FULFILLING THE FUTURE

→ A forward look through the lens of the urban food system

Why this book?

Ready or not, our world is transforming dramatically: population is increasing, natural resources are becoming more constrained, and humans are flocking to urban centers. New and unique challenges are cropping up and affecting all industries. Culture is shifting with a priority on identity, sharing, and transparency. Simultaneously, technology is evolving at an accelerated pace, with growing harnessable potential.

The food system in future urban environments, and more specifically distribution and fulfillment, will simultaneously be more constrained and need to meet an exponentially increasing demand. In this book, we will investigate **how urban food fulfillment will need to transform to meet the needs of people in future cities.**

While the challenges we face are pressing and numerous, we are hopeful and optimistic of the future—one where innovative minds are focused on new ideas, and organizations collaborate to create groundbreaking solutions.

❝ The vast majority of the U.S. population (87%) **will live in urban areas,** according to UN projections. The nation's cities will likely continue to accumulate all the power, technology and wealth, while rural areas fall behind.[1]

Axios

❝ Given that 80 percent of all food is expected to be consumed in cities by 2050, they have to be central to this story.[2]

World Economic Forum

There is no one city of the future.

In the late 1800s and early 1900s, under the pressure of rapid industrial growth and urbanization, cities were forced to modernize to accommodate their increasing populations. Cities developed at different paces, prioritizing certain innovations for specific problems they faced. Unsanitary conditions and poor public health triggered the development of the sewage system in London. The need for safe street lights and public transit sparked New York City to establish an electric power grid. The decimation of flammable wooden buildings in the Great Chicago Fire led to an architectural renaissance of steel-and-stone structures and skyscrapers.[3–9] These innovations laid some of the foundations of modern life, as cities developed across the globe.

We believe the next wave of urban innovation will play out in a similar manner, albeit to solve new and uniquely modern challenges. Solutions like automation, connectivity, or renewable energy will be developed for different locations and unique reasons, but will eventually form the landscape of all future cities. Similarly, we cannot design a one-size-fits-all urban food fulfillment system. As every city evolves differently, the approach to food fulfillment must flex to meet each city's specific needs.

Our research

We explored trends in urban planning, environment and climate, transportation and logistics technology, farming and food production, consumer behavior, and more—which led us to five driving forces that will affect the evolution of urban food fulfillment.

1. Rapid urbanization

Urban environments will become more complex and dense as populations increasingly flow toward cities. The food system will need to meet increasing demand for ingredients new and old, to integrate new sources of food (e.g. lab grown meat, or vertical farming), and to operate in increasingly difficult settings more nimbly and flexibly than ever.

2. Climate change and global vulnerability

Climate patterns will become more unpredictable and damaging, and global conditions more unstable. Food sources and fulfillment methods will need to be diversified, sustainable, and transparently provided to ensure equal access to affordable, nutritionally-dense food.

3. Sharing and partnerships

The wicked problems of urbanization (e.g. density, limited space, strained resources) will require symbiotic partnerships, shared real-time data, and experimentation between the public and private sectors. Entities will no longer be able to operate in silos, and collaboration across competitors will become more common.

4. Resource mindfulness

Space, ingredients, and energy will become more scarce as the world's population increases and moves to cities. In the future, resource mindfulness will be a necessity, not an option.

5. Intentional automation

Automation is not the end-all-be-all solution for the future of cities and urban fulfillment. Understanding the opportunities and limitations of automation, and balancing it with human capital, will create solutions that are flexible and appropriate in a variety of contexts.

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In the following pages, we will explore five model cities that explore the consequences of these driving forces on the urban food system. These fictional cities are not intended to be mutually exclusive—aspects of all five could exist in the same city. Instead, they are meant to help us speculate what challenges and solutions urban fulfillment will see in the future.

THE DENSE CITY

Nowhere to grow but up.

The Dense City, offering economic opportunity and a stable climate, has become one of the most crowded urban areas for people-per-square-mile in the world. This megacity and its infrastructure has evolved over many decades, and as a result, it does not have the luxury to start over—it must instead continuously adapt, reconfigure and repurpose.

Because of this, a culture and technical platform has emerged for sharing of all kinds, between individuals but across businesses: shared spaces, shared equipment, shared services, and more. Shared mobility services and vehicle ownership limitation have attempted to improve congestion in the city, but gridlocked streets are still the norm. Housing regulations have been established, but good, affordable places to live are still in short supply. Similarly, space for business and civic life is scarce, and digital infrastructure struggles to keep up with the density of broadband data flow.

In these extreme urban conditions, the City government, industry players, and community members all creatively collaborate in order to thrive.

Rapid urbanization, and its effects, are the major driving forces of the Dense City.
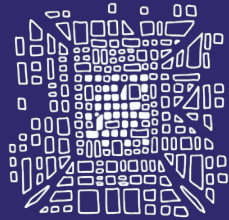
Urbanization

People will continue to move to cities, due to better economic prospects, job opportunities and quality of living.

"By 2030, it is expected that nearly 5 billion (61%) of the world's 8.1 billion people will live in cities."

UNESCO [1]

Limited space for people, structures

As more people move into cities, space for living and working will be increasingly strained and placed at a premium.

"The infrastructure for many American cities was created in the post-war [2] era and has neared or surpassed its planned lifespan. Additionally, this infrastructure often supports a larger population than projected."

Grayline Group [2]

Challenges

Overcrowding

Congestion

Strain on space

Limited supply of critical resources

City Goals

Meeting demand and needs of many people in a small area

Using space and resources efficiently

The Food System of the Dense City

Do more with less.

Facing an overcrowded city and strained supplies of critical resources, this city will have to adapt to use space and resources as efficiently as possible, while finding innovative ways to serve its community. Here are five solutions to address food system challenges of the Dense City of the future.

1. Alternative Food Sources

As the population in the Dense City increases, the demand for food and water will continue to grow as the traditional sources for these essentials will become more strained. City leaders, food producers, and other innovators will need to discover creative new ways to serve the needs of this growing city with alternative farming and food sources.

→ Smart Cookie: Beyond Meat
This plant-based food producer is introducing plant-based meat sources to the mainstream and producing the Future of Protein™ at scale, helping deliver nutrition to more people with less reliance on resource-heavy livestock production.[4]

2. Urban Consolidation
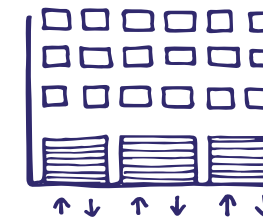
Space will also be in high demand, and traffic congestion will become an acute challenge for cities to solve. To reduce congestion and be more efficient, Urban Consolidation* will become a common distribution model for urban fulfillment, and shared logistics services will be utilized to streamline last mile.

> 66 The rising economic opportunity in urban environments is pulling our workforce away from the once thriving rural communities that surrounded a booming agricultural economy—these extreme demographic conditions challenge the sustainability and health of our food system, from production to food recovery.[3]

Relish Works, The Food System

→ **Smart Cookie: Freight Logistics Hub at Quayside, Toronto**

Quayside will model urban freight consolidation at scale (rerouting deliveries efficiently, managing waste removal, offering shared storage space for residents) through a neighborhood logistics hub in order to increase efficiency and improve the overall mobility system for its citizens.[5]

3. Micro-fulfillment and Shared Storage
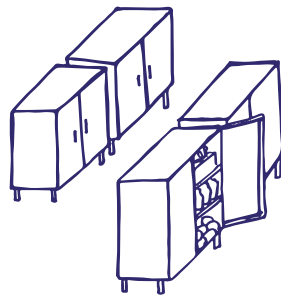
In addition to congested streets, available urban real estate will be limited and come at a premium price. As a result, a network of micro-fulfillment centers* and shared storage facilities will be established, allowing operators to order smaller, more frequent, and fresher shipments of food, while eliminating the need to store food on premise. This will help maximize precious restaurant space, allow orders to be fulfilled quickly and efficiently, and lighten overall traffic congestion with smaller delivery vehicles.

→ **Food for Thought**

What if… restaurants within the same building or neighborhood shared refrigerator, storage and kitchen space? What if the food distributor owned this space and items were available for purchase on the spot?

→ **Smart Cookie: City Tech Collaborative Advanced Mobility Initiative (Chicago)**

City Tech Collaborative and Millennium Park Garage have partnered and plan to test new urban mobility and distribution ideas using an under-utilized parking garage, helping to reimagine fulfillment in an increasingly dense city.[6]

4. Mandated Delivery Times

Deliveries will be mandated to off-hours only to reduce commercial traffic and overall street congestion. Avoiding peak traffic times will make deliveries smoother for both distributors and operators, as well as generally improve living conditions in the city.

❝ Urbanization in the United States coincides with a deep need to modernize city infrastructure, for which many American cities was created in the post-war era and has neared or surpassed its planned lifespan.[3]

Grayline Group

Smart Cookie: Off-Hour Deliveries Program (NYC)

New York City's Off-Hours Deliveries Program incentivizes goods delivery during the off-peak hours of 7pm to 6am in efforts to decrease congestion and reduce carbon emissions.[7]

5. Reroute Waste

With limited resources and more mouths to feed, absolutely no edible food can go to waste in the Dense City of the future. Real-time information, responsive logistics, and partnerships with public entities will allow uneaten excess food to be quickly rerouted to those in need.

→ **Smart Cookie: Goodr**

Powered by blockchain technology, this Atlanta-based tech company provides a secure ledger that tracks organizations' surplus food waste from pickup to donation, analyzes food waste data, and coordinates safe collection and distribution of food donations to nonprofits and people in need.[8]

Sound familiar?

Emerging megacities around the globe are already dealing with the pressures of overpopulation and attempting to address the issues of overcrowding, limited space, and strained resources.

"Every day, the number of urban residents increases by roughly 200,000."

Futures Platform [9]

"Today, urban areas contribute more than 80% of global GDP, which is set to increase as the world's urban population doubles by mid-century."

Gensler Research Institute [10]

"1/3 of urban dwellers worldwide—1.2 billion people—lack access to safe and secure housing. Lower- and middle-income countries especially struggle as governments cannot build out services and infrastructure fast enough to accommodate new arrivals."

Robin King, Director of Knowledge Capture and Collaboration at WRI Ross Center for Sustainable Cities [11]

Dense Cities are finding creative urban space and housing solutions.

Manila, Philippines

Size of city center:
42.5 km² (16.6 sq mi)[12]

Population (city center, 2016):
1.78 million[13]

Density: 41,882 people/km²

Megaworld, a Filipino development company, has invested $5 billion into creating 10 enormous vertical office-and-housing "townships" for employees of the booming telemarketing business to work, live, and play in suburban Manila.[14]

Mumbai, India

Size of city center:
619 km² (239 sq mi)[15]

Population (city center, 2017):
12.5 million[16]

Density: 41,882 people/km²

Dharavi, the largest slum in Mumbai, is home to an estimated 869,565 people per square mile.[17] Mumbai's city leaders have long planned the demolishment and rebuilding of Dharavi, but research group Urbz is taking a new approach to understanding the unique structure of the neighborhood. They have learned that the area, with the help of professional contractors, has actually been developed in a sophisticated and systematic way that addresses the economic, family and community needs of the people that live there. The Urbz "Ideal Home, Dharavi Contractor" project seeks to prioritize the community's needs and development process, while advocating for the neighborhood to be made cleaner, more accessible and easier to live in overall.[18]

New York City, New York

Size of city center:
783.8 km² (302.6 sq mi)[19]

Population (2018, estimated):
8.4 million[20]

Density: 10717 people/km²

As one of the largest food systems in the US—serving its 8.4 million residents and over 60 million tourists annually—New York City has established a number of strategies to make food resilient and accessible across its five boroughs. In reaction to their resiliency plan *OneNYC: The Plan for a Strong and Just City*, the city commissioned a study to better understand and ultimately improve their food distribution system.[21,22]

How can you prepare?

Whether you're a restaurant operator, city leader, or other player in the urban logistics world, here are some considerations for preparing for the challenges of the Dense City.

How can growing demand for food be met in nutritious and sustainable ways?

Food suppliers, restaurant operators and grocery owners may benefit from searching for new and innovative sources of protein, like lab-grown meat or meat alternatives. Supporting food innovators will help take these products mainstream and help them scale in order to feed more people. Food innovators should consider utilizing food nutrition optimization, data, and new agricultural technology.

How can urban mobility and transit systems be improved, while continuing to increase fulfillment efficiency?

City planners and government leaders might consider piloting some of the new urban logistics solutions outlined in this report, including urban consolidation and micro-fulfillment, which are believed to help make fulfillment more efficient while minimizing large, bulky vehicles coming into city centers. Zoning regulations and suggested nighttime deliveries may also help reduce traffic congestion from delivery vehicles.

How can food and urban fulfillment stakeholders work better in an environment of limited space and limited resources?

The sharing economy is a promising solution to address limited space, especially in areas around shared storage and mobility services. A new industry of shared, refrigerated food storage space would allow operators to utilize their restaurant space to its fullest potential, as well as make food deliveries less cumbersome by moving them off-premise. Shared last-mile logistics services could allow larger distributors to save costs on transportation, fleet, and staff.

> ❝ Cities such as Singapore, a city with half the surface area of London, will have to consider underground spaces in zoning activities instead of merely growing upwards or spreading out to the sea.[9]
>
> *Futures Platform*

THE EFFICIENT CITY

Continuous optimization.

In the interest of economic gains and consumer demand, this City has become a shining example of optimized and efficient operations. However, automation and technology are thoughtfully integrated with human capital, creating technology solutions that feel balanced and human-centered.

Strong investments in physical and digital infrastructure have built a robust, real-time view into the city that powers the Efficient City's services—every vehicle, building and significant object are wired together to provide continuous feedback and control. Because of this ubiquitous collecting, sharing, and applying of data, the city has also become a leader in responsible and safe data usage and citizen-empowering ownership practices.

An initiative for technology-driven disruption, and the hyperconnectivity that powers it, are the major driving forces of the Efficient City.
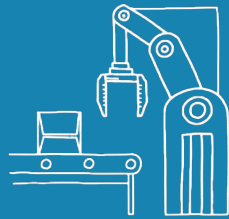
Smart technology and automation

Internet-connected technology and automated systems will help drive efficiencies across industries.

"Microsoft has also announced that it is investing $5B in IoT technology from 2018 to 2022, which will attempt to improve the technologies required for smart cities to function."

CB Insights [1]

Data collection and sharing

Sharing data across organizations, both public and private, will be crucial to solving problems in a holistic manner.

"A city is considered to be 'smart' when it can collect and analyze mass quantities of data from a wide variety of industries, from urban planning to garbage collection."

CB Insights [1]

Rising Inequality

Class divide and wealth inequality will continue to widen as a result of automation and loss of middle-income jobs.

"Inequality represents the greatest societal concern associated with the Fourth Industrial Revolution."

Klaus Schwab, Founder and Executive Chairman, World Economic Forum [2]

Challenges

Data privacy, transparency issues

Widening class divide and wealth inequality, driven by automation and loss of middle-income jobs

City Goals

Efficiency and optimization

Establish an identity as innovator, testing ground


The Food System of the Efficient City

Go above and beyond.

In a city operating largely on automation and data sharing, government and citizens alike will demand transparency across the food system to ensure safe and responsible practices. Here are five solutions to achieve this in the food system of the Efficient City.

> 66 Smart cities have the potential to solve major problems and drive innovations, bringing people together to create thriving ecosystems.[3]
>
> *Diane Hoskins, Co-CEO, Gensler*

1. Optimized Food Sources
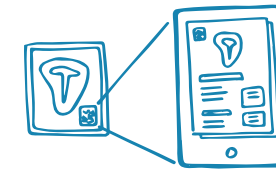
Leveraging powerful data and strides in agricultural technology, food sources have the potential to become optimized in both yield and nutrition. This will help meet the demand of a growing urban population, while minimizing resources (e.g. water, energy, animal products) and creating a more sustainable food system.

→ **Smart Cookie: Spread Co.**

This Japanese vertical-farming innovator has developed methods to produce generous yield (648 heads of lettuce per square meter annually) with minimal resources and energy, securing the abundance and affordability of fresh food during climate crisis.[4,5]

2. Tracing and Tracking
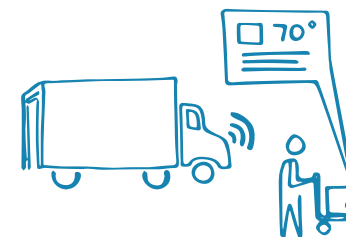
The Efficient City will generate its own ledger of food system data, allowing all stakeholders to track and trace information like food quality and safety, sustainability, and steps along the food chain. This will be made possible through a system of smart packaging and sensors, as well as blockchain technology. This will help build trust with consumers and ensure food safety standards across the food system.

→ **Smart Cookie: Ripe.io**

This blockchain-enabled food sourcing platform uses real-time data to improve transparency and can enable traceability across the food system, from source to consumer.[6]

Food system traceability refers to systems that provide visibility into the flow of goods throughout any stage of the food chain—production, processing and distribution. Traceability consists of two components: tracing (a recorded history of a product's life cycle across the food chain) and tracking (the ability to pinpoint the location of a particular product at any given time).[7]

3. Distribution and Fulfillment Automation

Automation is leveraged across the food system in the Efficient City, specifically in during distribution and fulfillment. The most effective, groundbreaking technology solutions are employed within warehouses, during long haul transportation, and within the last mile of food delivery, all in the name of efficiency and optimized resource usage.

→ Smart Cookie: Volvo
The major truck maker is testing truck platooning convoys that are powered by connectivity technology and automated driving support systems—a technology that could make getting large deliveries of food from source to cities more efficient and more cost- and resource-effective.[8]

→ Food for Thought: Automation Job Training
What if... suppliers offered job training programs for workers in the areas of alternative farming, robotics engineering, and data science, in order to address loss of jobs due to automation?

4. Predictive Ordering and Responsive Delivery

In this City, a comprehensive understanding of real-time city conditions (weather, traffic, etc.) and meticulous supply and demand forecasting leads to less inventory management and more predictive, efficient and direct deliveries. As demand forecasting becomes more accurate, the need for distribution centers and large-scale warehouses could be eliminated, majorly disrupting the current model of the food system.

→ Smart Cookie: Zest Labs
This agricultural tech company uses sensors and smart technology that optimizes food routes for freshness, helping to quickly meet real-time demand for fresh food.[9]

❝ Automation will drive efficiencies, but human capital will remain the differentiator in tech-growing world.[21]

Relish Works, The Food System

→ Food for Thought: Operator-to-Grower Data Channel
What if... consumer demand could be communicated directly to growers from the operators who purchase and sell their goods, in order to streamline inventory management and assist in forecasting?

5. Intelligent Inventory and Packaging

Smart storage solutions for suppliers and operators provide a real-time view into supply and powers automated ordering when inventory is low, reducing manual guess work. Smart storage could also facilitate easy and secure key drop deliveries (deliveries outside of normal business hours) and eliminate the need for the operator to be present.

*In a Nutshell: Key Drop Delivery:
Key drop deliveries occur outside of normal business hours, and have the potential for faster deliveries and reduced last mile costs, due to minimized traffic and curb congestion, and reduced failed delivery attempts. Off-premise storage lockers or smart storage can help support these deliveries by providing a secure location for key drop deliveries while operators are not present.

❝ Whether for food safety, nutrition, or environmental and social responsibility, consumers are demanding more transparency from retailers and brands about the lifecycle for the products they consume.[20]

Gensler Research Institute

Sound familiar?

Cities around the world, especially those with aging infrastructure and growing urban populations, are striving for efficiencies in the public and private realms through the implementation of smart technology. However, they must be intentional and mindful in their solutions, in order to create a society that is equitably benefited from these developments.

By 2022 in megacities (population of at least 10 million people), governments and enterprises could save an annual $5 million and $14 million, respectively, with the implementation of smart systems, automation and IoT technology.
Information Age[10]

32% of jobs in OECD countries are at risk of significant change, 14% of which could be automated, indicating the need for a responsive labor market and job training for those affected.
Organisation for Economic Co-operation and Development[11]

The global smart cities market size is projected to be worth $1.4T within the next 6 years.
CB Insights[1]

Efficient Cities are ahead of the curve with technology.

Barcelona, Spain

Population (2016): 1.6 million[12]

Already a leader in smart systems for public transit, waste management, and efficient street lighting, Barcelona recently introduced their 2017-2020 Digital City Plan to ultimately make the city a more "open, fair, circular and democratic city with a more plural and diversified economy." Strategies to meet this goal include establishing an open source code for government agencies, reducing the digital divide by bolstering digital infrastructure, promoting digital education for the public, and facilitating an active, participatory democracy.[13]

Tokyo, Japan

Population (2016): 1.6 million[14]

Japan's bullet train is a fitting example of the country's culture of cutting edge innovation. The Yamanote Line, which loops around central Tokyo, is used by 34 million passengers a week with trains running every two to three minutes. Beyond its incredibly fast speeds, the line is also benefiting from IoT technology developments. A new system of "Condition-Based Maintenance" is allowing train operators to perform maintenance without disrupting this busy route, by collecting and analyzing real-time data on equipment status, identify weaknesses, forecast failures and schedule repairs. This keeps the train moving smoothly and reliably for the millions of people who rely on it every day.[15]

Boston, Massachusetts

Population (2018): 694,000[16]

As home to some of the most prestigious academic institutions in the world and one of the first cities to introduce smart city initiatives in 2010, Boston is leading the way in citizen-centric digital solutions. The city has developed a suite of apps to help improve life in the city, including BOS:311 to report non-emergency issues like potholes and graffiti, StreetBump to collect and monitor real-time road conditions, and *Where's My School Bus* to live track school transportation. The city is focused on "participatory urbanism" and building solutions that empower their citizens to engage and make informed decisions.[17–19]

How can you prepare?

Whether you're a food distributor, food safety expert, or data analytics specialist, here are some considerations for stepping up your game in the Efficient City.

How can transparency and traceability be established across the food system?

Beginning to collect, aggregate, and analyze data is the first step to building a more transparent process. Producers and distributors can begin utilizing sensors across their processes, including temperature sensors and smart packaging materials, in order to begin tracking food safety and real-time location information. Applying blockchain technology at scale can then help make the data secure, credible, and accessible.

How can needs be met as close to real-time as possible, reducing wasted food, time, and resources?

Accurate demand forecasting is at the center of just-in-time delivery, but many aspects need to be in place to achieve it. Food producers, distributors and operators should consider sharing data amongst themselves in order to capture an accurate real-time and transparent view of supply and demand. Distributors might consider bolstering their demand forecasting capabilities by incorporating data analysis and predictive analytics. They can also position themselves in new ways to become the liaison between producers and operators, making the entire food system more efficient.

> ❝ The [technology] revolution could yield greater inequality, particularly in its potential to disrupt labor markets. As automation substitutes for labor across the entire economy, the net displacement of workers by machines might exacerbate the gap between returns to capital and returns to labor.[2]

Klaus Schwab, Founder and Executive Chairman, World Economic Forum

THE VULNERABLE
CITY

In competition with Mother Nature.

Close to the coast, this City is bearing the brunt of rising sea levels, tumultuous weather and generally miserable extremes. The near-at-hand sources for food and fresh water are also under threat, with shortages occurring more frequently. No longer an occasional state, crisis is the new normal, with emergency preparations perpetually in place.

As a result, digital infrastructure is in place to monitor and alert, and react in real-time. Leaders have taken extreme measures to protect the City's precious resources, like regulating energy and water use, zoning deliveries and waste removal, and banning single-use containers. The private sector has little choice but to play along.

Climate change and global vulnerability are major driving forces of the Vulnerable City.
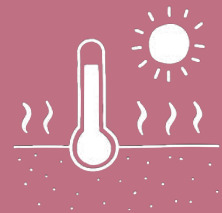

Extreme weather events

Extreme weather, like heat waves, floods, droughts, and hurricanes, have become more frequent and intense in the previous few decades.[1]

"Record for number of weather and climate disasters that exceeded $1 billion (U.S. dollars) in losses was set in 2011."

American Meteorological Society [2]

Rising sea levels

As oceans absorb the majority of increased atmospheric temperatures, water expands and glaciers melt, causing sea levels to rise.[1]

"Global sea level has risen by about 8 inches since reliable record keeping began in 1880. It is projected to rise another 1 to 4 feet by 2100"

U.S. Global Change Research Program [1]

Shortage of arable land, resources

The combination of climate stressors and increased population will affect the amount of arable land per capita available for growing crops and livestock.[3,4]

"By mid-century, when temperature increases are projected to be between 1.8ºF and 5.4ºF and precipitation extremes are further intensified, yields of major U.S. crops and farm profits are expected to decline."

U.S. Global Change Research Program [3]

Hotter temperatures

Temperatures in the United States have been increasing, and are expected to continue increasing correspondingly to rising levels of global emissions.[1]

"Climate models project that the same summertime temperatures that ranked among the hottest 5% in 1950-1979 will occur at least 70% of the time by 2035-2064 in the U.S. if global emissions of heat-trapping gases continue to grow."

U.S. Global Change Research Program [1]

Challenges

Limited access to resources

Constant threat of disaster or rapid environmental change

City Goals

Resiliency

Safety and security

Survival

The Food System of the Vulnerable City

Expect the unexpected.

Facing limited access to resources and threat of disaster or rapid environmental change, the Vulnerable City must remain prepared for emergencies at all times. These are five differentiators that will keep the food system of the Vulnerable City equipped and ready for anything.

> ❝ Climate resilience, the capacity to adapt to change or spring back from disaster, is the most pressing challenge and greatest opportunity that cities face.[5]
>
> *Gensler Research Institute*

1. Diversified Food Sources
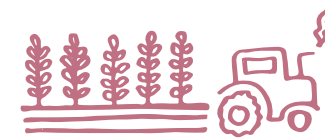
Food supplies must be diversified—sourced from outside and inside the city, being grown on large farms, hydroponic pods, or in a lab. In order to reduce the scarcity risk in emergency situations, the Vulnerable City must have a backup plan.
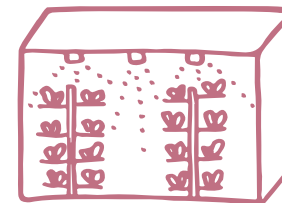
→ Food for Thought

What if… modular indoor farm containers were available for restaurant operators to rent to grow their own produce?

2. Nimble Logistics

Unpredictable weather, traffic, and safety conditions will constantly affect fulfillment in this future city. Suppliers and logistics providers will need to be equipped with real-time data and automated technology, able to be deployed with a moment's notice, in order to continue to serve the city's population in all conditions.

→ Food for Thought
What if… food distributors incorporated weather analytics and real-time transit data to anticipate problems and make automated changes to in-progress fulfillment?

3. Decentralized Distribution and Reserve Centers

In times of severe weather or natural disasters, food, water and other vital supplies must be kept protected and available. Strategically distributed storage and warehousing of food will ensure fulfillment can continue, even if certain city areas or warehouses are inaccessible. Emergency food reserves will also be crucial in feeding people in times of need.
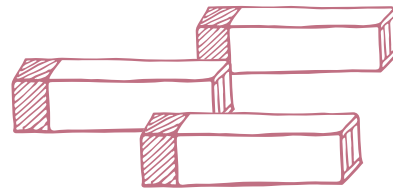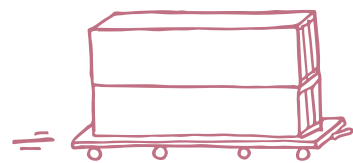
→ Smart Cookie: Square Roots
This urban farming company building tech-enabled hydroponic farms in portable and compact shipping containers, creating a sustainable food source that can be easily set up anywhere.[6]

4. Creative Solutions for Fulfillment Logistics

The ability to be responsive and flexible will be of the utmost importance in the Vulnerable City, which means opportunities to test and scale new logistics technology solutions, like drones, robots and automated vehicles.

→ Smart Cookie: Gatik AI
Gatik's autonomous vehicle technology, which focuses on short hauls of goods using light-commercial trucks and vans, is a promising solution for agile fulfillment in times of need.[7]

❝ Extreme events in many cities include heat waves, droughts, heavy downpours, and coastal flooding, are projected to increase in frequency and intensity [under changing climate conditions].[22]

Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network

❝ Many cities in the U.S. are prioritizing resilience planning to better prepare for severe natural disasters such as earthquakes, hurricanes and superstorms. Food systems, however, have been largely overlooked in these planning efforts.[23]

The Initiative For A Competitive Inner City

5. Operating in Regulated Delivery Zones

In the Vulnerable City, in order to preserve resources and move goods efficiently, mandatory delivery zones have been established and have each been assigned a specific logistics provider. Food suppliers will need to collaborate closely with each other and with logistics partners, in order to distribute their goods within this highly regulated environment.

→ Food for Thought
What if… logistics providers partnered with cities to be the designated transportation partners for urban food fulfillment?
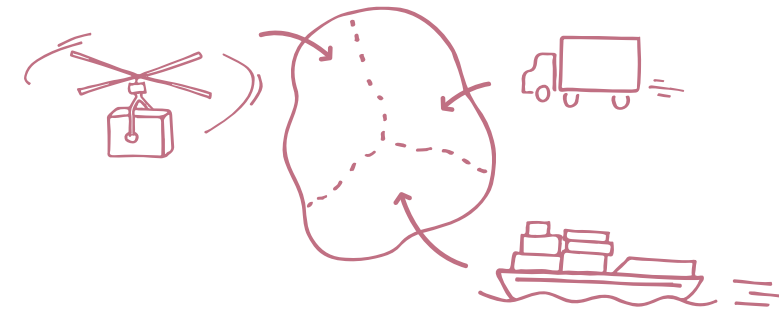
Sound familiar?

Coastal cities are literally on the front lines of climate vulnerability, as rising sea levels, flooding and diminishing shoreline already threaten their way of life. Cities under climate pressure are innovating to combat these threats and thrive into the future.

By 2045, most US coastal communities are expected to see roughly one foot of sea level rise.

Cambridge, MA: Union of Concerned Scientists. [8]

By 2045, one-third of major coastal areas along the East and Gulf Coast can over expect 180 tidal floods per year, while nine of these cities could average over 240 per year.

Cambridge, MA: Union of Concerned Scientists. [8]

By 2100, annual flooding worldwide could cause $1 trillion in losses and submerge areas that are now home to more than 150 million people.

CQ Researcher [9]

❝ While projections for future climate change are most often defined globally, it is becoming increasingly important to assess how the changing climate will impact cities. The risks are not the same everywhere. Sea level rise will affect the massive zones of urbanization clustered along the world's tidal coastlines and most significantly those cities in places where the land is already subsiding.[22]

Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network

# Vulnerable Cities are building now to combat future disasters.

Miami, Florida

Population (2019, Miami-Dade County): 2.75 million[10]

Due to its coastal location, porous limestone bedrock and billions in coastal property, Miami is particularly vulnerable to rising sea levels. The saltwater intrusions associated with rising sea levels are already taking a toll on building foundations.

In response, the city has established the *Miami Forever Bond* program, a collaboration between city planners, innovators, and citizens to focus on solutions for flood defenses, affordable housing and a new waterfront.[11–13]
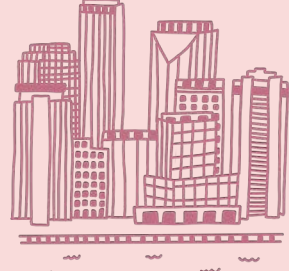
New Orleans, Louisiana

Population (2018, total metro area): 1.27 million[14]

Due to sitting below sea level, its proximity to two major bodies of water, and its location on the path of dangerous and ever more frequent hurricanes, New Orleans is notoriously vulnerable to incredibly destructive storm surges and flooding.[11, 12]

As a commitment to resilience, the city joined the Rockefeller Foundation's *100 Resilient Cities* program and established their Resilience Strategy in August, 2015, in which they mention the importance of a resilient and accessible food system for all their residents.[15–17]

Shanghai, China

Population (2019): 26.32 million[18]

Literally meaning "above the sea," Shanghai has been declared the most vulnerable major city to serious flooding, based on factors such as numbers of people living close to the coastline, time needed to recover from flooding, and measures to prevent floodwater. Its population faces massive displacement if global temperatures increase by just 3 degrees Celsius.

In response, the city is building China's largest deepwater drainage system beneath Suzhou Creek waterway, as well as waterfront flood prevention walls along their waterfront. In 2015, they joined forces with Milan Urban Food Policy Pact as an effort to build sustainable and equitable urban food systems.[19–21]

How can you prepare?

Whether you're a city planner, a food producer, or a logistics provider, here are some considerations for preparing for the challenges of the Vulnerable City.

How can food be protected and sustainably provided, in both stable and unstable conditions?

Food innovators and established food producers and suppliers might both consider exploring technologies in alternative farming and lab-grown food. Establishing new and more sustainable (e.g. less reliant on natural resources and energy) methods of producing food will create more secure ways of meeting increasing demand for nutrition. For city planners and food distributors, consider new warehousing strategies that move away from the massive, single-source distribution model of today into a smaller, more dispersed system of warehouses and fulfillment centers.

How can fulfillment be made flexible and secure in the face of climate constraints?

In order to react effectively to situations in the Vulnerable City, both the public and private sectors must consider symbiotic partnerships across industries, in order to share relevant data and understand real-time city conditions. Beyond this element, automation and new logistics technology might be other solutions for being able to deploy food and supplies to those in times of need.

> ❝ In Los Angeles, 15 of its 22 supermarket warehouse suppliers (68%) and 42 of its 60 warehouse suppliers (70%) are located in "at risk" areas, putting them at risk for slight damage to specially-designed structures and considerable damage to ordinary structures.[23]
>
> *The Initiative For A Competitive Inner City.*

THE GREEN CITY

It's not easy being green.

The goal of this City is not merely to reduce-reuse-recycle, but to become a shining example of sustainability and a producer of sustainable resources for others. At the core of the Green City is a community passionate about contributing to and achieving green initiatives, prioritizing local food, and willing to do their part to establish a new way of sustainable, communal living.

To reinforce these community drivers, green legislation on carbon output, resource consumption, and regulations on the food supply chain and waste management have been established. With the support of the government and its citizens, the Green City is powered by a strong circular economy where every input and output is considered and put to good use.

Technology-driven disruption, and the hyperconnectivity that powers it, are the major driving forces of the Green City.

Resource consumption in cities

As urban concentration of population continues to increase, disproportionate consumption of resources and contributions to global greenhouse gas emissions will expand in cities.

"Cities are aggregators of materials and nutrients, accounting for 75% of natural resource consumption, 50% of global waste production, and 60-80% of greenhouse gas emissions."

Ellen MacArthur Foundation [1]

Reduction of pollution and negative environmental conditions

If remained unchecked, urban density of people and emissions will produce environmental conditions that are increasingly hazardous to human health.

"Approximately 80% of urban areas have air pollution levels that exceed the World Health Organization's limits."

World Health Organization [2]

Community demand for sustainability

With increased visibility on the impact that increased waste and diminishing resources have on the environment, consumers will demand products and services that support a sustainable, zero-waste circular economy.

"Consumers see the impact of their purchases on the world and their health, and need help making sustainable choices."

Nielsen [3]

Challenges

Connecting disparate systems and organizations in order to achieve a circular economy

Upfront costs necessary to meet green regulations

Achieving scale with small, local resources in order to power entire city

City Goals

Resource conservation and self-sustainability

Eliminate waste and establish circular economy

Localization of resources

The Food System of the Green City

Close the Loop.

Motivated by a commitment to a sustainable future and circular economy, the Green City is focused on bringing the food source closer to the consumer and closing the loop on waste.

1. Local Food

In an effort to shorten the food chain and reduce energy usage, an emphasis will be placed on local food. Prioritized by city government and citizens alike, food will be sourced from high-density urban producers and nearby peri-urban* farms.

*In a Nutshell: Peri-urban Areas
Peri-urban areas are defined as the transition regions from rural to urban, located just outside of urban centers (more specifically, the MacArthur Foundation defines these areas as the 20km radius surrounding cities). These areas will be crucial to establishing local and regenerative agriculture at scale for cities of the future. [4,5]

→ **Food for Thought**
What if... it was cheaper to get food from nearby, because sanctions have been placed on food imports? What if an entire city embraced the local food movement at scale?

→ **Smart Cookie: Bright Farms**
This indoor farming company builds community greenhouses and sells its produce locally, which could help build local food systems from the ground up.

❝Cities could be uniquely positioned to drive a global transition towards a circular economy, with their high concentration of resources, capital, data, and talent over a small geographic territory, and could greatly benefit from the outcomes of such a transition. [1]

Ellen MacArthur Foundation

2. Renewable Energy and Sustainable Practices

Renewable energy such as solar, wind and geothermal will be embraced in both the transportation and food production sectors.

→ **Food for Thought**

What if... cities sourced from nearby farms following regenerative agricultural practices that help rebuild and enhance ecosystems, improve diversity of crops, and support long-term yields?[6]

3. Circular Economy

The entire city will function as a circular economy* where a premium is placed on efficient ways to reuse materials. Reusable shipping and packaging materials become standard and distributors will become key players in waste pickup.

→ **Smart Cookie: Loop**

This new packaging and delivery service offers consumers their favorite brands (Crest, Haagen Dazs) in replenishable containers, and are partnering with Kroger and Walgreens to bring the idea to scale.[7]

*In a Nutshell: Circular Food System Economy

A circular food economy is a closed-loop system that produces, processes, distributes, and consumes food while striving to be regenerative and free of wasted materials or resources. It is supported by principles of (1) designing out waste and pollution, (2) keeping products and materials in use, and (3) regenerating natural systems.[8]

❝ The linear economy is hugely wasteful: most of the value in materials we use is 'lost' to landfills, and the things we make are consistently under-utilised. This is amplified in the urban context where analysis has found significant structural waste in key sectors such as mobility, food, and the built environment. For example, in Europe, the average car is parked 92% of the time, 31% of food is wasted along the value chain, and the average office is used only 35–50% of the time, even during working hours.[19]

Ellen MacArthur Foundation

4. Increased Green Legislation

The government in the Green City has created a set of laws and regulations to support the sustainable values of the people. Taxes have been placed on carbon usage to discourage polluting activities and regulations may enforce restrictions on waste and limit long-distance food imports.

→ **Food for Thought:**

What if... there was a governing body that regulated sustainable practices across the food system from source to consumer, that held companies accountable for green behavior?

Sound familiar?

Places around the world have already begun taking steps to make a more positive impact on the environment. These cities are making a commitment to more circular and sustainable systems, and are setting an example for the rest of the world for how to be green without compromising on lifestyle.

"By 2025, cities are expected to generate 2.2 billion tonnes of solid waste per year."

World Economic Forum[9]

"In 2018, the EU created a framework to 'cut emissions in the EU by at least 40% below 1990 levels by 2030.'"

European Commission[10]

"Food production accounts for 11% of global greenhouse gas emissions. With the inclusion of food distribution and land use, its impact rises to 30%."

C40 Cities: Food System Network[11]

❝ Hyperlocalization is the desire to grow one's own food is related to willingness to recycle. It also means that some people who used to be mere consumers now also become producers. Instead of consuming ready-made products, they can now be served with raw materials as well as products and services that enable or improve local production.[20]

Futures Platform

Green Cities are striving for zero waste.

Oslo, Norway

Population (2016): 606,258[12]

Oslo, known in Europe as the "Electric Vehicle Capital of the World" due to low carbon dioxide emissions and high proportion of pedestrian and hydroelectric powered rail traffic, is taking the next step to becoming self-sustaining. A new energy-positive city is being built next to the Oslo Airport, with plans to be fully walkable, and equipped with auto-lighting, "smart" waste technology, and security technology. The Oslo Airport City will sell excess energy that is produced to the neighboring airport to de-ice planes.[13, 14]

Vancouver, Canada

Population (2016): 1.6 million[15]

Vancouver has initiated their Greenest City Action Plan, a strategy to become the greenest city in the world by 2020. Utilizing collaboration between City Council, residents, businesses, organizations, and government, this plan focuses on improvements in the areas of climate and renewables, green buildings, transportation, clean water, local food, clean air, and an overall lighter footprint. In addition to these individual goals, the city plans to become zero waste by 2040.[16]

Portland, Oregon

Population (2018): 694,000[17]

Portland has been an early advocate of sustainability since the 1990s, as one of the first cities in the world to develop a master plan for pedestrians. They've developed over 92,000 acres of green spaces with trails and parks for biking and walking, and have the highest rate of biking-to-work of any US city. A large amount of Portland's energy is renewable, with the goal to supply all electricity needs in the city with renewables by the year 2035 and to use 100% renewable energy sources throughout the city by 2050.[18]

How can you prepare?

Whether you're a community organizer, an urban farmer, or a data expert, here are some considerations for preparing to succeed in a Green City.

How can we engage partners within the food system to create a circular economy, rather than just linear?

As the world moves towards a zero-waste future, food system processes will need to change to accommodate a circular economy. Distributors and operators should consider how shifts toward renewable energy and reuse may affect their service models, and how it may highlight new service opportunities.

How can food system players collaborate to lead the way in sourcing, traceability, and waste management within the food system?

As food sourcing, traceability, and waste management becomes a consumer priority and/or mandated by law, organizations should consider how collaboration can help them reach new standards. By working together rather than against each other, organizations can bring more value to the consumers they serve.

> **"** Urban density can actually create the possibility for a better quality of life and a lower carbon footprint through more efficient infrastructure and planning.[22]

C40 Cities

THE BOOMING CITY

The big [industry] boom.

This city is defined by its swift economic growth and the subsequent population boom, due to its expanding industry and generally favorable climate. Infrastructure to support this growth can hardly be built fast enough, and experimentation of all kinds is flourishing. The Booming City is establishing its reputation as an innovative environment for organizations and thought leaders, in order to attract new talent and ideas to the area.

The private sector has taken advantage of this climate of experimentation by leading the way for advancements in new businesses and technology. City government is trying to keep up with these strides by supporting its citizens and organizations through collaborative partnerships and an open regulatory environment.

A thriving economy and booming industry growth, and attempts to catch up to the growth, are the major driving forces of the Booming City.
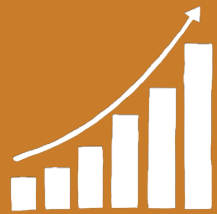
Rapid economic growth

Cities with growing industries invite jobs, innovation, and subsequent economic growth to the region.

"Smaller cities are realizing there is a niche for them to occupy, particularly in attracting companies and talent."

Gensler Research Institute [1]

Surge in population

An economic growth invariably attracts new people seeking to enter the job market of thriving industries in Booming Cities.

"As urban migration changes the dynamics of cities, many will face challenges in meeting the needs of their growing populations, including for housing, transportation, energy, and infrastructure."

Gensler Research Institute [2]

New urban development and infrastructure

In order to succeed, Booming Cities must physically keep up with the growth that comes with an increasing economy and population.

"The most essential component to a boomtown is this: Are people coming, and is the metro growing to keep up?"

MagnifyMoney [3]

Challenges

Economic, industry and population growth that could outpace infrastructure development

Data and business regulations playing catch-up to the technology landscape

City Goals

Establish an identity as a center for innovation, creating major technological advances

Attract innovative businesses and people

Support the already strong economy

The Food System of the Booming City

Go for growth.

Faced with an influx of capital and bright minds, the Booming City is a healthy environment for technology development and growth. Below are a few ways that this city can translate their priority on innovation to the food system.

1. Symbiotic Partnerships

Technological advances utilizing large quantities of data requires cooperation between public and private organizations. By partnering with each other rather than competing, organizations allow for rapid infrastructure growth.

→ Smart Cookie: B2 Civic Solutions (Sprint + Kansas City Partnership)

Kansas City's former CIO has founded a new smart city consultancy, B2 Civic Solutions, that has developed a replicable model for rolling out smart city initiatives in communities. Kansas City's public-private smart city initiatives with Sprint have allowed for free public Wi-Fi, smart street lights, and interactive kiosks.[4, 5]

❝ The story of the United States is the story of people migrating to different cities and towns to build new lives through new opportunities. From the promise of gold to the promise of big tech in Northern California; from trading furs to building cars in Detroit; from the prosperity of shipping to the prosperity of hospitality in Charleston, the country is built on boomtowns.[3]

MagnifyMoney

2. Open data environment

The Booming City's passion for innovation and a "wild west" mentality around development will encourage an open data environment, where anyone can access, use, or share data. This spirit of collaboration and sharing of digital resources will allow for more transparent companies, government and organizations, and will facilitate learning and growth.

→ Food for Thought:

What if... there was an open-source platform for restaurant operators that allowed them to easily implement and interconnect a variety of tools and services to manage and grow their business?
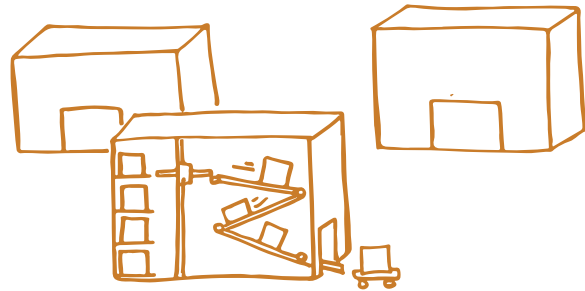
3. Advanced Warehouse Technology

As new innovation drives higher expectations for service, new warehouse innovations will be necessary to meet growing demand. The status quo will not be acceptable, and the fast-paced nature of the Booming City will create a race for the most innovative warehouse.
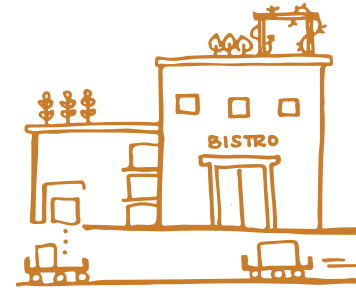
→ Smart Cookie: Ocado Technology

Ocado is an automated, online grocery store in the UK that has gained traction by selling its automated warehouse technology to other stores, like Kroger in the United States. Their hive-grid technology allows robots to lift, move, and sort product, moving one step closer to a completely automated warehouse.[6]

❝ The rising economic opportunity in urban environments is pulling our workforce away from the once thriving rural communities that surrounded a booming agricultural economy—these extreme demographic conditions challenge the sustainability and health of our food system, from production to food recovery.[22]

Relish Works, The Food System

4. Predictive Ordering and Responsive Delivery

A desire to experiment and a well funded private sector creates a city that is a testbed for transportation technology. The ability to build a new infrastructure allows for creative new solutions to food delivery.

→ Smart Cookie: Nuro

Nuro is developing fully autonomous, on-road vehicles designed to transport goods quickly, safely, and affordably direct to consumers.[7]

Sound familiar?

Traditionally second-tier cities are experiencing economic growth due to their affordable real estate and the room for new startup companies to grow. The results are booming, collaborative technology hubs in unexpected places.

"Since 2000, small cities with between 100,000 and 250,000 residents have enjoyed a 13.6% population growth rate, more than twice that of New York, Los Angeles and Chicago, and roughly 10% faster than the national growth rate."

Forbes[8]

Across the top fifty US "surge cities," only the Jacksonville and Las Vegas metro areas ranked in the top 10 for job creation, population growth, and wage growth.

Forbes[10]

From 2017 to 2018, population in New York, Los Angeles and Chicago dipped, while population increased in a number of mid-sized cities.

US Census via Smart Cities Dive[9]

❝ The Fourth Industrial Revolution has the potential to raise global income levels and improve the quality of life for populations around the world.[21]

World Economic Forum.

Booming Cities are ahead of the curve with technology.

Surat, India

Population (2017): 4.5 million[11]

Surat is set to experience considerable growth over the next 15 years, with GDP predicted to grow by 9.2% by 2035. The city, known traditionally for its thriving textiles and diamond market, is investing in new smart technology initiatives such as smart meters, LED streetlights, integrated transport-mobility, and enhanced Wi-Fi connectivity, priming the area for new economic growth.[12–14]

Provo, Utah

Population (Salt Lake City, 2018): 1.2 million—up 7.6% from 2011 [15, 3]

Population (Provo-Orem metro area, 2018): 633,768—up 12% from 2011 [16, 3]

Known as the "Silicon Slopes", the Salt Lake City and Provo area has become a technology hotbed with expanding job growth. In Provo alone, 20% more businesses employed 30% more workers in 2016, up from 2011. Due to its affordability and tech growth—in recent years, five $1B valuation startups have been established in the area, including education platform Pluralsight, smart-home equipment maker Vivint, and data analytics firm Qualtrics—Salt Lake City and Provo are increasingly attractive to young tech workers from all over the country.[3, 17]

Raleigh, North Carolina

Population (2018): 469,298—+16% from 2010[18]

A revitalized downtown and concentration of prestigious universities have cultivated a new tech hub in the Raleigh, Durham, and Chapel Hill area, also known as the Research Triangle. In 2018 alone, companies in the region raised $2.45 billion in venture capital. Raleigh-Durham is also home to an increasingly healthy job market and is home to a number of promising startups like the business website analytics company Pendo, the green building materials producer BioMasonry, and food startup Seal the Seasons.[17, 19, 20]

How can you prepare?

Whether you're a city planner, a food producer, or a logistics provider, here are some considerations for preparing to succeed in the Booming City.

How can we utilize technology to create new operational and business models?

As technology in other industries grow and new business models are developed, food distributors and restaurant operators alike might consider re-imagining how they do business as well. Forward-thinkers should consider how they can integrate new technologies and open source data into their day-to-day operations in order to grow their business in what will be a competitive marketplace.

How can the food chain be shortened and developed to meet new demand from a quickly expanding customer and operator base?

As the economy in the Booming City grows, demand will rise for both restaurants and food suppliers. In order to meet this high demand, the path that food takes to its final destination may be shortened. Whether this is through new innovations in urban farming, urban warehousing or new methods of fulfillment, a highly competitive market means customers will be willing to pay for speed and efficiency.

❝ What was perhaps less understood, but has become glaringly obvious with time, is the importance of geography as a means of production in the information age. As the Surge Cities data shows, today's entrepreneurs are increasingly clustering in America's largest and best-educated urban areas.[10]

Inc.

Evolution of the Food System

Our five model cities helped us explore the challenges and solutions on the future urban food system, which we learned must be secure, nimble, smart, local, sustainable, and innovative. But how does it come together, and how does it differ from the food system of today?

Food System of Today

→ **The current food system is defined by its linearity and scale.**

Linear
The food system today is mostly a one-way route that goes from farm to plate to landfill, without taking advantage of excess food or resource waste produced.

Large deliveries, less frequent
Currently, food is transported in large quantities across large distances, from source to warehouse to consumer. For this reason, the system is modeled around less frequent, large-scale deliveries. For this reason, distribution centers must be built to house massive amounts of food at any one time.

Why does it need to change?

Inflexible and not resilient
The scale and pace of the current food system makes reacting to real-time events or disasters difficult, and must evolve in order to survive in vulnerable cities of the future.

Not suited for urban environments
Large scale distribution and delivery doesn't work well with the narrow city streets or restaurants with limited storage space in the extremely dense cities of tomorrow.

Wasted food and resources
Food waste, resource consumption, and greenhouse gas emissions must be reduced or eliminated in the future to meet the demands of consumers and climate conditions.

Food System of Tomorrow

→ **The future food system will transform to be a more responsive, local, and closed-loop ecosystem.**

Circular
The food system of tomorrow will be defined by its ability to reduce and reuse excess food, energy or other resources—completely eliminating waste from the system.

Local food sources
Strides in alternative agriculture and food production will allow the majority of food to be sourced locally and sustainably.

Smaller deliveries, more frequent
Local food at scale will fuel more frequent deliveries to operators and consumers, providing them with fresher food more regularly.

What are the advantages?

Smart and nimble
Small-scale, more local fulfillment, powered by robust real-time data and analytics, will allow the future food system to react quickly and respond to changing demand.

Distributed and decentralized
Less reliance on massive food warehouses and a more dispersed network of hubs means a more resilient and secure food system.

Competitive for urban areas
This more flexible system will be better suited for city conditions, allowing broadliner distributors to serve the needs of operators across rural, suburban, and urban regions.

Food System of Today

→ Fewer, very large deliveries into city centers

→ Large semi-trucks delivering to many places across the city

→ Reliance on long-range transportation of food from outside farms, producers

→ Food system centering on massive distribution centers

→ Local food on a small scale, no scaled distribution model

→ Reliance on fossil fuels for transporting food

→ Majority of all waste (edible, inedible, packaging, recyclables) ending up in landfills

Food System of Tomorrow

→ Consolidation and fulfillment of local food at scale

→ Alternative lab-produced food at scale

→ Collaborative private/public relationships

→ Urban fulfillment system of urban consolidation and mircofulfillment centers

→ Suburban distribution continues

DC

UCC

→ Transparency and traceability across food system

→ Smaller scale, more optimized distribution centers

→ Alternative urban/ vertical farming

→ Automated long-haul distribution

MFC

MFC

CAFÉ

→ Innovative, nimble last mile methods

→ Resuable packaging materials across food system

→ Edible food waste, inputs for bioenergy are moved back to the urban center

→ Smaller, more frequent deliveries

RESTAURANT

RESTAURANT

CAFÉ

→ Compost and reusable packaging materials transported back to food source by distributors

→ Inedible organic waste composted for food source

→ Outgoing waste and deliveries move back through UCC

URBAN FOOD REGULATION LANDSCAPE

→ Reusable packaging washed and prepped for reuse

In Conclusion...

The opportunities and pressures that cities experience will become major drivers of innovation across all industries, but especially food. Rapid changes in population density, climate, and societal norms mean that urban centers will demand more food in increasingly complex settings.

At Relish Works, we want to be a part of the conversation around helping the food service industry benefit from the opportunities of a more connected, flexible world—as well as helping them overcome the challenges that more dense, volatile, and crowded cities will create for them.

This book has been researched, written, and produced by Relish Works.

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