	887	30	38
Financial District-Battery Park City	2	1	3530.32	23.23	0.58	$115,822.49	$ 19,631.31	$ 1,917.95	0.11	0.11	251	41	1	110	1	757	65	64
Upper West Side (Central)	1	1	4800.47	42.64	0.88	$121,117.57	$ 31,399.21	$ 2,073.96	0.17	0.23	100	75	1	169	0	907	11	64
Chinatown-Two Bridges	1	1	3606.20	38.86	0.35	$ 26,997.45	$ 6,907.66	$ 912.15	0.09	0.07	824	87	1	203	1	146	17	114
Harlem (North)	1	0	3372.80	34.83	0.54	$ 50,292.00	$ 9,360.67	$ 1,138.80	0.08	0.10	46	927	4	412	1	170	34	98
East Village	1	1	4064.83	37.47	0.73	$ 70,762.40	$ 14,106.72	$ 1,671.96	0.09	0.14	215	108	2	338	1	698	50	111
Upper East Side-Lenox Hill-Roosevelt Island	1	1	4387.85	35.52	0.76	$ 91,576.86	$ 20,380.10	$ 1,982.36	0.17	0.14	169	36	2	91	2	793	45	61
Upper East Side-Yorkville	1	0	6237.39	40.28	0.82	$106,920.76	$ 23,274.42	$ 2,090.29	0.13	0.15	145	45	1	125	0	911	37	72
Upper East Side-Carnegie Hill	1	1	3005.21	48.25	0.93	$178,310.83	$ 46,759.45	$ 2,107.61	0.30	0.22	82	11	0	65	0	955	21	68
Manhattan Average per NTA			**2723.42**	**27.25**	**0.50**	**$ 63,860.14**	**$ 13,765.13**	**$ 1,231.84**	**0.10**	**0.11**	**130**	**119**	**1**	**243**	**0**	**438**	**17**	**52**

Table 8 | Independent Variable – AIA: American Indian and Alaska, NHPI: Native Hawaiian and Pacific Islander



grocery "dark store" + retail food store + facilities

Figure 41 | Map of Grocery "Dark Stores" Count, Retail Food Store Count, and Facilities Count,

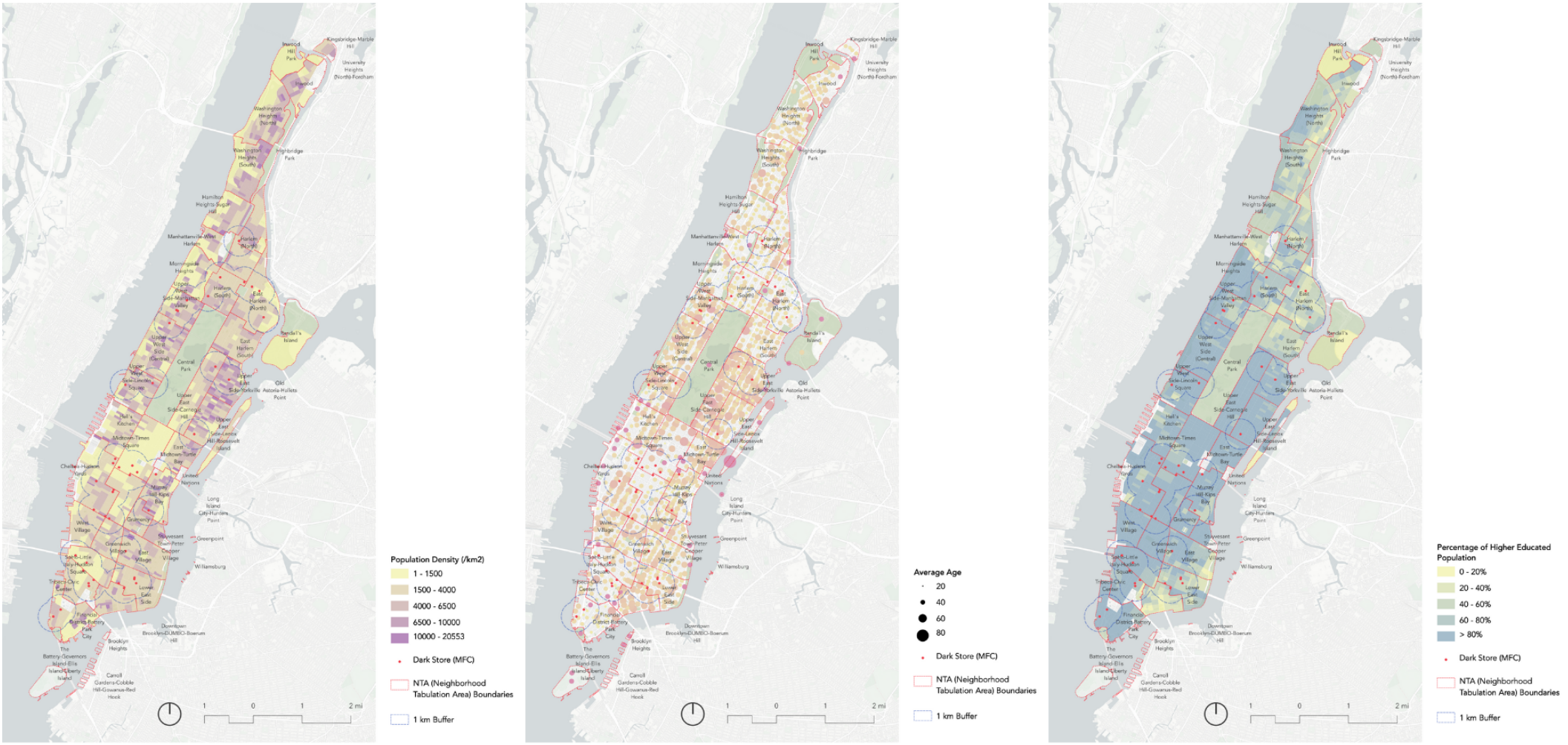


Figure 42 | Map of Population Density, Average Age, and Percentage of Higher Education Population, US Decennial Census 2020

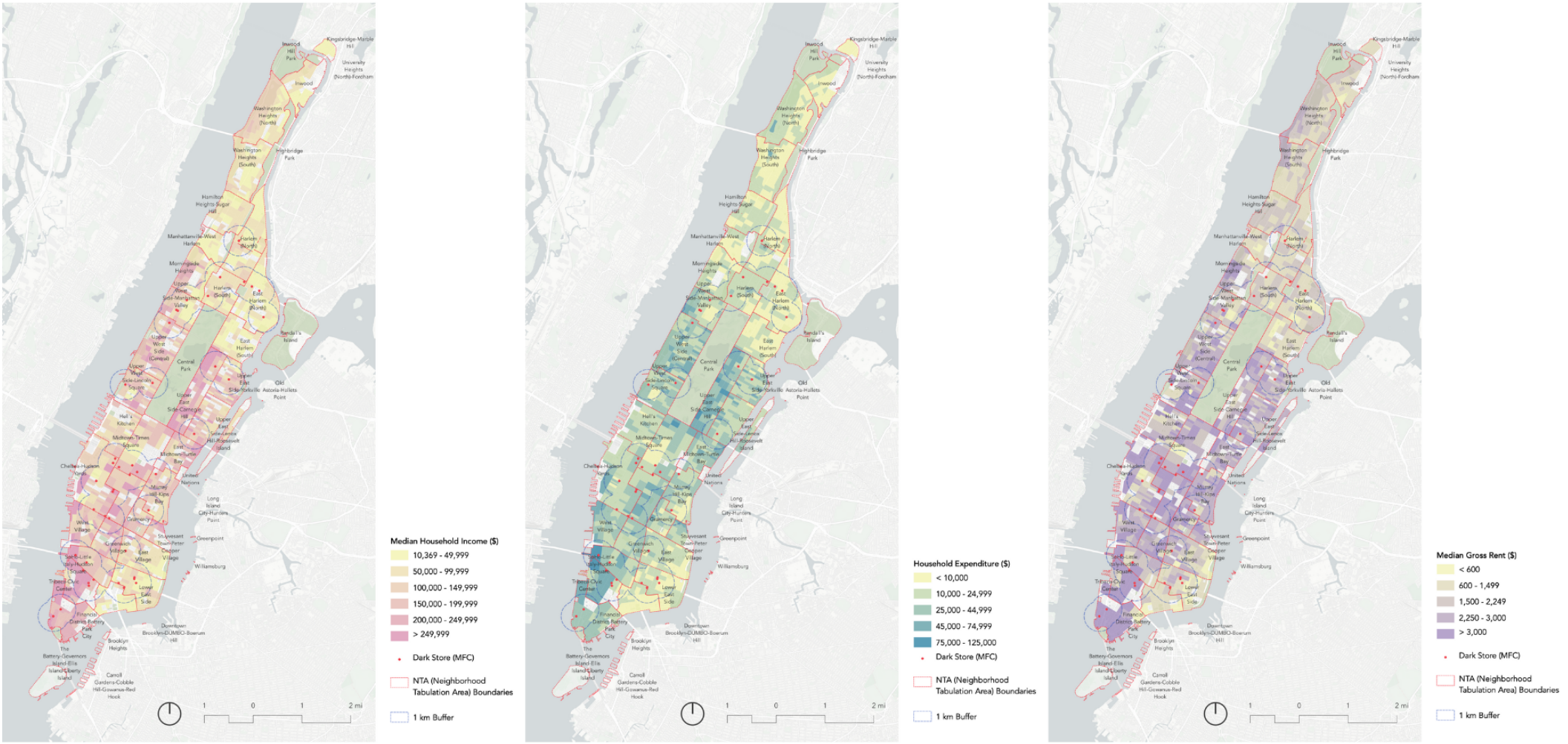


Figure 43 | Map of Median Household Income, Household Expenditure, and Median Gross Rent, US Decennial Census 2020

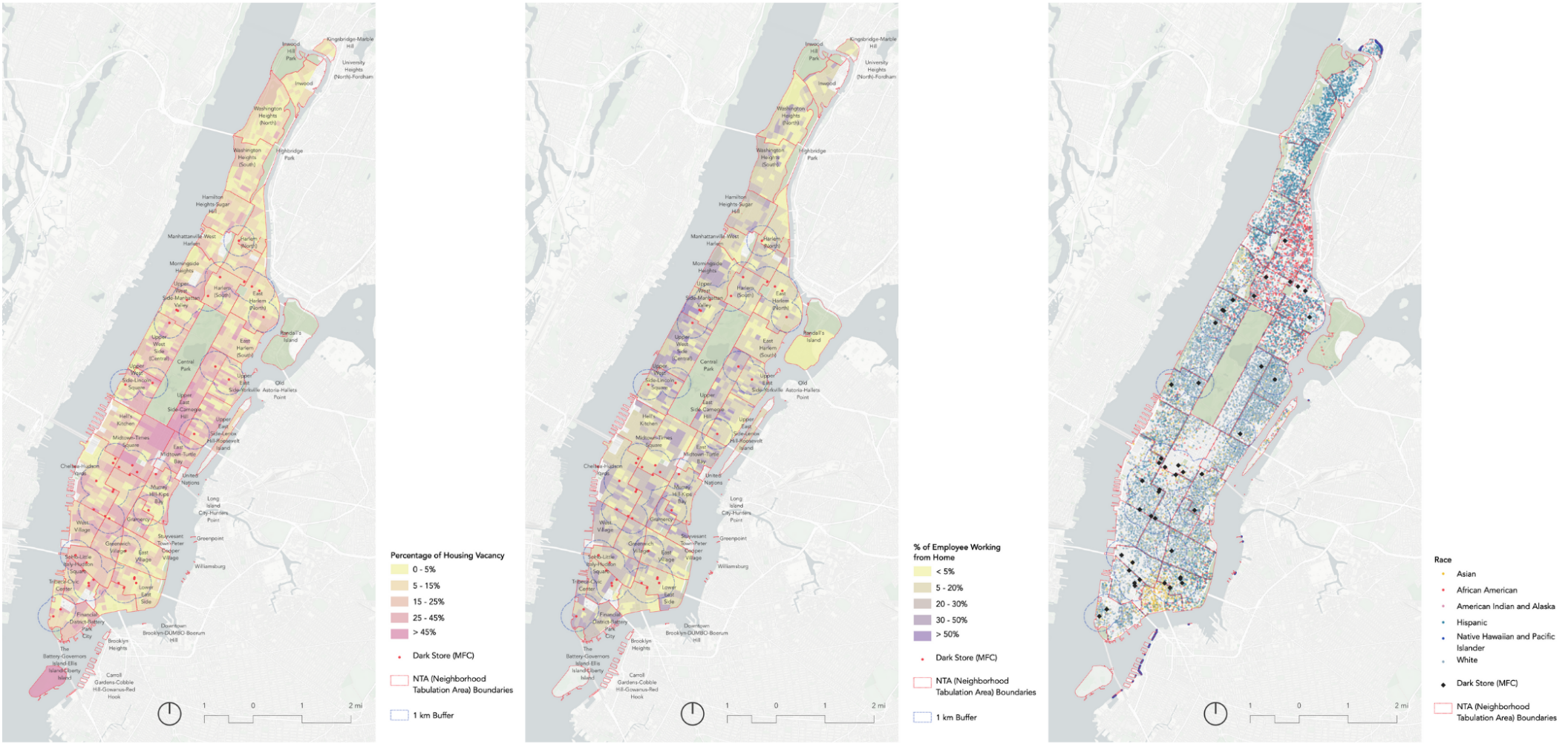


Figure 44 | Map of Housing Vacancy, Percentage of Employee Working from Home, and Race, US Decennial Census 2020

By combining the insights from industry interviews with the findings of the spatial analysis, I gained a more comprehensive understanding of the factors influencing the distribution of grocery "dark stores" in Manhattan. Overall, the location selection analysis highlighted the complex interplay of various factors in determining the distribution of grocery "dark stores" in Manhattan. Understanding the demographic, economic, and spatial characteristics of the target market is crucial for these companies to optimize their location strategies and effectively serve their customers.

5.1.3. Catchment Area Analysis (Target Audience)

This analysis aims to understand the target audience of each store using the Thiessen polygon, also known as the equal competition method, to provide a visual representation of the spatial relationships between points and their respective catchment areas. An evaluation of the independent variable by each catchment territory confirmed the concentration of demographic characteristics captured by each grocery "dark store." From this more granular analysis compared to the Neighborhood Tabulation Area analysis, we could better understand the target audience of each store.

	Pop. Density	Age	% of Pop with Higher Education	Median Household Income	Household Expenditure	Median Gross Rent	Housing Vacancy	% of Employee Working from Home
Grocery Dark Store 2022	1587.98	28.75	0.55	$ 44,185.94	$ 9,315.63	$ 821.96	0.11	0.12
Grocery Dark Stores 2023	1903.39	27.23	0.52	$ 51,372.00	$ 10,967.86	$ 955.89	0.10	0.11

Table 9 | Average Catchment Analysis Grocery "Dark Stores" in 2022 and 2023

Grocery "Dark Stores" 2022

This analysis shown in Table 9 suggests that grocery "dark stores" have higher catchment revenue from household expenditure and exposure to higher population density in the Upper East, Upper West, and Midtown Manhattan. In these areas, grocery "dark stores" capture household expenditure above the mean of grocery "dark stores" household expenditure across Manhattan. This is linear with median household income and gross rent. These stores tend to capture a higher percentage of employees working from home, while interestingly tend to catch customers in areas where housing vacancy is slightly higher than the average. Grocery "dark stores" rank in the top 50% of higher potential sales numbers that tend to capture customers between 29 to 42 years old, with an above-average percentage of the population with higher education.

Grocery "Dark Stores" 2023

In 2023, with 50% of existing grocery "dark stores" getting eliminated from the market, grocery "dark stores" have a higher average than in 2022 due to lesser competition. The findings shown in Table 9 still indicate that higher catchment revenue still happens in stores that are in Upper East, Upper West, and Midtown Manhattan, and still indicate the same statistics for the percentage of employees working from home and the percentage of the population with higher education. However, grocery "dark stores" rank in the top 50% of higher potential revenue and tend to capture younger customers than 2022 (between 28 and 38), one year younger by average.

Takeaways

The analysis of catchment areas using the Thiessen polygon method provides valuable insights into the target audience and revenue potential of grocery "dark stores" in Manhattan. The findings indicate that these stores tend to attract customers in areas with higher population density and higher household expenditure. The Upper East, Upper West, and Midtown Manhattan Areas (Figure 45 & 46 and Table 10) emerge as key locations for grocery "dark stores", capturing above-average household expenditure and demonstrating a correlation with higher median household income and median gross rent. Interestingly, these stores also tend to capture a higher percentage of employees working from home, suggesting a potential alignment with the changing work dynamics brought about by the COVID-19 pandemic. Furthermore, the analysis highlights a slight shift in the target demographic, with the average age of customers decreasing slightly in 2023 compared to 2022. Overall, these insights help to better understand grocery "dark stores" location planning in Manhattan.

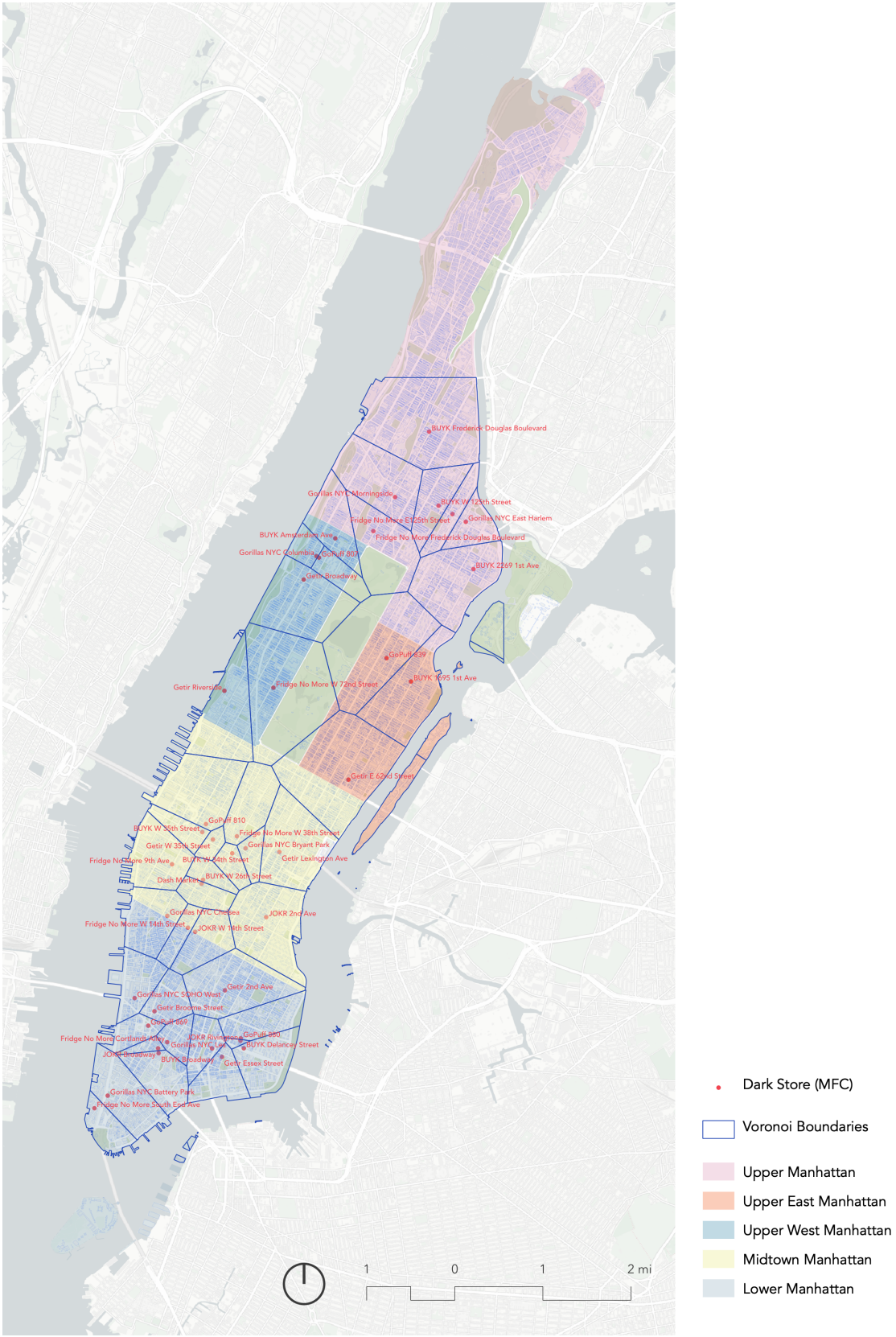


Figure 45 | Voronoi (Thiessen Polygon) Analysis, Grocery "Dark Stores" 2022

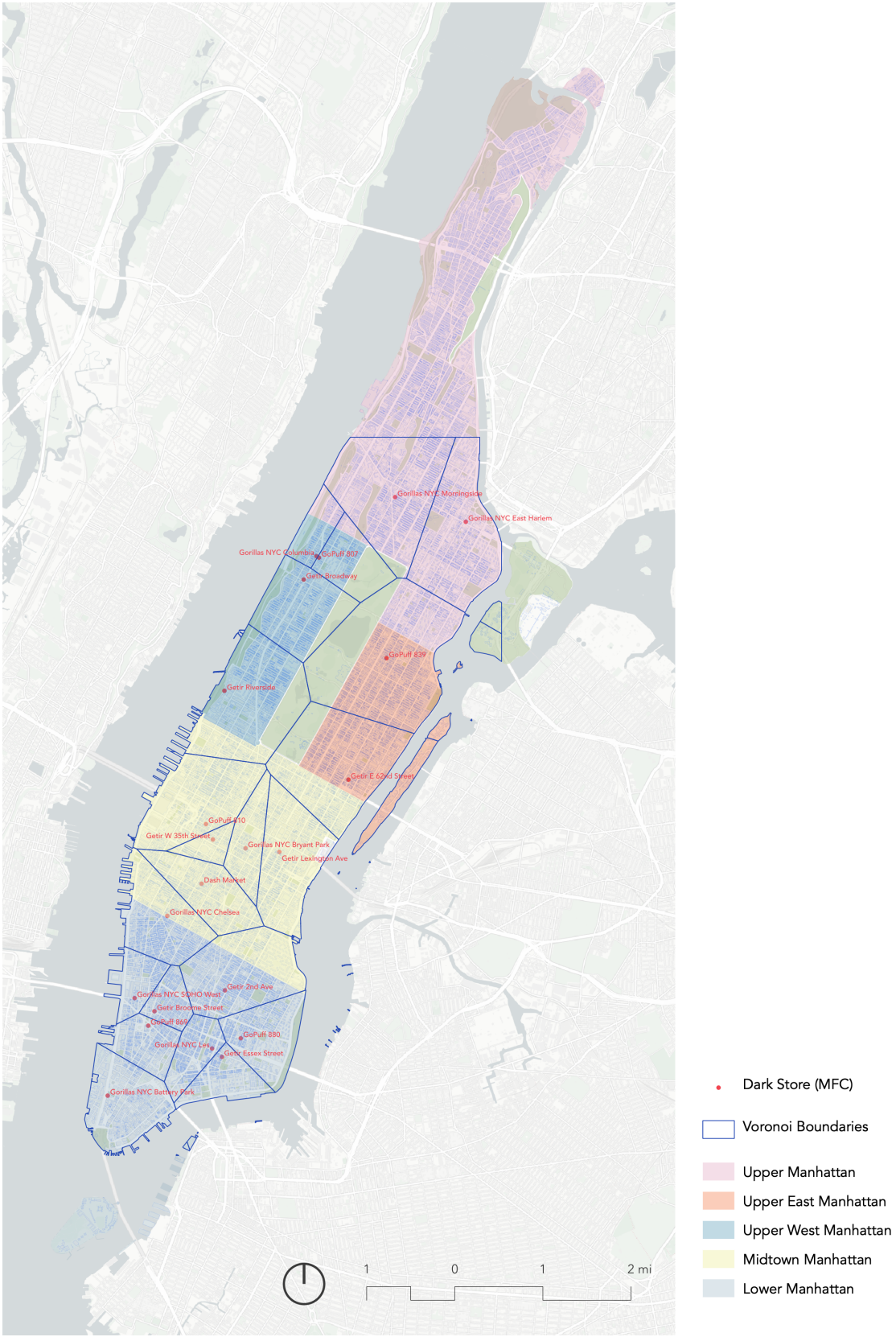
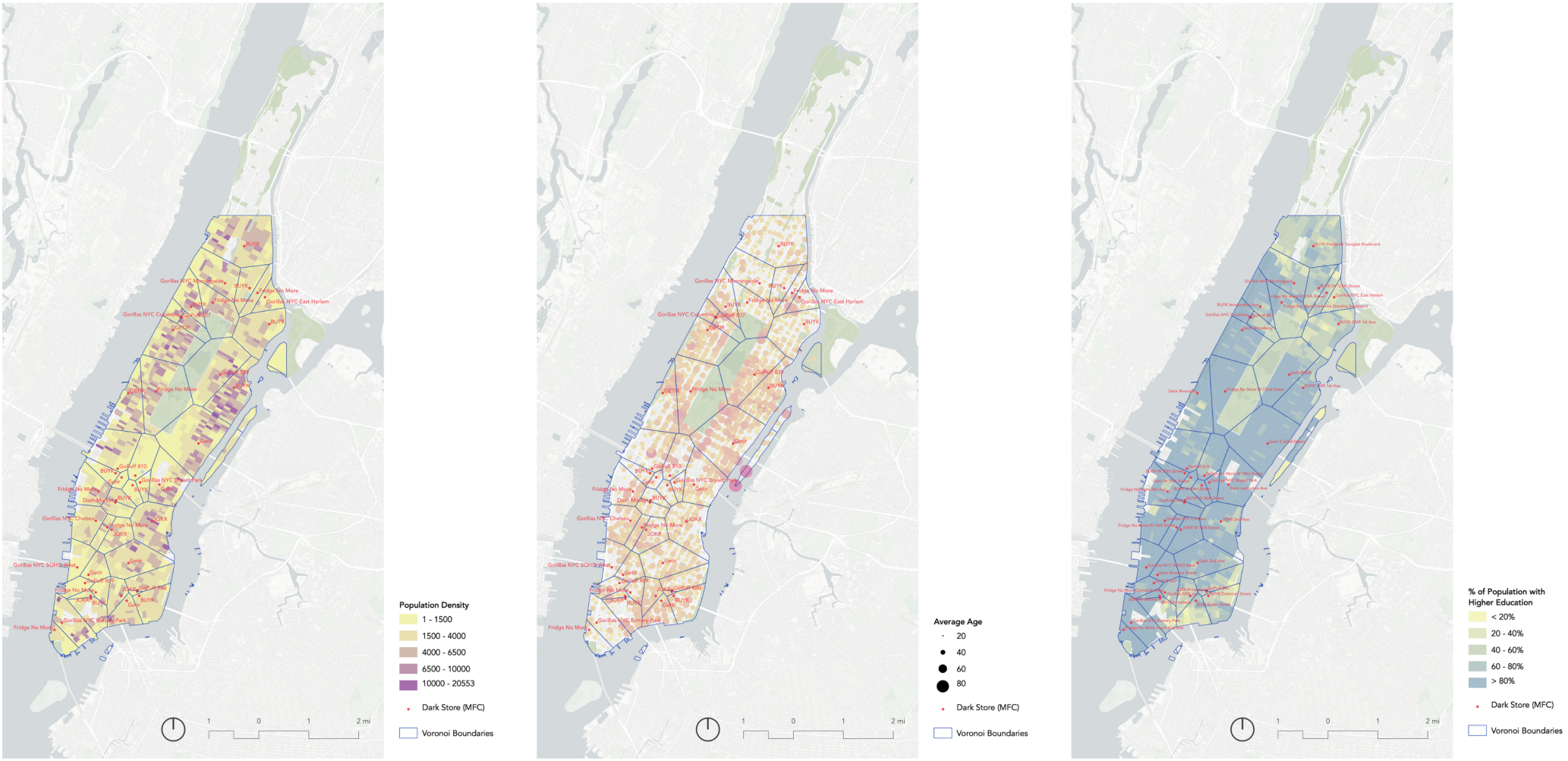


Figure 46 | Voronoi (Thiessen Polygon) Analysis, Grocery "Dark Stores" 2023

No	DBA Name	Area	Pop. Density	Age	% of Higher Educated Pop.	Median Household Income	Household Expenditure	Median Gross Rent	% of Housing Vacancy	% of Employee Working from Home
1	Getir Broadway	Upper West	3467.38	33.26	0.67	$ 73,564.34	$ 19,895.33	$ 1,271.58	0.12	0.17
2	Getir E 62nd Street	Upper East	2426.38	30.19	0.60	$ 83,534.79	$ 19,219.10	$ 1,215.90	0.19	0.12
3	Fridge No More W 72nd Street	Upper West	2490.78	32.25	0.67	$ 74,950.82	$ 17,927.66	$ 1,337.54	0.17	0.16
4	GoPuff 839	Upper East	2445.15	29.39	0.55	$ 69,575.43	$ 17,733.19	$ 1,093.89	0.13	0.12
5	JOKR W 14th Street	Midtown	1736.38	30.88	0.72	$ 78,461.85	$ 15,636.49	$ 1,170.79	0.15	0.15
6	Gorillas NYC Battery Park	Lower	2903.57	22.38	0.58	$ 89,672.50	$ 15,548.71	$ 1,488.51	0.11	0.11
7	Gorillas NYC Columbia	Upper West	2869.87	45.33	0.89	$ 71,905.39	$ 15,454.62	$ 916.93	0.11	0.29
8	BUYK 1695 1st Ave	Upper West	3468.06	30.73	0.60	$ 58,967.48	$ 14,356.84	$ 1,270.21	0.10	0.11
9	Dash Market	Midtown	1400.01	28.88	0.66	$ 50,857.27	$ 14,137.57	$ 878.22	0.09	0.13
10	Gorillas NYC Chelsea	Midtown	1658.48	34.96	0.74	$ 66,615.78	$ 13,935.31	$ 1,207.91	0.14	0.16
11	Fridge No More W 38th Street	Midtown	803.61	42.95	0.82	$ 65,925.82	$ 13,166.53	$ 1,457.17	0.30	0.12
12	JOKR 2nd Ave	Midtown	2680.27	27.53	0.63	$ 62,183.68	$ 12,687.38	$ 1,362.95	0.11	0.15
13	Fridge No More South End Ave	Lower	1086.12	19.87	0.51	$ 71,718.08	$ 11,555.61	$ 1,186.00	0.08	0.10
14	JOKR Broadway	Lower	402.16	39.12	0.92	$ 42,953.81	$ 11,084.54	$ 599.35	0.19	0.21
15	Getir Lexington Ave	Midtown	2052.08	25.26	0.55	$ 57,389.79	$ 10,919.37	$ 1,188.98	0.12	0.10
16	BUYK W 34th Street	Midtown	465.78	29.10	0.70	$ 56,163.36	$ 10,714.68	$ 760.47	0.15	0.15
17	Gorillas NYC SOHO West	Lower	582.23	21.22	0.45	$ 43,136.94	$ 10,493.35	$ 776.67	0.08	0.11
18	Fridge No More 9th Ave	Midtown	2192.56	34.82	0.68	$ 49,180.44	$ 10,467.90	$ 927.01	0.09	0.14
19	Getir Riverside	Upper West	2198.86	26.91	0.55	$ 48,337.71	$ 10,364.15	$ 760.12	0.11	0.11
20	BUYK Amsterdam Ave	Upper West	2691.45	31.82	0.63	$ 48,665.36	$ 9,841.50	$ 934.60	0.09	0.14
21	Getir 2nd Ave	Lower	2019.14	28.36	0.60	$ 47,084.04	$ 9,318.39	$ 996.52	0.09	0.11
22	BUYK W 26th Street	Midtown	835.22	24.83	0.62	$ 51,306.85	$ 9,239.36	$ 743.35	0.11	0.16
23	GoPuff 869	Lower	321.86	22.10	0.50	$ 30,379.15	$ 8,863.13	$ 449.80	0.11	0.12
24	Getir Broome Street	Lower	1148.08	28.18	0.64	$ 49,532.45	$ 8,825.05	$ 920.02	0.12	0.13
25	Fridge No More W 14th Street	Lower	948.46	24.78	0.55	$ 43,654.32	$ 8,247.24	$ 701.13	0.11	0.11
26	Gorillas NYC Bryant Park	Midtown	772.98	24.99	0.61	$ 37,599.08	$ 6,857.22	$ 768.94	0.14	0.08
27	Fridge No More Frederick Douglas Boulevard	Upper	2128.59	25.00	0.45	$ 33,228.40	$ 6,804.28	$ 651.92	0.07	0.08
28	GoPuff 810	Midtown	1413.67	22.10	0.43	$ 34,821.91	$ 6,594.06	$ 798.04	0.08	0.07

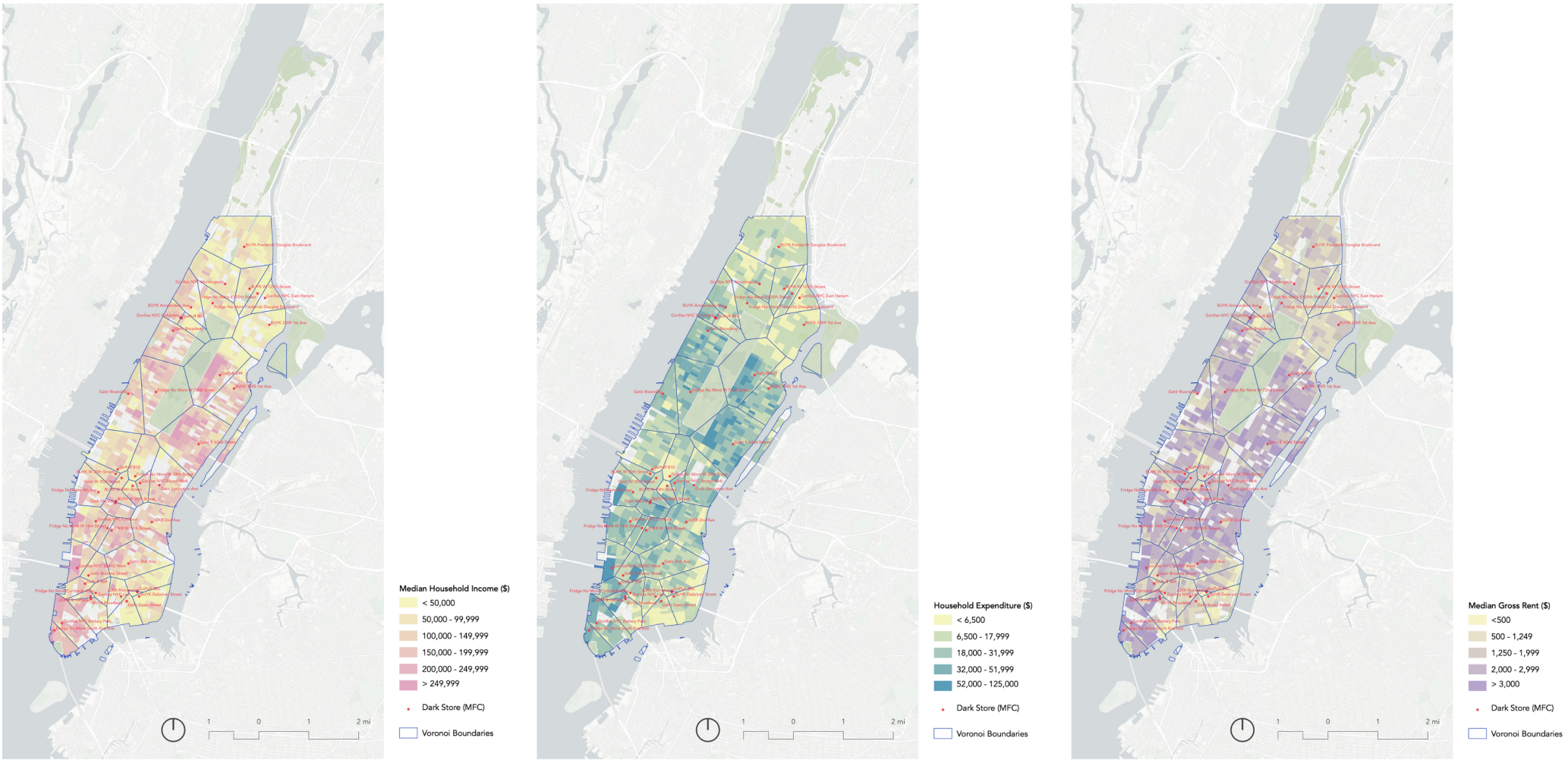
No	DBA Name	Upper	Pop. Density	Age	% of Higher Educated Pop.	Median Household Income	Household Expenditure	Median Gross Rent	% of Housing Vacancy	% of Employee Working from Home
29	Gorillas NYC Morningside	Upper	1889.32	24.58	0.45	$ 33,174.27	$ 6,078.90	$ 698.84	0.08	0.10
30	BUYK Frederick Douglas Boulevard	Lower	2542.69	26.97	0.40	$ 29,734.29	$ 6,059.93	$ 780.40	0.06	0.09
31	BUYK Broadway	Midtown	1019.62	25.31	0.39	$ 27,362.89	$ 5,733.14	$ 449.65	0.09	0.09
32	BUYK W 35th Street	Upper West	363.50	21.11	0.45	$ 35,473.00	$ 5,708.82	$ 760.08	0.09	0.07
33	GoPuff 807	Lower	1875.21	35.32	0.54	$ 28,870.95	$ 5,419.28	$ 683.58	0.12	0.13
34	Gorillas NYC Les	Lower	1393.95	30.63	0.39	$ 21,917.50	$ 5,105.64	$ 528.04	0.08	0.10
35	GoPuff 880	Lower	1488.60	27.84	0.44	$ 26,863.27	$ 5,026.90	$ 657.89	0.06	0.09
36	Fridge No More Cortlandt Alley	Upper	769.59	24.56	0.40	$ 23,352.30	$ 4,685.95	$ 382.71	0.10	0.10
37	BUYK 2269 1st Ave	Upper	1955.22	28.82	0.35	$ 18,686.54	$ 4,599.24	$ 659.71	0.08	0.07
38	BUYK W 125th Street	Lower	1035.38	23.61	0.38	$ 22,189.02	$ 4,454.90	$ 498.01	0.07	0.09
39	BUYK Delancey Street	Upper	1242.51	21.65	0.25	$ 17,688.07	$ 3,466.87	$ 272.37	0.03	0.05
40	Fridge No More E125th Street	Lower	1222.68	33.84	0.42	$ 13,855.14	$ 3,282.44	$ 466.71	0.06	0.07
41	Getir Essex Street	Upper	1540.77	25.30	0.24	$ 13,966.58	$ 3,220.89	$ 424.30	0.04	0.05
42	Gorillas NYC East Harlem	Lower	1360.61	34.66	0.41	$ 12,787.96	$ 3,015.21	$ 435.40	0.05	0.07
43	JOKR Rivington	Midtown	495.43	40.58	0.64	$ 14,461.58	$ 2,453.93	$ 345.72	0.06	0.09
44	Getir W 35th Street	Upper West	66.85	22.96	0.48	$ 12,431.21	$ 1,687.02	$ 288.30	0.17	0.08
	Average		**1587.98**	**28.75**	**0.55**	**$ 44,185.94**	**$ 9,315.63**	**$ 821.96**	**0.11**	**0.12**

Table 10 | Dark Store 2022 Catchment Area



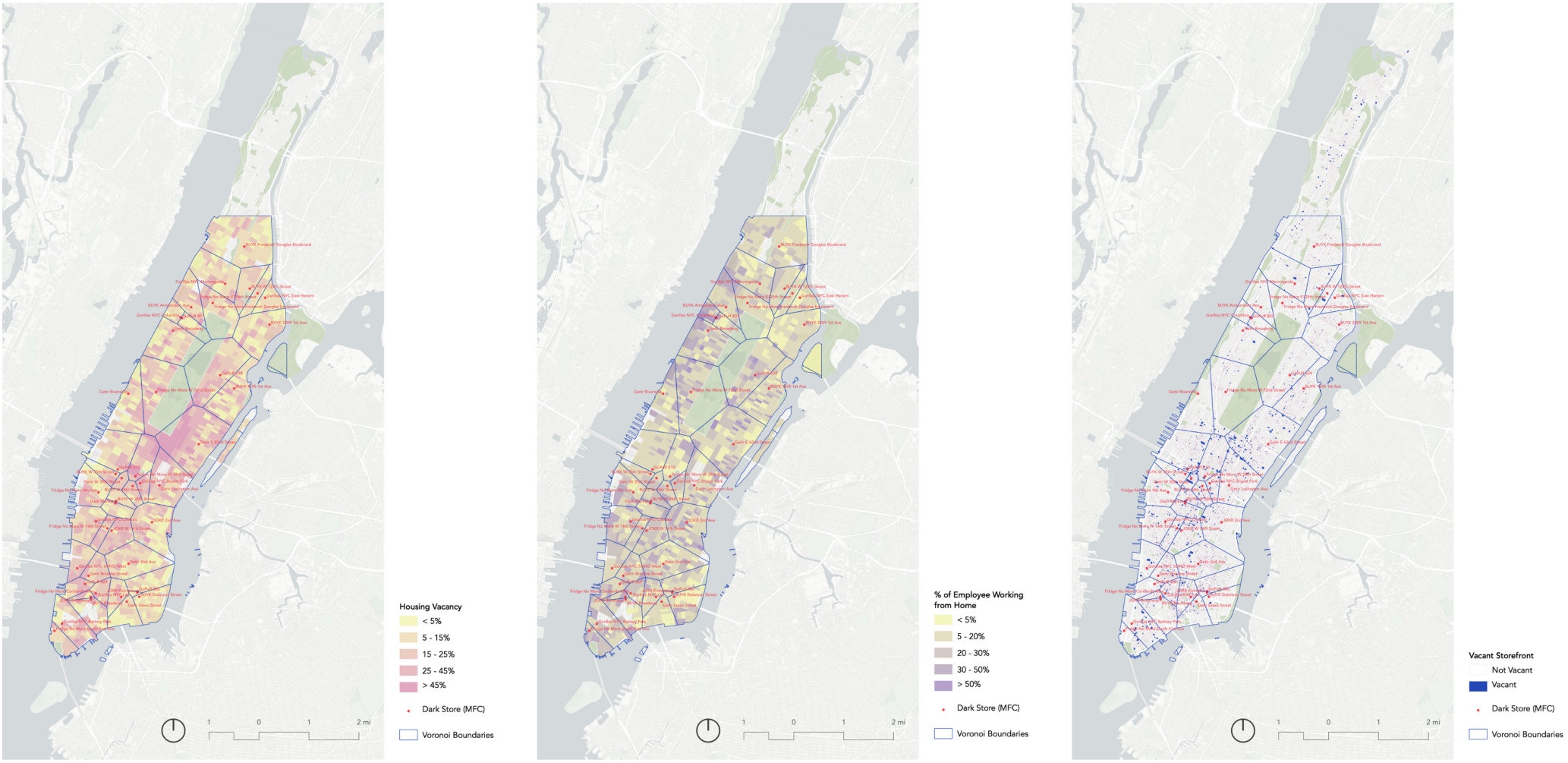
population density + average age + education

Figure 47 | Grocery Dark Stores 2022 and Map of Population Density, Average Age, and Percentage of Higher Education Population, US Decennial Census 2020



median hh income + hh expenditure + median gross rent

Figure 48 | Grocery Dark Stores 2022 and Map of Median Household Income, Household Expenditure, and Median Gross Rent, US Decennial Census 2020

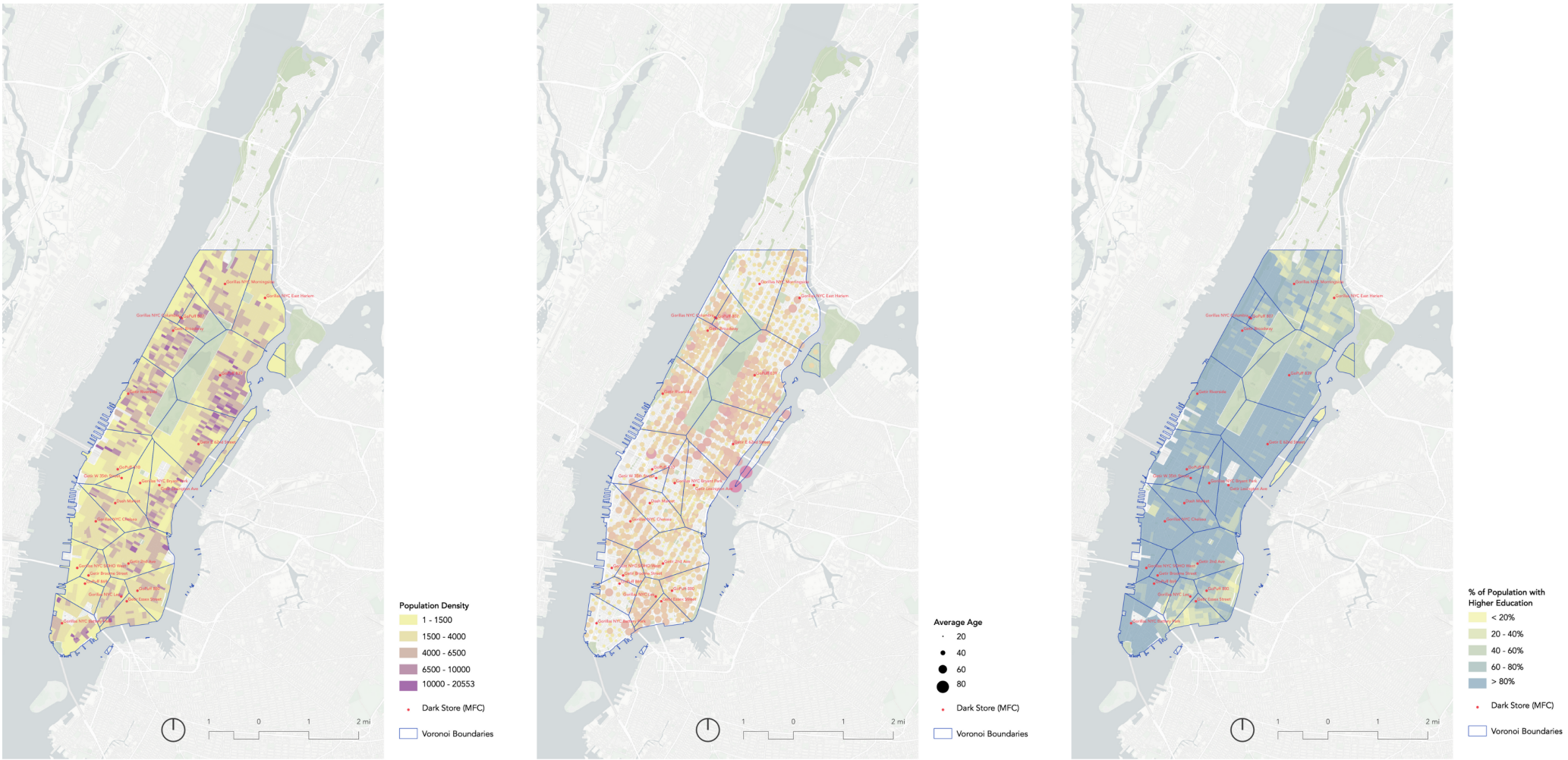


housing vacancy + WFH employee + vacant storefront

Figure 49 | Grocery Dark Stores 2022 and Map of Housing Vacancy, Percentage of Employee Working From Home, and Vacant Storefront, US Decennial Census 2020, NYC Open Data

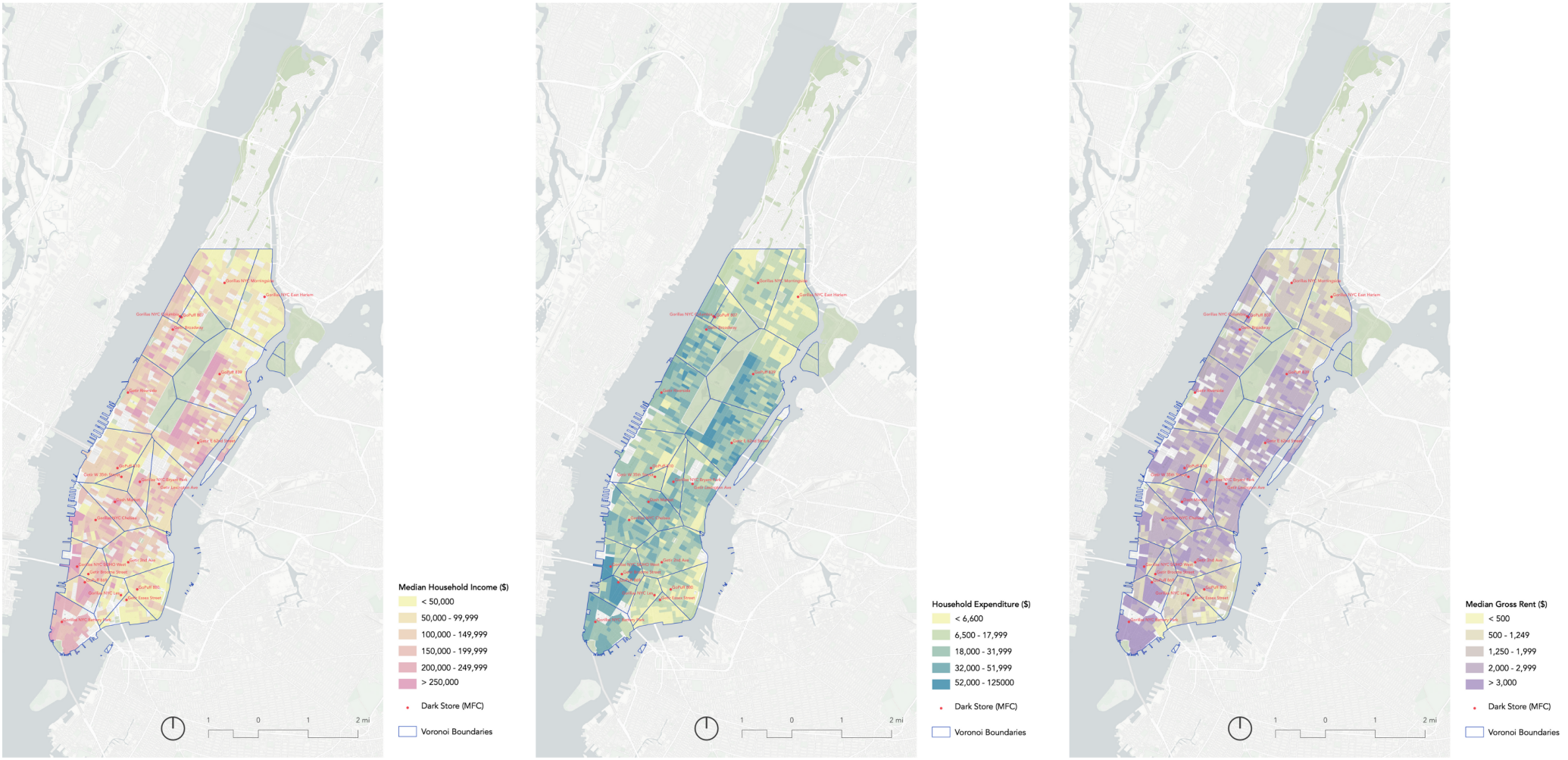
No	DBA Name	Area	Pop. Density	Age	% of Higher Educated Pop.	Median Household Income	Household Expenditure	Median Gross Rent	% of Housing Vacancy	% of Employee Working from Home
1	Getir Broadway	Upper West	3488.72	32.49	0.66	$ 80,303.53	$ 20,695.58	$ 1,387.72	0.12	0.17
2	Getir E 62nd Street	Upper East	2540.10	30.41	0.60	$ 82,851.55	$ 19,578.45	$ 1,270.62	0.19	0.12
3	GoPuff 839	Upper East	3283.92	29.57	0.56	$ 70,580.34	$ 17,367.63	$ 1,291.30	0.11	0.11
4	Getir Riverside	Upper West	2777.27	28.58	0.58	$ 70,955.38	$ 16,338.85	$ 1,213.02	0.13	0.13
5	Gorillas NYC Battery Park	Lower	2587.04	18.48	0.46	$ 90,839.12	$ 15,925.48	$ 1,495.56	0.09	0.09
6	Gorillas NYC Chelsea	Midtown	1844.56	29.75	0.62	$ 73,953.53	$ 15,367.58	$ 1,259.41	0.13	0.14
7	Gorillas NYC Columbia	Upper West	2950.53	37.50	0.80	$ 71,600.24	$ 13,840.64	$ 1,037.09	0.11	0.23
8	Dash Market	Midtown	1840.75	29.12	0.61	$ 59,349.12	$ 13,485.41	$ 1,071.57	0.10	0.14
9	Getir 2nd Ave	Midtown	2261.10	27.91	0.60	$ 59,964.65	$ 11,612.42	$ 1,186.82	0.10	0.13
10	GoPuff 869	Lower	587.42	20.27	0.40	$ 46,048.66	$ 11,272.80	$ 672.81	0.08	0.10
11	Getir Lexington Ave	Midtown	2366.98	26.59	0.57	$ 59,668.96	$ 11,244.92	$ 1,245.13	0.13	0.12
12	Gorillas NYC Bryant Park	Midtown	781.25	29.15	0.67	$ 47,560.41	$ 10,336.24	$ 993.55	0.19	0.11
13	Gorillas NYC SOHO West	Lower	572.76	21.43	0.47	$ 41,221.94	$ 9,909.72	$ 739.22	0.08	0.10
14	Getir Broome Street	Lower	1156.65	28.35	0.65	$ 51,030.55	$ 9,321.07	$ 964.16	0.12	0.14
15	GoPuff 810	Midtown	1426.73	22.91	0.46	$ 44,121.63	$ 8,199.30	$ 993.67	0.10	0.08
16	GoPuff 807	Upper West	2385.37	31.45	0.54	$ 30,317.49	$ 7,542.10	$ 768.36	0.10	0.13
17	Gorillas NYC Morningside	Upper	2135.61	25.18	0.45	$ 38,088.43	$ 7,098.31	$ 773.18	0.08	0.10
18	GoPuff 880	Lower	1581.19	25.38	0.37	$ 26,379.52	$ 5,002.71	$ 559.64	0.05	0.07
19	Gorillas NYC Les	Lower	1525.10	26.34	0.34	$ 22,420.18	$ 4,918.33	$ 507.88	0.08	0.08
20	Gorillas NYC East Harlem	Upper	1816.31	26.77	0.35	$ 20,829.87	$ 4,708.01	$ 650.56	0.07	0.07
21	Getir W 35th Street	Midtown	449.23	25.89	0.40	$ 27,024.90	$ 4,179.20	$ 538.89	0.09	0.07
22	Getir Essex Street	Lower	1516.00	25.43	0.26	$ 15,073.99	$ 3,348.28	$ 409.49	0.05	0.06
	Average		**1903.39**	**27.23**	**0.52**	**$ 51,372.00**	**$ 10,967.86**	**$ 955.89**	**0.10**	**0.11**

Table 11 | Dark Store 2023 Catchment Area



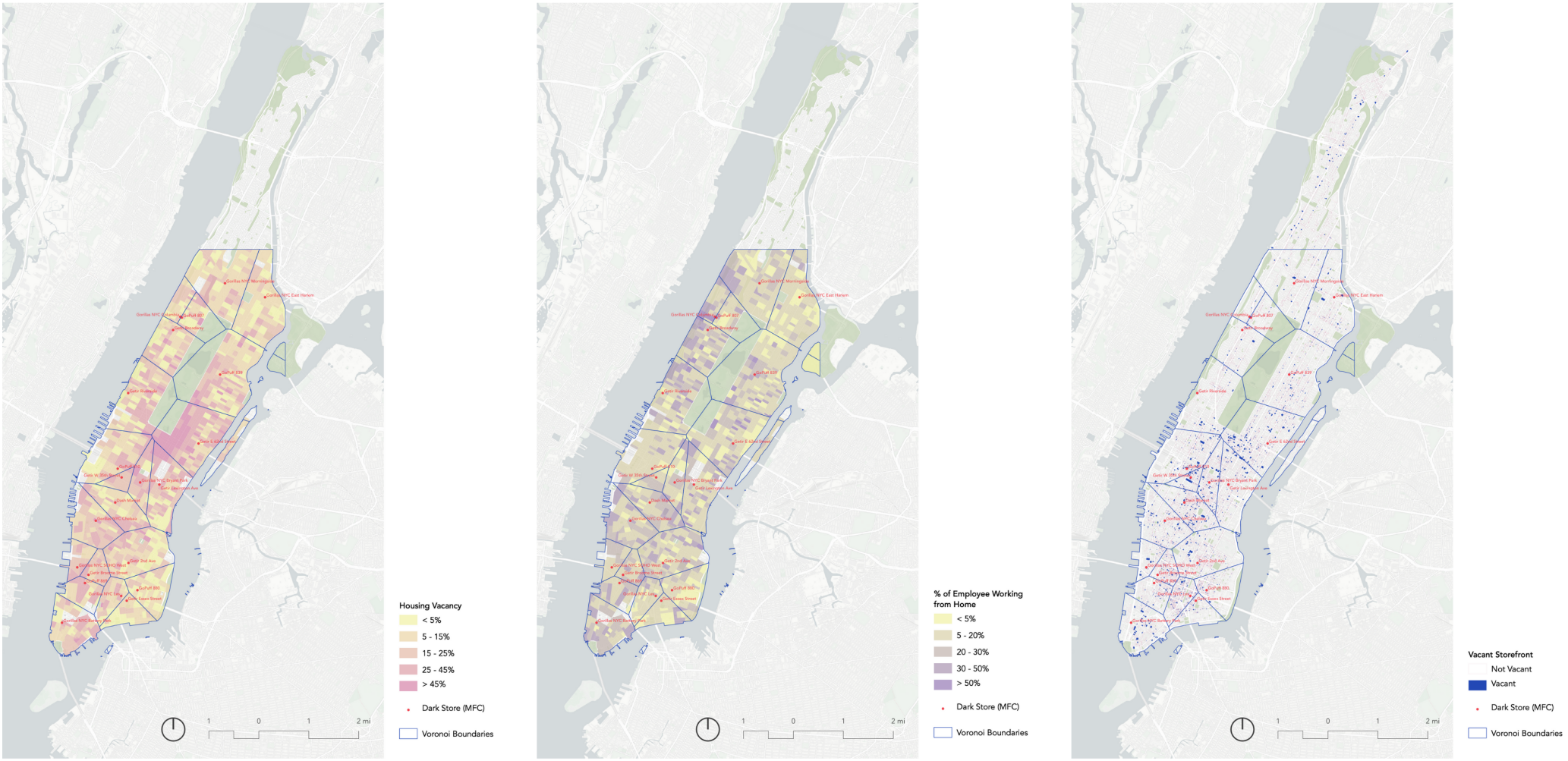
population density + average age + education

Figure 50 | Grocery Dark Stores 2023 and Map of Population Density, Average Age, and Percentage of Higher Education Population, US Decennial Census 2020



median hh income + hh expenditure + median gross rent

Figure 51 | Grocery Dark Stores 2023 and Map of Median Household Income, Household Expenditure, and Median Gross Rent, US Decennial Census 2020



housing vacancy + WFH employee + vacant storefront

Figure 52 | Grocery Dark Stores 2023 and Map of Housing Vacancy, Percentage of Employee Working From Home, and Vacant Storefront, US Decennial Census 2020, NYC Open Data

5.2. Part Two: Grocery "Dark Stores" and Public Spaces

This part of the thesis will examine the impact of grocery "dark stores" on urban fabric in Manhattan. In April 2022, the Office of Council Member Gale Brewer did a survey of grocery "dark stores" in Manhattan. Through their survey, the office of Council Member Gale Brewer observed non-compliance with zoning of these grocery "dark stores" by setting up in areas not zoned for warehouses and for not allowing customers in to shop, and not accepting cash. This analysis is built on the existing data from the survey, delving further into the impacts of potential zoning and land-use violation.

Figure 53 | A sign barring the public from entering a BUYK delivery hub on the Upper West Side on Thursday, March 3, 2022. Source: Luke Cregan for NY City Lens

Potential of Zoning Violation: Warehouse or Grocery Store?

In April 2022, Council Member Gale Brewer did a sample survey of 26 grocery "dark stores" and put together an interactive map with the civic tech group Beta NYC (Figure 54) identifying the locations of these micro-fulfillment centers, which found 81 percent were operating outside the zoning designation permitting warehouse use. She says the "dark stores," some of which have papered-over windows so passersby could not look in, compete with actual grocery stores and bodegas, and reduce foot traffic in retail corridors (Chadha & Garcia, 2022).

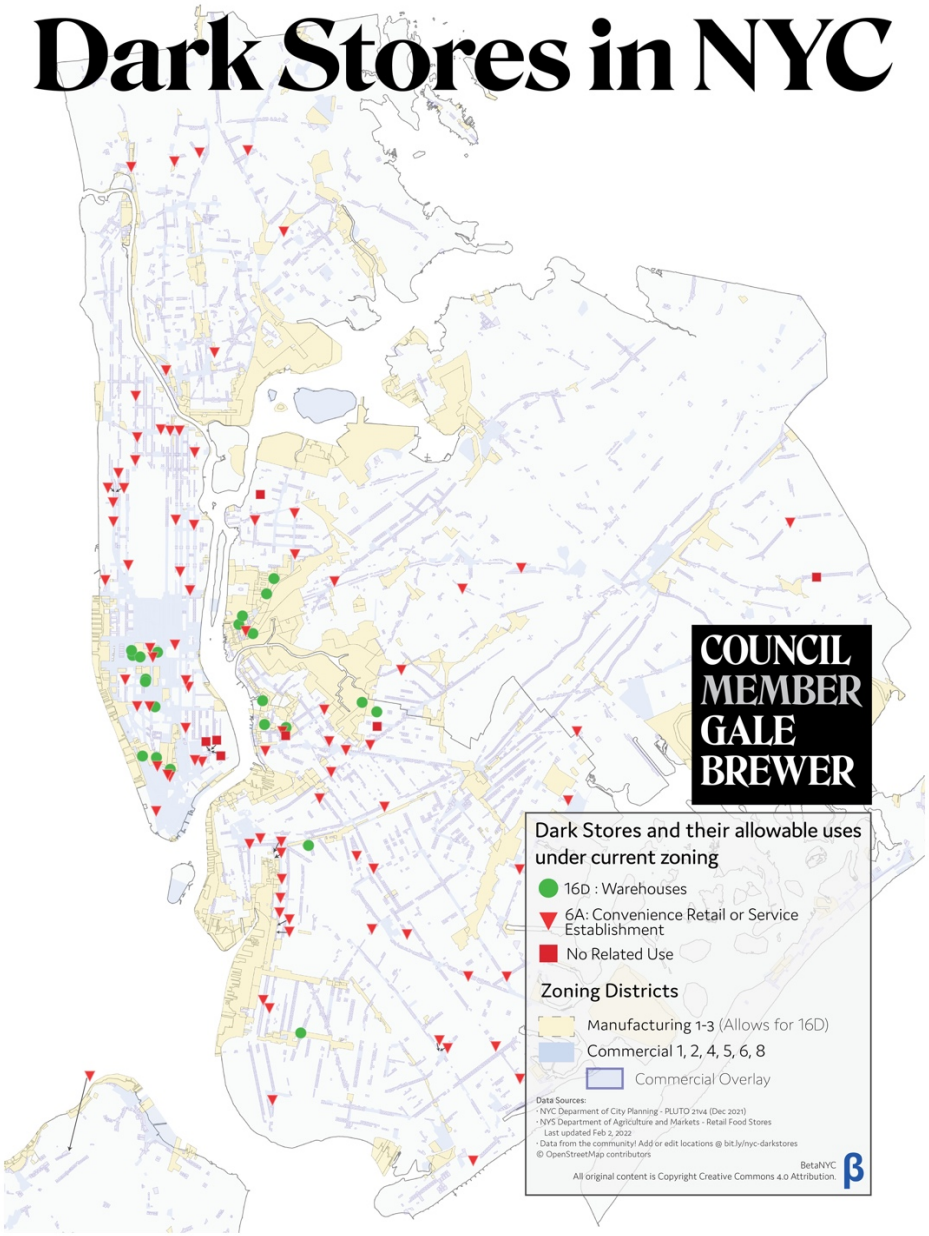


Figure 54 | Beta NYC & Council Member Gale Brewer Map of Dark Stores in NYC

Council Member Gale Brewer mentioned that from zoning perspective, the facilities operate in a gray area between commercial and industrial land use. For example, the GoPuff storefront on the Lower East Side is located in a residential zoning district and located in a mixed residential and commercial use building (Miao, 2022). Traditional fulfillment centers are typically categorized as warehouses which are zoned for manufacturing and some commercial districts.

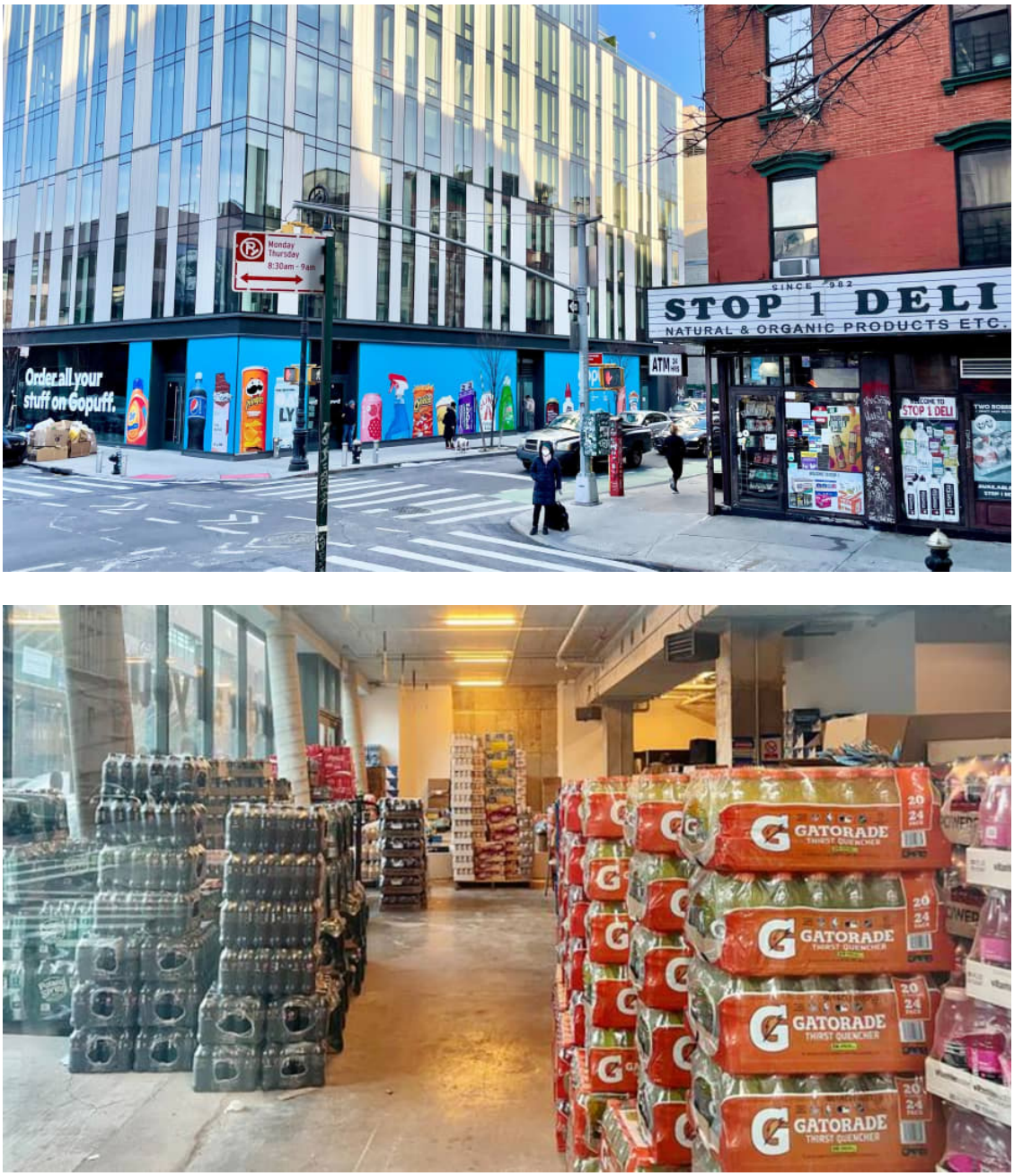


Figure 55 | A GoPuff location and the inside on the Lower East Side of Manhattan across from Stop 1 Deli. Jan. 12, 2022, Hannah Miao, CNBC

5.2.1. Zoning and Land-Use Regulation

I overlaid grocery "dark stores" use code with designated zoning in Manhattan to look at a more granular scale where the potential zoning violation take place. From the datasets, I found that these locations on the map below (Figure 56) are the three stores in 2022 and left with 1 store in 2023 that do not comply to zoning regulation – one of them is the case of mentioned above. They were all located in residential district that did not allow for Use Code 16D to be in the area.

Figure 56 | Potential Zoning and Land Use Violation

Zoning District

Based on the existing Use Group, grocery "dark stores" are allowed to be located under Commercial: C1, 2, 4, 5, 6, 8, including commercial overlay district and Light Manufacturing District: M1 (Table 12). In a C8 District, any use listed in Use Group 16 that involves the production, processing, cleaning, servicing, testing, or repair of products, goods, or materials shall conform to the performance standards for M1 Districts as outlined in Sections 42-20 and 42-28 inclusive, relating to Performance Standards.

Zoning District	
Commercial Overlay	C1-1 to C1-5, C2-1 to C2-5
	A commercial overlay in New York City is an area located in a residential zoning district that allows for commercial use. You can have a commercial building or mixed-use building in a residential zone. These uses are usually retail, restaurants, bakeries, beauty salons, small offices, et cetera.
C1 - Local Retail Districts	designed to provide for local shopping and wide range of retail stores and personal establishments catering to frequently recurring needs.
	designed to promote convenient shopping and the stability of retail development by encouraging continuous retail frontage and prohibiting local service and manufacturing establishments which tend to break such continuity.
C2 - Local Service Districts	provide wide range of essential local services not involving regular local shopping
C4 - General Commercial Districts	major and secondary shopping centers, which provide for occasional family shopping needs and for essential services to business establishments over a wide area and which have a substantial number of large stores generating considerable traffic

	designed to promote convenient shopping and the stability of retail development by encouraging continuous retail frontage
C5 - Restricted Central Commercial Districts	designed to provide for office buildings and the great variety of large retail stores and related activities which occupy the prime retail frontage in the CBD and serve entire metropolitan region
C6 - General Central Commercial Districts	designed to provide for the wide range of retail, office, amusement service, custom manufacturing and related uses normally found in the CBD and regional commercial centers but to exclude non-retail uses which generate a large volume of trucking
C8 - General Service Districts	designed to provide for necessary services for a wider area than is served by C2
	often involve objectionable influences e.g., noise from heavy service operations and large volumes or truck traffic
M1 - Light Manufacturing Districts (High Performance)	designed for wide range of manufacturing and related uses which can conform to a high level of performance standards
	provide buffer between R or C districts and other industrial uses which involves more objectionable influences

Table 12 | Grocery "Dark Stores" Zoning District Classification, NYC Zoning Regulation

Use Group (Use Code)

Grocery "dark stores" in Manhattan operated under four different use groups: 6A (convenience retail), 16D (warehouses – self-service storage facilities), Battery Park Special District, and no related use group. The findings indicate that 68.2% of grocery "dark stores" in 2022 are under use group 6A, 22.7% are under use group 16D: Warehouse, 6.8% is under 'no related use,' and 2.3% is under Battery Park Special District use group (n = 44) as seen in Figure 57. In 2023, data shows that 68% of grocery "dark stores" are under use group 6A, 27% under 16D, and 5% under 'no related use' (n = 22), as seen in Figure 58.

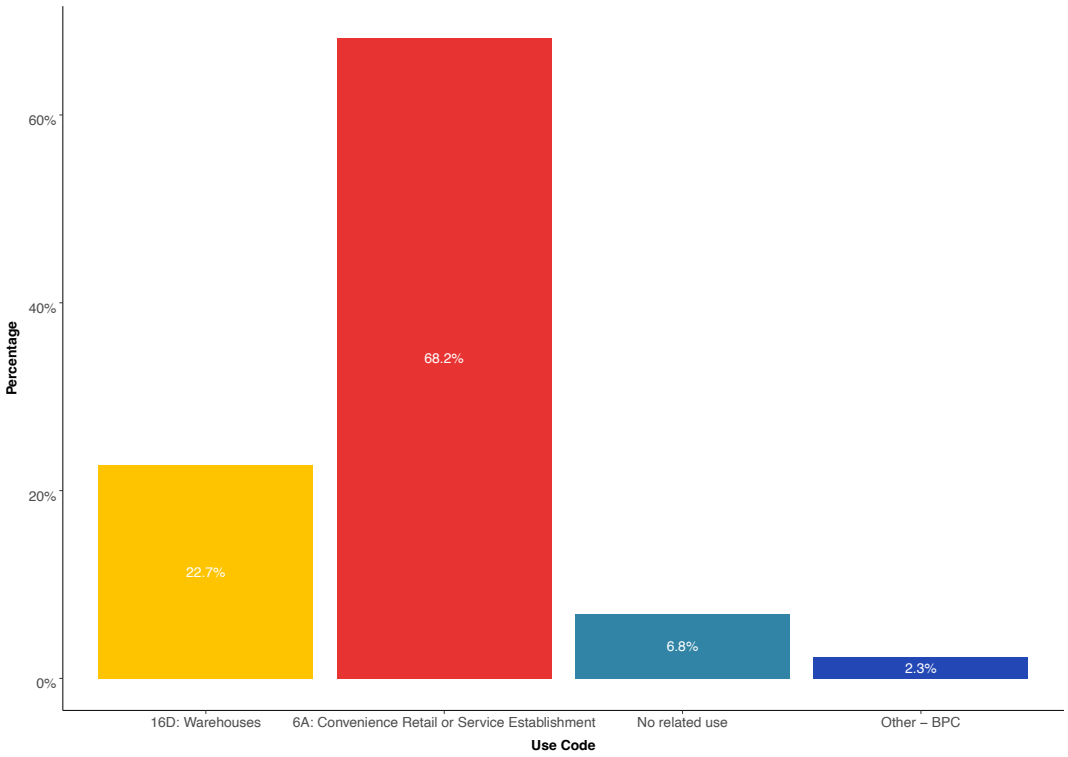


Figure 57 | Grocery "Dark Stores" 2022 Use Code Percentage, n = 44

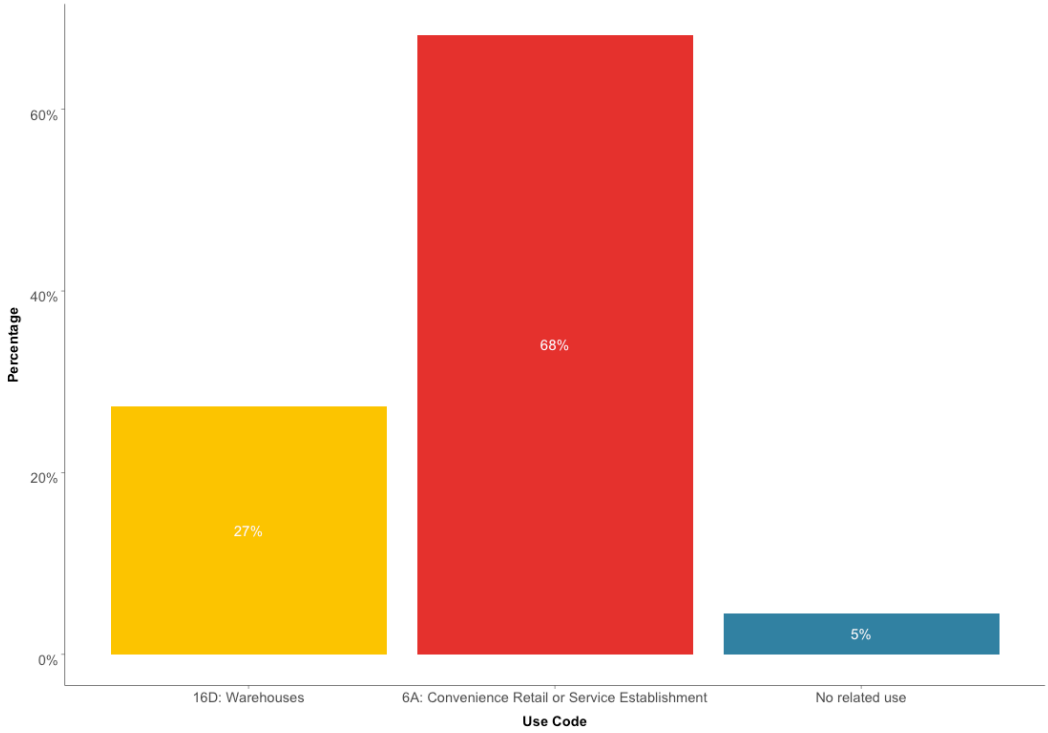


Figure 58 | Grocery "Dark Stores" 2023 Use Code Percentage, n = 22

Use Group 6

Use Group 6 consists primarily of retail stores and personal service establishments, which provide for a wide variety of local consumer needs and have small service areas. Food stores, including supermarkets, grocery stores, meat markets, or delicatessen stores, are listed in subgroup A. Use group 6 is allowed in Zoning Districts C1, 2, 4, 5, 6, 8, MI, M2, M3 (Garodnick, 2023).

Use group 6 contains the most common set of commercial uses in the Zoning Regulations, including staples of neighborhood retail corridors throughout the city, such as grocery stores and delis (retail food store), restaurants (eating and drinking establishments), barber shops and beauty parlors, and drug stores, amongst dozens of other uses that provide for a variety of local consumer needs[11].

Several of these commercial zoning districts were designed with emphasis on the character of the streetscapes and attracting foot traffic. The 1958 *Zoning New York City* report that laid out the zoning framework adopted by the City in 1961, speaks about the retail character of a C1 District:

> *In catering to similar shopping habits, such uses contribute to a mutual interchange of customers. Experience with shopping centers has demonstrated that stores which attract customers who are in turn prospects for adjacent retail establishments are highly beneficial to the entire commercial concentration center* (Smith & Smith, 1958).

This principle facilitating a continuous corridor for customers to frequently patronize establishments is further in the 'statement of legislative intent' provisions of ZR Section 31-11:

> *The district regulations are designed to promote convenient shopping and the stability of retail development by encouraging continuous retail frontage and by prohibiting local service and manufacturing establishments which tend to break such continuity.*

Use Group 16

Use Group 16 consists of automotive and other necessary semi-industrial uses which are required widely throughout the city and involve offensive noise, vibration, smoke, dust, or other particulate matter, odorous matter, heat, humidity, glare, or other objectionable influences, making such uses incompatible with residential and other commercial uses. Grocery "dark stores" under the Use Group 16D, "self-service storage facility" is categorized under a moving or storage office, or a warehouse establishment, to store personal property, where such facility is partitioned into

[11] ZR Section 32-16

individual, securely subdivided space for lease; or such facility consists of enclosed or unenclosed floor space which is subdivided by secured bins, boxes, containers, pods or other mobile or stationary storage devices. Such floor space or storage devices are less than 300 square feet in area and are to be leased or rented to persons or businesses to access, store, or remove property on a self-service basis. 16D (self-service storage facilities) is allowed in C8, M1, M2, M3 (Garodnick, 2023).

Special Battery Park City and 'No Related Use'

The Special Battery Park City District is designed to promote and protect public health, safety, and general welfare. Zone B in this district is designed for commercial and mixed development with ancillary retail and service uses. 'No related use' group indicates that these grocery "dark stores" are not under any Use Group category that is allowed to operate in its Zoning District. They are located in a residential district with no commercial overlays.

Takeaways

Looking at the distribution of grocery "dark stores" Use Code and Zoning District in 2022 and 2023 (Figure 59 and 60), the analysis further indicates that these stores are primarily situated in Commercial and Residential Districts with Commercial overlays, aligning with the permitted uses in their respective zoning districts (Table 13). However, it is important to acknowledge that there is still a small number of grocery "dark stores" that require further examination to ensure compliance with the zoning regulation. It is crucial to address these cases and ensure that all grocery "dark stores" fully comply with zoning and land-use regulations to maintain the integrity of urban fabric in Manhattan.

In addition to that, it is worth noting that grocery "dark stores" representatives have expressed a commitment to complying with local zoning and permitting obligations, including making adjustments to their operations to meet guidelines and exploring the transformation of stores into neighborhood amenities. Those guidelines include allowing customers to be admitted to a space and providing them a place to wait for their order to be prepared and delivered to them in person – readjusting their operations layout that will align with local guidelines. With ongoing efforts to address zoning and land-use concerns, there is a potential for these stores to evolve and better integrate into the urban fabric while meeting the needs of local communities.

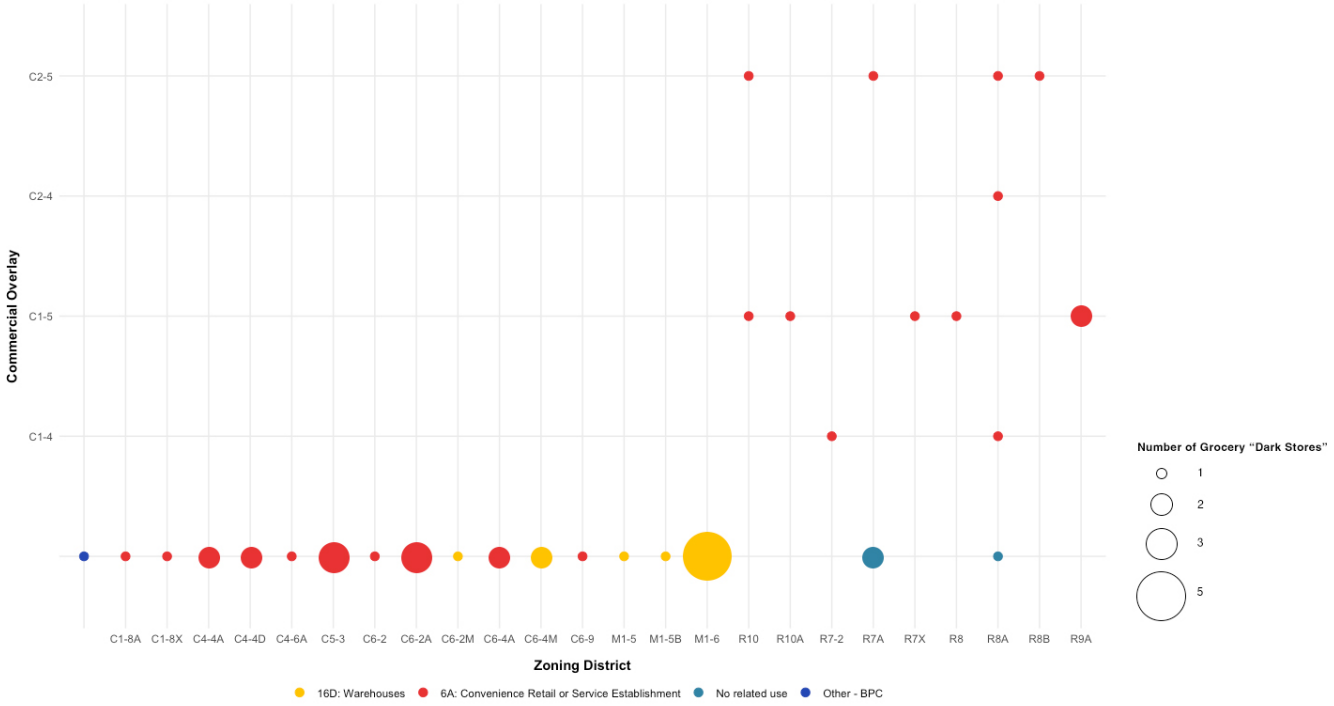


Figure 59 | Distribution of Grocery "Dark Stores" Zoning District and Commercial Overlay, 2022

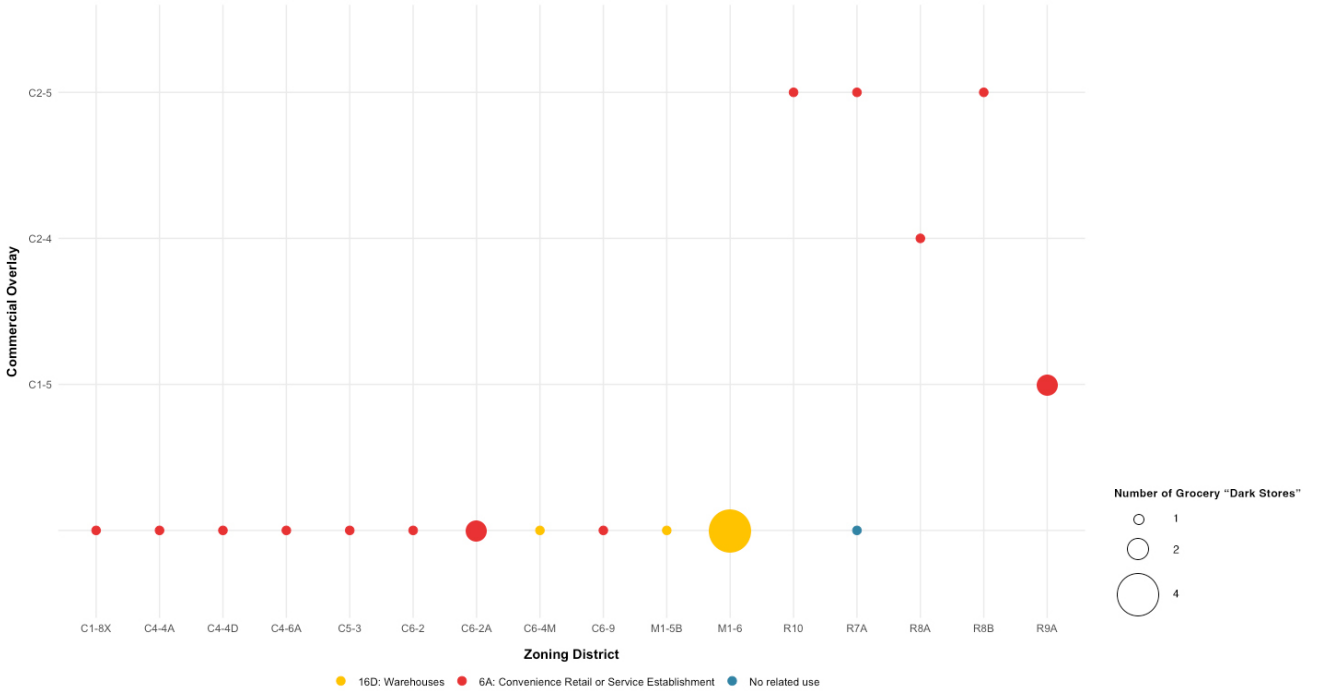


Figure 60 | Distribution of Grocery "Dark Stores" Zoning District and Commercial Overlay, 2023

Use Group Permitted in Commercial and Manufacturing District																		
Districts	**Use Group**																	
	Residential		**Community Facility**		**Retail and Commercial**											**General Service**	**Manufacturing**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Local Retail C1	x	x	x	x	x	x												
Local Service C2	x	x	x	x	x	x	x	x	x					x				
General Commercial C4	x	x	x	x	x	x		x	x	x		x						
Restricted Central Commercial C5	x	x	x	x	x	x			x	x	x							
General Central Commercial C6	x	x	x	x	x	x	x	x	x	x	x	x						
General Service C8				x	x	x	x	x	x	x	x	x	x	x		x		
Light Manufacturing M1				x	x	x	x	x	x	x	x	x	x	x		x	x	

Table 13 | Use Group Permitted in Commercial and Manufacturing District, source: NYC Zoning Resolutio

5.2.2. Impact to Building, Façade Design, and Streetscape

Apart from the potential zoning violation, the presence of grocery "dark stores" also raises concerns about the impact on street life and the overall quality of life in the community. Council Member Gale Brewer worried that if grocery "dark stores" remain unregulated, the small business and community character in the neighborhood will be lost. The covered storefronts of these stores limit visibility and contribute to a lack of active street engagement, potentially diminishing the vibrant character of neighborhoods. She emphasized the importance of bodegas, convenience stores, and local groceries which play curical role in providing affordable, fresh, and healthy food to New York City residents. The rise of quick-service grocery delivery apps poses a threat to the resilience and survival of these local businesses (O'Connell-Domenech, 2021)

In the survey conducted by Council Member Gale Brewer's office, a sample of 26 grocery "dark stores" was examined, with three of them founded to be closed. Grocery "dark stores" that were included in the survey are Getir (35%), Gorillas (26%), GoPuff (22%), Dash (9%), and JOKR (8%). The survey focused on various aspects, including public access to space, the ability to shop onsite, window transparency, shelf pricing, and item pricing. However, for the purpose of the research, the analysis has primarily focused on public access to space, the ability to shop online, and window transparency as key indicators of the impact of grocery "dark stores" on urban fabric and community.

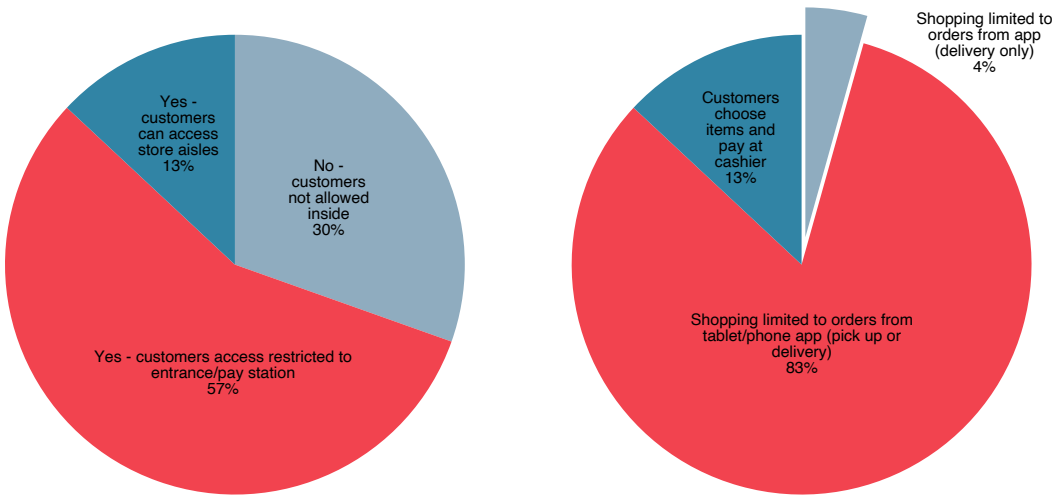


Figure 61 | Survey on Public Access to Space and Ability to Shop Online (n = 26). Source: Office of Council Member Gale Brewer

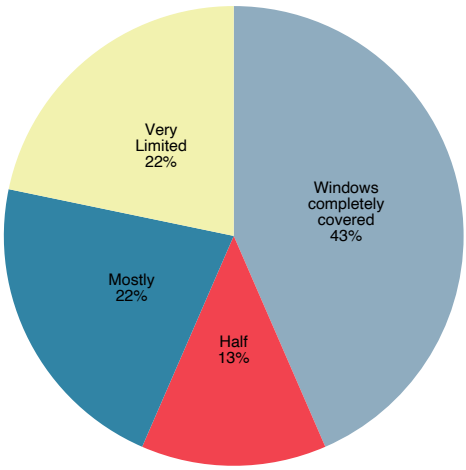


Figure 62 | Survey on Window Transparency (n = 26). Source: Office of Council Member Gale Brewer

The survey conducted by the Office of Council Member Gale Brewer sheds light on three distinct characteristics of grocery "dark stores" that set them apart from traditional grocery stores and supermarkets, particularly those that provide delivery services, especially during the COVID-19 pandemic since 2020, such as Target, Whole Foods, and FreshDirect. Firstly, a significant majority of these grocery "dark stores" restrict or entirely prohibit customer access to the store aisles. This contrasts with the convenience of traditional stores that allow customers to freely navigate and choose their desired items. Instead, 57% of the surveyed grocery "dark stores" only permit customers to enter restricted areas, such as entrance or pay stations, while 30% do not allow customers on-site at all.

Secondly, the survey reveals that 87% of these grocery "dark stores" exclusively facilitate ordering through tablet or phone applications for either pick-up or delivery. This reliance on digital platforms further emphasizes the absence of a conventional in-store shopping experience, as only 13% of customers have the option to physically enter the store, select their items, and pay at the cashier.

Lastly, an intriguing characteristic of these grocery "dark stores" is their lack of traditional storefronts. Approximately, 43% of the surveyed stores have completely covered storefronts, with an additional 22% being very limitedly covered, 22% mostly covered, and 13% half-covered. These storefronts are often adorned with artwork-like stickers that obscure the view through the windows. The distinct visual feature sets them apart from traditional grocery stores, which typically have open and transparent storefronts.

Figure 63 | Gorillas and Getir in Manhattan, photos by Author

Takeaways

Looking at these findings, the unique characteristics of these stores blur the clarity of Zoning District and Use Group classification – whether they belong to Commercial or Manufacturing District. Their physical condition determines more self-storage facilities which not adhering the requirements of Commercial District Zoning regulations. In fact, some of these stores are located in contextual commercial districts indicated by A, D, or X suffixes such as C1-8A, C1-8X, C4-4D; supplementary bulk regulations mandate that all developments maintain street wall[13] (a wall or portion of a wall of a building facing a street) continuity and a harmonious relationship with other building in the area.

The survey results highlight the need for further examination and regulation to address the potential implications of these emerging retail models on the urban fabric and the long-term viability of local businesses.

5.3. Part Three: Will Grocery "Dark Stores" Phenomenon Stay?

Starting mid-2022 to 2023, the number of grocery "dark stores" in Manhattan was cut in half from 44 stores to 22 stores. Stores such as BUYK, Fridge No More, and JOKR were pulling out of cities or had filed for bankruptcy. Will these new evolutions and changes in grocery activities continue to stay?

From the findings, I found that changes to the number of grocery "dark stores" establishments per NTA vary from 33% to 100% (Table 14). Their exits were influenced by the consolidation of the ultrafast delivery sector in the country as the space faced dwindling investor funding, a competitive economic environment, and political influence. For example, in an article by Grocery Dive, JOKR CEO, and co-founder Ralf Wenzel mentioned that the company decided to leave the United States to focus its resources

[13] NYC Zoning Regulation

on Latin America because the region is still underpenetrated and underserved. In addition, Fridge No More and BUYK shut down from the US market due to US Sanctions on Russia, as Russian investors backed both startups (Garber, 2022).

NTA Name	2022	2023	% Change
Upper West Side-Manhattan Valley	3	2	33%
Upper West Side-Lincoln Square	2	1	50%
Upper West Side (Central)	1	1	0%
Upper East Side-Yorkville	1	0	100%
Upper East Side-Lenox Hill-Roosevelt Island	1	1	0%
Upper East Side-Carnegie Hill	1	1	0%
Tribeca-Civic Center	4	1	75%
SoHo-Little Italy-Hudson Square	2	2	0%
Murray Hill-Kips Bay	2	1	50%
Midtown-Times Square	3	2	33%
Midtown South-Flatiron-Union Square	2	0	100%
Lower East Side	4	2	50%
Harlem (South)	3	1	67%
Harlem (North)	1	0	100%
Financial District-Battery Park City	2	1	50%
East Village	1	1	0%
East Harlem (North)	3	1	67%
Chinatown-Two Bridges	1	1	0%
Chelsea-Hudson Yards	7	3	57%

Table 14 | Percentage of Grocery "Dark Stores" Changes per NTA from 2022 to 2023

On average, grocery "dark stores" that survived the following year, although not significant, had higher potential in coming in the year 2022 and closer demographic characteristics than the general average (Table 15 and 16). In addition, the surviving stores had more extensive funding from Venture Capitalists: billions versus millions. Moreover, a surviving company such as GoPuff has been around in the United States since 2013, steadily progressing and expanding its operations and technology platform. GoPuff CEO Yakir Gola mentioned that it is indeed a complex business to scale; for example, to expand their service line to include alcohol, the process takes six months to 3 years, depending on the state. However, in California, GoPuff tried to acquire BevMo! which is helpful for them to scale.

	Pop. Density	Age	% of Pop. with Higher Education	Median Household Income	Household Expenditure	Median Gross Rent	% of Housing Vacancy	% of Pop. Working from Home
General Average	1587.98	28.75	0.55	$ 44,185.94	$ 9,315.63	$ 821.96	0.11	0.12
Dark Store Still Operating in 2023 Average	1695.23	28.40	0.54	$ 45,637.20	$ 9,896.02	$ 838.56	0.11	0.12
Dark Store Only Operating in 2022 Average	1480.73	29.10	0.55	$ 42,734.69	$ 8,735.24	$ 805.36	0.11	0.11

Table 15 | Comparison Average of Grocery "Dark Stores" Still Operating in 2023 versus Only Operating in 2022

New York City is full of people, but with so many different grocery "dark stores" and convenience to other retail food stores, consumers are constantly taking advantage of promotions, low prices, and free items. These companies are burning money as part of their promotion. The biggest challenge faced by rapid grocery delivery companies is covering the costs of their operation and expansion. Infrastructure such as vertically integrated supply chain planning and analytics platform that includes AI and machine learning become of enormous importance in determining the long-term existence and growth of grocery "dark stores" by focusing on more efficient supply chain management and customer acquisition process.

In general, e-commerce and quick commerce platforms such as Amazon and all other online retail deliveries platform got a massive tailwind from COVID-19 restrictions. People were looking for options to get their needs delivered. However, an industry expert during the industry interview mentioned that in the future, the grocery store would evolve to be built with packing and operation areas that people cannot see anymore. With their current business model and real estate prices keep increasing, grocery "dark stores" provide a leaner inventory profile with a smaller footprint that is able to save real estate costs and limit the complexity of the store layout and where things are. In the short run, some of these companies, such as Gorillas and GoPuff, have also started to allow customers to walk in and browse for items to comply with city regulations.

Takeaways

The demand for quick and convenient grocery delivery has been amplified during the COVID-19 pandemic, which has contributed to the optimism surrounding these services, However, the sustainability of the grocery "dark stores" business model is yet to be determined. The growth of these services can be influenced by factors such as customer satisfaction, operational efficiency, and market competition. To determine the sustainability of grocery "dark stores" it will be necessary to monitor how these services evolve, adapt to market condition, and address challenges such as profitability, customer loyalty, and market consolidation. The unit economics and long-term viability of the grocery "dark stores" model will need to be evaluated over time to determine its sustainability and potential in cities and on the industry.

No	DBA Name	Population Density	Age	% of Pop. with Higher Education	Median Household Income	Household Expenditure	Median Gross Rent	Housing Vacancy	% of Employee Working from Home
1	Getir Broadway	3467.38	33.26	0.67	$ 73,564.34	$ 19,895.33	$ 1,271.58	0.12	0.17
2	Getir E 62nd Street	2426.38	30.19	0.60	$ 83,534.79	$ 19,219.10	$ 1,215.90	0.19	0.12
3	GoPuff 839	2445.15	29.39	0.55	$ 69,575.43	$ 17,733.19	$ 1,093.89	0.13	0.12
4	Gorillas NYC Battery Park	2903.57	22.38	0.58	$ 89,672.50	$ 15,548.71	$ 1,488.51	0.11	0.11
5	Gorillas NYC Columbia	2869.87	45.33	0.89	$ 71,905.39	$ 15,454.62	$ 916.93	0.11	0.29
6	Dash Market	1400.01	28.88	0.66	$ 50,857.27	$ 14,137.57	$ 878.22	0.09	0.13
7	Gorillas NYC Chelsea	1658.48	34.96	0.74	$ 66,615.78	$ 13,935.31	$ 1,207.91	0.14	0.16
8	Getir Lexington Ave	2052.08	25.26	0.55	$ 57,389.79	$ 10,919.37	$ 1,188.98	0.12	0.10
9	Gorillas NYC SOHO West	582.23	21.22	0.45	$ 43,136.94	$ 10,493.35	$ 776.67	0.08	0.11
10	Getir Riverside	2198.86	26.91	0.55	$ 48,337.71	$ 10,364.15	$ 760.12	0.11	0.11
11	Getir 2nd Ave	2019.14	28.36	0.60	$ 47,084.04	$ 9,318.39	$ 996.52	0.09	0.11
12	GoPuff 869	321.86	22.10	0.50	$ 30,379.15	$ 8,863.13	$ 449.80	0.11	0.12
13	Getir Broome Street	1148.08	28.18	0.64	$ 49,532.45	$ 8,825.05	$ 920.02	0.12	0.13
14	Gorillas NYC Bryant Park	772.98	24.99	0.61	$ 37,599.08	$ 6,857.22	$ 768.94	0.14	0.08
15	GoPuff 810	1413.67	22.10	0.43	$ 34,821.91	$ 6,594.06	$ 798.04	0.08	0.07
16	Gorillas NYC Morningside	1889.32	24.58	0.45	$ 33,174.27	$ 6,078.90	$ 698.84	0.08	0.10
17	GoPuff 807	1875.21	35.32	0.54	$ 28,870.95	$ 5,419.28	$ 683.58	0.12	0.13
18	Gorillas NYC Les	1393.95	30.63	0.39	$ 21,917.50	$ 5,105.64	$ 528.04	0.08	0.10
19	GoPuff 880	1488.60	27.84	0.44	$ 26,863.27	$ 5,026.90	$ 657.89	0.06	0.09
20	Getir Essex Street	1540.77	25.30	0.24	$ 13,966.58	$ 3,220.89	$ 424.30	0.04	0.05
21	Gorillas NYC East Harlem	1360.61	34.66	0.41	$ 12,787.96	$ 3,015.21	$ 435.40	0.05	0.07
22	Getir W 35th Street	66.85	22.96	0.48	$ 12,431.21	$ 1,687.02	$ 288.30	0.17	0.08

No	DBA Name	Population Density	Age	% of Pop. with Higher Education	Median Household Income	Household Expenditure	Median Gross Rent	Housing Vacancy	% of Employee Working from Home
23	Fridge No More W 72nd Street	2490.78	32.25	0.67	$ 74,950.82	$ 17,927.66	$ 1,337.54	0.17	0.16
24	JOKR W 14th Street	1736.38	30.88	0.72	$ 78,461.85	$ 15,636.49	$ 1,170.79	0.15	0.15
25	BUYK 1695 1st Ave	3468.06	30.73	0.60	$ 58,967.48	$ 14,356.84	$ 1,270.21	0.10	0.11
26	Fridge No More W 38th Street	803.61	42.95	0.82	$ 65,925.82	$ 13,166.53	$ 1,457.17	0.30	0.12
27	JOKR 2nd Ave	2680.27	27.53	0.63	$ 62,183.68	$ 12,687.38	$ 1,362.95	0.11	0.15
28	Fridge No More South End Ave	1086.12	19.87	0.51	$ 71,718.08	$ 11,555.61	$ 1,186.00	0.08	0.10
29	JOKR Broadway	402.16	39.12	0.92	$ 42,953.81	$ 11,084.54	$ 599.35	0.19	0.21
30	BUYK W 34th Street	465.78	29.10	0.70	$ 56,163.36	$ 10,714.68	$ 760.47	0.15	0.15
31	Fridge No More 9th Ave	2192.56	34.82	0.68	$ 49,180.44	$ 10,467.90	$ 927.01	0.09	0.14
32	BUYK Amsterdam Ave	2691.45	31.82	0.63	$ 48,665.36	$ 9,841.50	$ 934.60	0.09	0.14
33	BUYK W 26th Street	835.22	24.83	0.62	$ 51,306.85	$ 9,239.36	$ 743.35	0.11	0.16
34	Fridge No More W 14th Street	948.46	24.78	0.55	$ 43,654.32	$ 8,247.24	$ 701.13	0.11	0.11
35	Fridge No More Frederick Douglas Boulevard	2128.59	25.00	0.45	$ 33,228.40	$ 6,804.28	$ 651.92	0.07	0.08
36	BUYK Frederick Douglas Boulevard	2542.69	26.97	0.40	$ 29,734.29	$ 6,059.93	$ 780.40	0.06	0.09
37	BUYK Broadway	1019.62	25.31	0.39	$ 27,362.89	$ 5,733.14	$ 449.65	0.09	0.09
38	BUYK W 35th Street	363.50	21.11	0.45	$ 35,473.00	$ 5,708.82	$ 760.08	0.09	0.07
39	Fridge No More Cortlandt Alley	769.59	24.56	0.40	$ 23,352.30	$ 4,685.95	$ 382.71	0.10	0.10
40	BUYK 2269 1st Ave	1955.22	28.82	0.35	$ 18,686.54	$ 4,599.24	$ 659.71	0.08	0.07
41	BUYK W 125th Street	1035.38	23.61	0.38	$ 22,189.02	$ 4,454.90	$ 498.01	0.07	0.09
42	BUYK Delancey Street	1242.51	21.65	0.25	$ 17,688.07	$ 3,466.87	$ 272.37	0.03	0.05
43	Fridge No More E125th Street	1222.68	33.84	0.42	$ 13,855.14	$ 3,282.44	$ 466.71	0.06	0.07
44	JOKR Rivington	495.43	40.58	0.64	$ 14,461.58	$ 2,453.93	$ 345.72	0.06	0.09
	Average	**1587.98**	**28.75**	**0.55**	**$ 44,185.94**	**$ 9,315.63**	**$ 821.96**	**0.11**	**0.12**

Table 16 | Average Capture of Grocery "Dark Stores" Still Operating in 2023 versus Only Operating in 2022

Chapter 6 |
Re-Thinking Retail: The Design and Planning of "Dark Stores" and Public Spaces

6.1. Platform Urbanism and the City

This research project premised around three key themes: the role of grocery "dark stores" in cities, their locations in urban areas, and their impact on the urban fabric, specifically looking at Manhattan. Technology is causing disruption and transformation in the way cities could provide their services to their citizens, especially in an on-demand world (Madden, 2020). Urban policy and planning decision-makers have encountered difficulties in dealing with the inconsistent and uncertain regulatory framework, where one market segment is governed by rigorous regulations while another has been able to bypass most regulations through technological innovation. Due to the fast-paced development within the sharing economy, determining the most suitable policy is convoluted.

On one hand, policymakers could opt to include urban disruptors, such as grocery "dark stores", under the scope of traditional regulation, which is rooted in outdated 19th and early 20th century planning concepts. On the other hand, policymakers might consider reducing some or all the regulatory requirements on traditional providers, such as bodegas, in order to level the playing field.

6.2. Grocery "Dark Stores" and New York City

The director for market strategy from one of the grocery "dark store" companies believes that these types of stores are positioned to play a significant role in the future of retail. By embracing the concept of grocery "dark store", retailers have the opportunity to explore the new frontiers in terms of delivery speed and efficiency. According to the director, future grocery stores may be designed with dedicated packing and operation areas that are not visible to customers, emphasizing th shift towards online ordering and delivery services.

While grocery delivery has been available since the early 20th century, the advent of internet and technology has significantly enhanced the customer experience. Websites and mobile applications now offer customers a higher level of information and transparency, enabling them to access real-time inventory data. This real-time inventory visibility benefits both customers and retailers. Customers can easily find the items they want to purchase, while retailers can gain insights into customer preferences and demand, leading to improved sales and reduced risk of inventory damage or wastage. Furthermore, the integration of geo-mapping information in real-time allows retailers to optimize and dynamically route their deliveries,

thereby increasing delivery efficiency. By leveraging these capabilities, retailers can streamline their operations and ensure faster and more accurate deliveries.

Implication on Grocery Activities

The transformation in retail spaces, particularly with the emergence of grocery "dark stores" and "pickup only stores", brings about changes in the dynamics of grocery activities. These new models often have smaller footprints, occupying about one-third of the size of larger retail chains like Aldi and Kroger, and they do not have traditional storefronts. The inventory profile is leaner, with approximately one-fourth of the SKUs compared to conventional stores. This allows for more efficient inventory management and cost savings in terms of real estate and store layout complexity.

In the case of grocery "dark stores". The layout of the store itself does not change significantly, as the primary focus is on facilitating quick grocery delivery. Instead, a new packaging area is added to support the fulfillment process. This transformation not only impacts the delivery method but also has implications for the economics, financing, and urban fabric of cities. The growth of online-led distribution infrastructure is appealing to investors due to its potential efficiency and cost savings.

It is worth noting that these changes are not limited to the grocery retail space. Starbucks, a prominent coffee chain, has also implemented "pickup only stores" designed exclusively for order pickups in New York City. These stores (Figure 64) are optimized for quick and convenient pickups, with not traditional retail storefronts. However, the transition from traditional storefronts to micro-fulfillment centers or "pickup only stores" without storefronts raises concerns about the liveliness and social cohesion of cities. Storefronts, retail shopping, and food retail establishments are essential components of the urban environment, contributing to the vibrancy and character of cities. The potential displacement of these traditional elements by MFCs or pickup-only models could impact the overall urban experience and community cohesion. Cities need to carefully consider the balance between embracing technological advancements in retail and preserving the social and cultural aspects that make urban areas thrive.

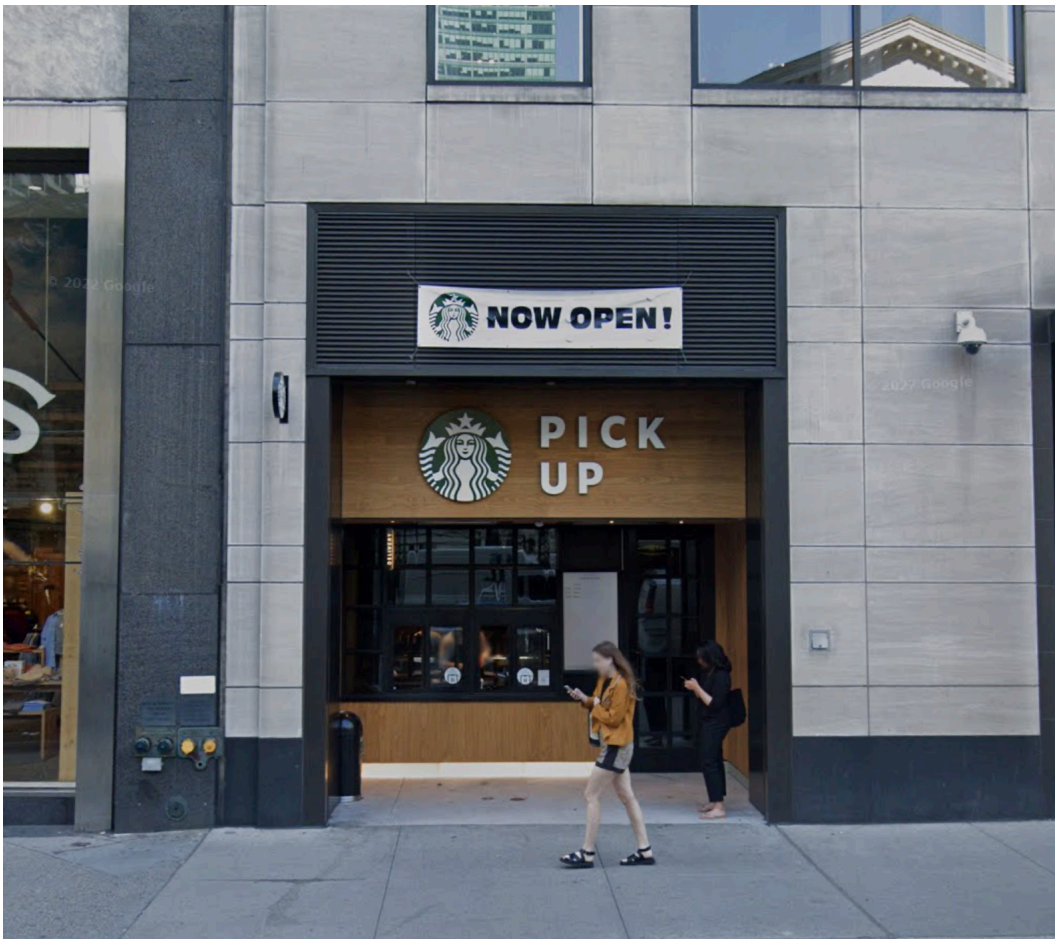


Figure 64 | Starbucks Pick Up Only Store in front of New York Public Library, source: Google Maps

Implication on Urban Fabric

The rise of grocery "dark stores" and other online retail has increased empty storefronts by 1% over the decade in Manhattan (Envelope, 2021). The presence of retail storefront clusters is strongly linked to urban walkability, as they promote pedestrian activity, activate adjacent public spaces, and contribute to reducing crime by providing "eyes on the street". A concentration of boutiques, bars, restaurants, retail stores, and the like are the kind of privately-owned but publicly-open spaces that draw people into cities (Cortright & Mahmoudi, 2016). At the neighborhood level, the presence of variety of small store and service businesses could contribute to the vibrancy and walkability of the streetscape.

The findings of the survey conducted by the Office of Council Member Gale Brewer reveals that the majority of grocery "dark stores" in Manhattan restrict or entirely prohibit customer access to store aisles, limiting their ability to browse and select items freely. This contrasts with the convenience and autonomy provided by the traditional stores that allow customers to navigate the aisles and choose their desired products. Furthermore, the absence of traditional storefronts in grocery "dark stores" with covered

windows adorned with artwork-like stickers create a visual departure from transparency and openness typically associated with traditional grocery stores. This has implications for the vibrancy and visual appeal on the urban landscape, potentially impacting the social fabric of neighborhoods and reducing pedestrian activity.

Despite needing more study, these distinct characteristics of grocery "dark stores" raise questions about their compatibility with the existing urban environment and their potential on the community. The concerns highlighted by Council Member Gale Brewer regarding the preservation of small businesses, community character, and street life resonate considering these findings It is important for city planners, policymakers, and stakeholders to consider the long-term implications and potential consequences of an over-reliance on grocery "dark stores" in shaping the future of urban retail.

Ultimately, finding a balance between the convenience and efficiency offered by grocery "dark stores" and the preservation of vibrant, inclusive, and socially cohesive neighborhoods is essential. Regulation and examining these emerging business models in terms of zoning regulations, community impact, and overall urban fabric can help ensure the evolution of retail aligns with the needs and values of the community they serve.

Implication on Local Economy

The emergence of quick commerce delivery services and grocery "dark stores" can have implications for the local economy and small-scale retail spaces. By crowding out core neighborhood businesses like bodegas and delis, these grocery "dark stores" may drive up rental costs for retail spaces, making it difficult for traditional community-oriented stores to afford the location they once occupied. New York bodega owners, in particular express concerns about the potential replacement of corner stores, which serve as vital community centers, with impersonal mobile applications (Waters, 2022).

Beyond economic impacts, the transformation from traditional grocery stores to grocery "dark stores" can also affect the social fabric of the neighborhoods. Local stores, such as bodegas, not only serve as places to purchase goods but also act as gathering spots where neighbors connect and engage in social interactions. These stores foster a sense of community and provide opportunities for spontaneous human contact.

6.3. Takeaways and Recommendations for New York City

The emergence of grocery "dark stores" in contrast to the generally favorable reception of MFCs and online delivery services, has sparked a sense of concerns among many. Early on, there was a prevailing concern that dark stores were eliminating retail opportunities, particularly as they began to proliferate. During an interview, Frank Ruchala, the Director of Zoning at the New York City Department of City Planning mentioned that it is worth noting what occupied these spaces before the advent of grocery "dark stores". Many of these locations had been vacant for extended periods, adding to the existing challenge of retail vacancies in the city. The question arises: Is this a problem in itself, or does it reflect a larger issue within the city? Despite the initial apprehension surrounding dark stores, Frank mentioned that in New York City, specifically Manhattan, this situation never escalated to a critical point where clear conclusions could be drawn.

However, the proliferation of grocery "dark stores" has inspired New York City to look at why and how this is happening and to think about the long-term future. Over the course of several decades, zoning regulations have played a significant role in addressing various issues related to retail spaces. In the 1960s and 1970s, concerns arose about the dominance of banks, which seemed to occupy every available retail location. In response to that, zoning measures were implemented to regulate the distribution and concentration of banks. Subsequently, in the 1990s and 2000s, the presence of banks and travel agencies in urban areas decreased significantly leading to a shift in the retail landscape. During this time, pharmacies became prominent occupants of retail spaces. The history of retail spaces reflect the constant evolution of new trends and changes. People have deep attachment to these spaces, as they contribute to neighborhood experience, and there is concern that alterations in retail establishments could impact their overall community experience.

Frank Ruchala mentioned that the grocery "dark store" debate and the issues surrounding it have provided the city with valuable insights and lessons, prompting them to consider the long-term future through the lens of planning. With skyrocketing rents, the global transformation of retail, and the ever-changing economic landscape, it becomes crucial to update and revise the existing rules to better reflect the dynamic nature of the city. As planners, Frank said, we need to contemplate the future of these companies and their place in our urban environment.

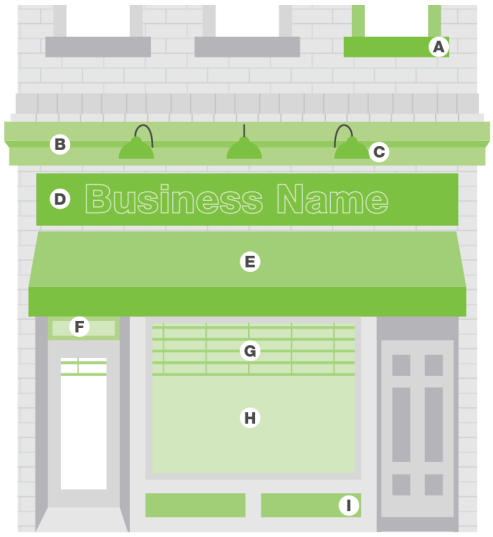
Additionally, the city face the challenge of determining when quick grocery delivery is the preferable option. Nevertheless, it is essential to consider the type of goods that are not typically sold in local store such as bodegas and to consider how the city and businesses can cater to those who are home bound, such as older people and individuals with disabilities. While the concept of grocery "dark store" may have

its drawbacks, city planners must still explore ways to serve and meet the needs of those who are unable to access traditional stores within a short walking distance.

Recommendations

Although online shopping competition is expected to persist, and traditional retail may never fully recover, New York City can seize the opportunity and even an obligation to foster innovative approaches to grocery "dark store" empty storefronts such as:

1. **Empty Storefront Guidelines.** NYC Storefront Improvement Guidelines should include minimum display window opening for grocery "dark stores" (Figure 65 and 66). By ensuring that grocery "dark stores" maintain adequate display window openings, the guidelines can help preserve the visual transparency and engagement between the store and the surrounding community. This will contribute to maintaining a vibrant and active streetscape, allowing pedestrians to have a sense of connection and interaction with the retail environment.



A Windows
Upper floor windows should be kept clear of signs and existing detail should be preserved and maintained.

B Cornice
The cornice is a significant decorative and unifying piece of the storefront. Be sure to preserve existing materials.

C Lighting
Lighting is used to illuminate signage and display windows. Good lighting is both eye-catching to shoppers and enhances safety.

D Signage
Signs provide the best space to advertise the name of a business. Effective signs are simple; they are not too large and fit within the scale of the building.

E Awning
Awnings add depth to the storefront and protect shoppers and window displays from sun and bad weather. They should fit appropriately above windows and doors and not project too far over the sidewalk.

F Transom Window
Transom windows allow for more light to enter the store. Keep them clear of opaque materials like cardboard or air conditioning units.

G Security
Security is important for protecting businesses and making customers feel safe. Open-grille security gates can be installed on the interior or exterior of the store. Interior is preferred, as it allows for a clean storefront and greater visibility.

H Display window
Display windows provide a great opportunity to show off merchandise. Be sure to limit the amount of signs and posters. Small decals are an effective and inexpensive alternative.

I Bulkhead
Bulkheads create a defined platform for window displays and are located at the base of the storefront. They should be proportionate to the size of the building.

Figure 65 | Current NYC Storefront Improvement Guidelines, source: NYC Small Business Services

Figure 66 | Implementation of Empty Storefront Guidelines. Source: Author.

2. **Retail Third-Space Storefronts Program** to commodify outdoor space while creating the opportunity for grocery retail destinations that can blend into the urban fabric while fostering play, exploration, and community engagement, for example, through the form of bars, coffee shops, or space to allow walk-ins to order through a platform and pick-up their orders in minutes.
3. **Enhance Collaboration with New York City Bodega Associations** to partner with bodegas and delis product in the grocery "dark stores" platform to enhance more efficient network and unique local products specific to certain neighborhoods in grocery "dark stores" application that caters more to the neighborhood needs.

6.4. Takeaways for Other Cities

Despite years of attention on platform urbanism: from Uber to Alipay, from Airbnb to Deliveroo, cities have not been fully able to mitigate the impact of these grocery "dark stores" present. The potential reshaping of private-public power geometries in the wake of platform urbanism is a crucial and emergent

issue: new urban platforms can serve as an interface not just between tech firms, governments, and citizens (Caprotti et al., 2022). These platforms serve more broadly as interfaces between how the relationship between private and public sectors is articulated and managed.

It is an important aspect to consider the relationship between specific cities and the growth of technology that promote platforms with urban impact. For a city, these issues are intricately linked not only to power dynamics between local authorities and specific urban areas but also to how to navigate diverse regulatory and policy environments, as these platforms often operate across different ones. Platform urbanism has given rise to problems, in part because social processes have been extracted from traditional regulatory frameworks that are often constrained nationally (Nash et al., 2017). Many governments are now grappling with platform-focused questions such as how to limit the oversupply of grocery "dark stores" in the city or how to ensure that the presence of grocery "dark stores" does not kill the economy of local grocery stores such as Bodega and delicatessen in Manhattan. However, some platform providers, in this case grocery "dark stores" are beginning to engage with regulatory processes as a means of gaining market access, political approval, and exploiting potentially lucrative niches. Grocery "dark stores" are starting to comply with considering opening their access for walk-ins and online pick-ups.

Cities need to consider the implications of different types of platforms and the specific geometry of their constituent actors in the digital era. There is a need for digital urban policy and regulation to comply with how platforms can reshape the nexus between businesses, cities, and citizens. While it is helpful to anticipate what can go wrong, it is even more critical to get in front of the trends to harness the benefit of the tech-enabled digital economy and urban ecosystem. As this thesis project exhibits, in the era of the internet era and platform urbanism, regulation does not necessarily mean following regulations according to existing rules and standards or enforcement through traditional institutions. Suppose society is to benefit from the opportunities provided by platform innovation. In that case, regulation must not be driven by the vested interests of those industries or institutions with the most to lose but rather by new assessments of what constitutes the public good (Nash et al., 2017). Cities and technology continue to evolve, and we need to ask whether there are alternatives to existing ways of organizing disruption in cities through platform urbanism.

6.5. Limitations and Next Steps

The research conducted in this thesis had some limitations. This thesis posed challenges in attempting to study a real issue, yet that issue was ongoing and evolving throughout the research. The author attempted to incorporate changes to the project into the project proposal but acknowledges that there may be some differences between the research questions being asked in the proposal and the actual project.

On data, there are limitations on the time to analyze the impact of grocery "dark stores" on the urban fabric by only using data from 2022-2023. The phenomenon started in mid-2021, and the data might be affected by changes in activities throughout the Covid-19 pandemic and longer timeframe is needed to better understand the impact. In addition to that, data on grocery "dark stores" and census data was collected and verified as much as possible. However, omissions of errors are expected with these amounts of data.

Future actions on grocery "dark stores" study should look at:

1. Other data variables that can support better understanding of the selection of grocery "dark stores" location and their target customers.
2. Diving deeper into studying the storefront index and analyzing the impact of empty storefronts on urban livability and walkability, to validate the potential impact of grocery "dark stores" on the urban fabric.
3. An approach of spatial autocorrelation metrics that indicate the likelihood of close observations sharing similar characteristics or autocorrelation might be important to look at. This could be measured by Moran I's Index and spatial lag coefficient. The result from the spatial regression model could quantify the magnitude and statistical significance of grocery "dark stores" clustering preferences and factors behind location preferences on average.
4. Retail storefront guidelines that emphasize on minimum window openings with certain degree of transparency that ensure security issue, enough lighting, bulkhead, and signage.
5. Response from planning department, such as New York City Department of City Planning on zoning and land use regulations.

Appendix

Thank you for taking your time to speak with me today. For a brief introduction, I am a second-year master's in city planning student at MIT and currently working on my thesis project on the evolution of grocery stores and their potential impact on cities. For my thesis work I will integrate spatial analysis to understand the spatial synergies between these store locations and urban amenities. I will also conduct interviews with city officials and those in the industry to understand their perception. Before we start, I want to let you know that confidentiality is assured, and you may decline to answer any question if you need to.

0.	**Introduction**	To start, could you share what is your role and responsibility in the company?
1.	**Grocery (stores)**	• How do you think grocery activities has changed with the influence of technology? • How these changes in activities produced a new form of retail space? • Some people called X "micro-fulfillment center" and some called "dark stores". What category is it under? • What is the idea behind [this company]? • When was it first established in the US? What drives the demand rise for this new typology of store?

2.	**Location**	• In which cities are these stores operating? Is it only in the US or do you have or know of international location as well?
		• What factors are being considered in selecting these locations?
		  o Is it only applicable in New York City? What do you think of other cities?
		  o Urban vs. suburban?
		• Do you do any analysis beforehand? If yes, what kind?
		• Who are your main target customers?

3.	**Operation**	• Could you share about the how the supply chain and logistics operation take place?
		  o How has the supply chain and logistics operation shifted? (From larger distribution center in the suburban area to smaller distribution center in the city)
		  o What do you think will be the future vision of such operation and why?
		• What makes you operate differently than bigger grocery stores such as Target, Walmart, Trader's Joe, etc.?
		• What products can customers find on your store?

4.	**Regulation**	Do you encounter any problems or issues from city officials and what kind?

Recently, the city officials in NYC have some concern about the presence of "dark stores" being not in the right zoning and how "dark stores" operates.

- Are you being aware of any new city regulations regarding your operation? If yes, what are they and why are they being put in place? How would your company address them?
- What is your strategy (opinion?) on the operation of?
    - E-bike
    - Payment method
    - Allowing customer to walk-in

Is there anything else you can tell me about your operation or the stores? Any items of interest I should know about or may have missed?

5.

And finally, can you suggest others I should speak with to better understand this issue? Any colleague in the industry or someone at your organization or in the city you could suggest or recommend?

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