SMART CITIES

Smart Mobility Plan for Corktown Neighborhood

"A Smart city is an urban area that uses different types of technology to improve environmental, financial, and social aspects of urban life."

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Smart Mobility Plan for Corktown Neighborhood

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Table of Content

Table of Content 5
Acknowledgments 7
Abstract 9
Thesis Statement 11
1. Introduction 13
1.1. Overview of Smart City Urbanism 14
2. Literature Review 17
2.1. Planning for Konza Technology City (KTC) in Kenya (Planning a new city) [10] 20
2.2. Planning for Toronto Tomorrow Project (physical development in an existing city) [12] 22
2.3. Technological development in the city of Rio de Janeiro [13] 24
2.4. New York Digital Roadmap, Technological Development [14] 25
2.5. Istanbul Smart City Project (physical development in an existing city) [15] 29
2.6. Columbus smart city Project 31
2.7. Boston Smart City Project 33
3. Corktown Neighborhood 35
3.1. Corktown Neighborhood Connections 37
3.2. Greater Corktown Area Existing Development Plans 37
3.3. Corktown Neighborhood Zoning 39
3.4. Building Footprint 39
3.5. Corktown Neighborhood Demographic Data Analysis 41
3.6. Walkability in Greater Corktown Area 44
3.7. Bus Access in Greater Corktown Area 44
3.8. Walking Time to Transit Station 45
3.9. Bike Access in Greater Corktown Area 45
3.10. Traffic Volume 47
3.11. Mobility in Corktown 48
4. Proposed Smart Mobility Plan 51
4.1. Smart Hubs 51
4.2. Development Plan for Michigan Avenue 53
5. Design 59

5.1. Smart Hub Elements 59
5.2. Location of Smart Hubs 60
5.3. Type I Smart Hub (14th St. & MICHIGAN Ave) 63
5.4. Type II Smart Hub (Martin Luther King Blvd. & 14th St.) 70
5.5. Type III Smart Hub (14th St. & Temple St.) 73
5.6. Summary of Smart Mobility Elements 76
6. Critical Discussion 79
7. Conclusion 81
List of Figures 82
List of Tables 85
References 86
Appendix 88

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Abstract

In this thesis the concept of smart cities with focus on smart mobility as a potential urban construct that can address the social and ecological sustainability challenges which society faces is explored. The characteristics of smart city concept were reviewed in the several smart city project around the world. The successful aspects and challenges that each project faced were considered. Improving the quality of life of residence, safety, sustainability, economy, education were the most important successful aspects of the project. The main challenges were privacy concerns, adaptability with new technologies and significant capital needed from the public budgets.

Historic Corktown neighborhood is the oldest neighborhood in the city of Detroit. The mobility system of Corktown needs significant improvements due to future increase in the number of workers in Michigan Central Station after redevelopment by Ford Motor Company. In this thesis a smart mobility plan was developed for this neighborhood to address the observed challenges. The main challenges for a smart mobility plan in this neighborhood are: mixed residential and commercial areas with several vacant lands, safety, access to credit card, smart phone and high speed internet for all the residence. The main goals of the plan include improve equitable and affordable mobility options, provide reliable smart mobility service, retain and attract residents and connect key destinations.

The main element of the developed plan is Smart Hub which is an integrated bus, bike and scooter sharing stations. Residence can use this hub to get access to mobility options by using smart interactive board even without having credit card, smart phone or high-speed internet. The Smart Hub has other elements including solar panel, smart trash bin, delivery box, high speed internet, active noise monitoring as a safety element. The hubs are placed in the locations with the most need for the mobility options according to the analysis of mobility data.

Thesis Statement

A Smart city is an urban area that uses different types of technology to improve environmental, financial, and social aspects of urban life. Strategic planning for urban growth has been oriented towards making cities more sustainable, livable and inclusive, both in a social and a physical sense during the past twenty-five years. In addition, recent global urbanization with a gradual shift in residence of the human population from rural to urban areas, combined with the overall growth of the world's population which could add another 2.5 billion people to urban areas by 2050 presses issues around sustainability that poses great challenges for cities.

The smart city concept has been developed as a strategy for working with cities as they face more challenges and become systematically more complex through interconnected frameworks, and increasingly rely on the use of Information and Communication Technology (ICT) to meet the needs of their citizens. Smart city term is distinguished by six conceptually distinct characteristics: smart economy, mobility, governance, environment, living and people. The main purposes of a smart city are environmental sustainability, functionality of urban systems, quality of life for all, knowledge-based development and community-driven development.

The motivation of this research is to use the smart city characteristics to investigate a smart city plan to improve the quality of life of residence of cities, such as Detroit. This thesis explores the concept of smart cities with focus on smart mobility as a potential urban construct that can address the social and ecological sustainability challenges which society faces. Historic Corktown neighborhood's mobility system needs significant improvements due to future increase in number of workers in Michigan Central Station after redevelopment by Ford and, in this thesis, a Smart Mobility plan will be developed for this neighborhood to address its future mobility challenges. The plan includes increase the efficiency, attractiveness and utilization of corridor and regional transit for all users and improve multi-modal connectivity between activity centers by using advanced technology. Existing mobility condition and demographic data were analyzed and the major challenges of the mobility system of the neighborhood were identified.

According to the observed challenges, Smart Hubs are designed to improve the mobility system. Smart hub is an integrated system of bus station, bike/scooter sharing station, ride sharing station and an interactive smart board. Three types of hubs were designed to improve the integrity of mobility system which help residence who may not have smart phone, access to high speed internet and credit card to use all different types of mobility system.

Chapter 1
Introduction

1. Introduction

During the past twenty-five years, strategic planning for urban growth has been oriented towards making cities more sustainable, livable and inclusive, both in a social and a physical sense, which is schematically shown in Figure 1-1. In addition, recent global urbanization trends and pressing issues around sustainability pose great challenges for cities [1].

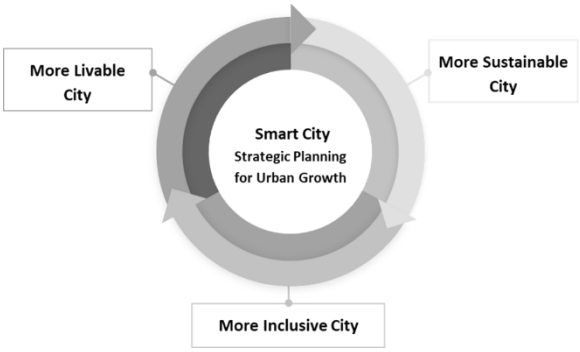


Figure 1-1: Strategic Planning for Urban Growth

The smart city concept has been developed as a strategy for working with cities as they face more challenges and become systematically more complex through interconnected frameworks, and increasingly rely on the use of Information and Communication Technology (ICT) to meet the needs of their citizens [2,3].

The main aims of the smart city are environmental sustainability, functionality of urban systems, quality of life for all, knowledge-based development and community-driven development, which are shown schematically in Figure 1-2.

Figure 1-2: The main aims of the smart city

1.1. Overview of Smart City Urbanism

Today, the smart city is one of the most popular urban ideals behind the genesis and development of cities. The smart city is a generic and optimistic concept for the city of the future and, in fact, no agreed widespread definition has yet been defined for that. However, smart city is distinguished by six conceptually distinct characteristics [1,4]:

- **Smart economy:** linked to a spirit of innovation, entrepreneurialism and flexibility of the labor market.
- **Smart mobility:** referred to modern, sustainable and safe transport systems
- **Smart governance:** related to participation in decision-making processes and quality of political strategies
- **Smart environment:** understood in terms of lack of pollution and sustainable management of resources
- **Smart living**: involving the quality of life, social cohesion, healthy environment and personal safety and housing
- **Smart people:** linked to the level of qualification of human and social capital, flexibility, creativity and participation in public life.

Smart city is indebted to policies and planning ideas migrating from the framework of New Urbanism which originated in the United States in the 1980s and later moved to Europe. For example, one of the major intellectual results of New Urbanism is the idea of Smart Growth, a planning strategy aimed at making cities more compact, less greedy and less soil consuming [5-8].

The main tool for smart city concept is information and communication technology (ICT), which integrates various physical devices connected to the internet network to optimize the efficiency of city operations and resolve the city challenges toward urbanization [3]. This is also defined as Urban Cybernetics which is referred to the science of communication and control of organized systems through a control loop used to monitor and control the urban system. This is schematically shown in Figure 1-3 which is from Clovity company [9].

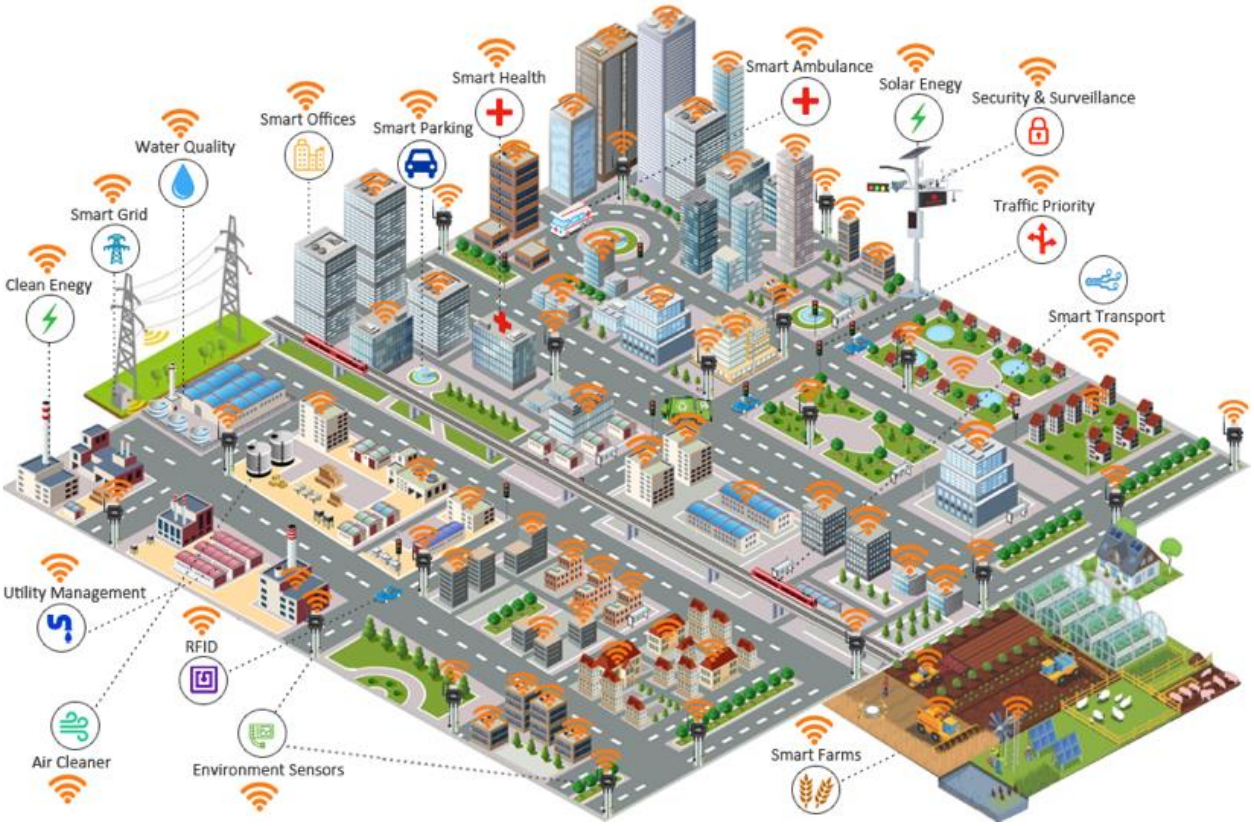


Figure 1-3: Clovity's smart city vision [9]

Chapter 2
Literature Review

2. Literature Review

Unlike smart city definition, underpinning the smart-city phenomenon is a shared firm faith in technology and innovation. That is based on information technology and engineering, infinite sources of data and energy, through which cities can be managed and powered, in a sustainable manner [4].

The origins of the faith in technology, and of the techno-urban development explained by the characteristics of the smart city, have ancient roots. The first image of a city fully developed in synch with technological development, goes back to 1627 with the publication of Francis Bacon's New Atlantis.

In the period between the end of the nineteenth century and the beginning of the twentieth century, we can find, across different geographical spaces, an increasing convergence between technological development and urban development. Indicative of this trend was the invention of the incandescent light bulb in 1879, followed by the introduction of electricity in the built environment through new urban infrastructures, thereby radically changing the metabolism and appearance of cities [4,5]. The new infrastructural landscape, allowed the domestic consumption of several novel technologies, such as the telephone, the radio and the television. Across the first half of the twentieth century, the development of ICT was relatively fast and in the 1970s, with the invention of the early computers, it led to a major technological tipping point whose effects on cities were going to be profound, but not immediately visible. In Figure 2-1, development of technology, urban challenges, urbanism types and smart city evolution during time are shown [6]. From a historical perspective, the first actual smart city is arguably Los Angeles which in the 1970s was a frontrunner in the use of what we now call big data. Not long after the experimental urbanism of Los Angeles, in the late 1980s, we find the case of Singapore which, at that time, was being advertised by the local government as an 'Intelligent Island'[6]. Currently, "Smart City" is so popular in all around the world and mainly Europe. The more popularity in Europe is based mainly on a mix of various forces, including: 1-the availability of substantial European financial resources to fund the eco-restructuring of cities; 2-the tendency of large private companies to invest in urban digitization projects; 3-the construction of a powerful rhetoric including salvation visions of technology; and 4- the image of clean, liveable, technologically advanced cities [7].

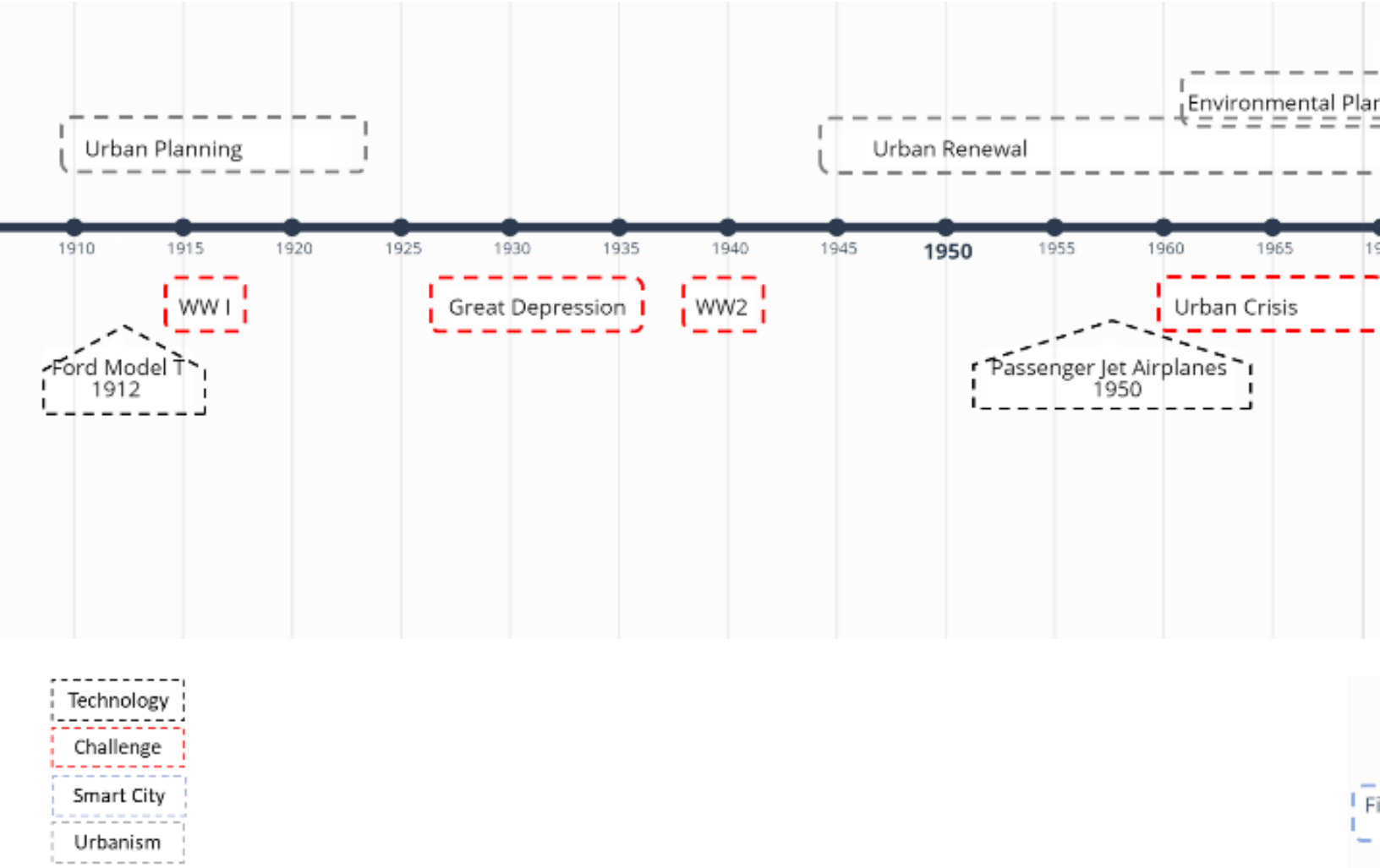
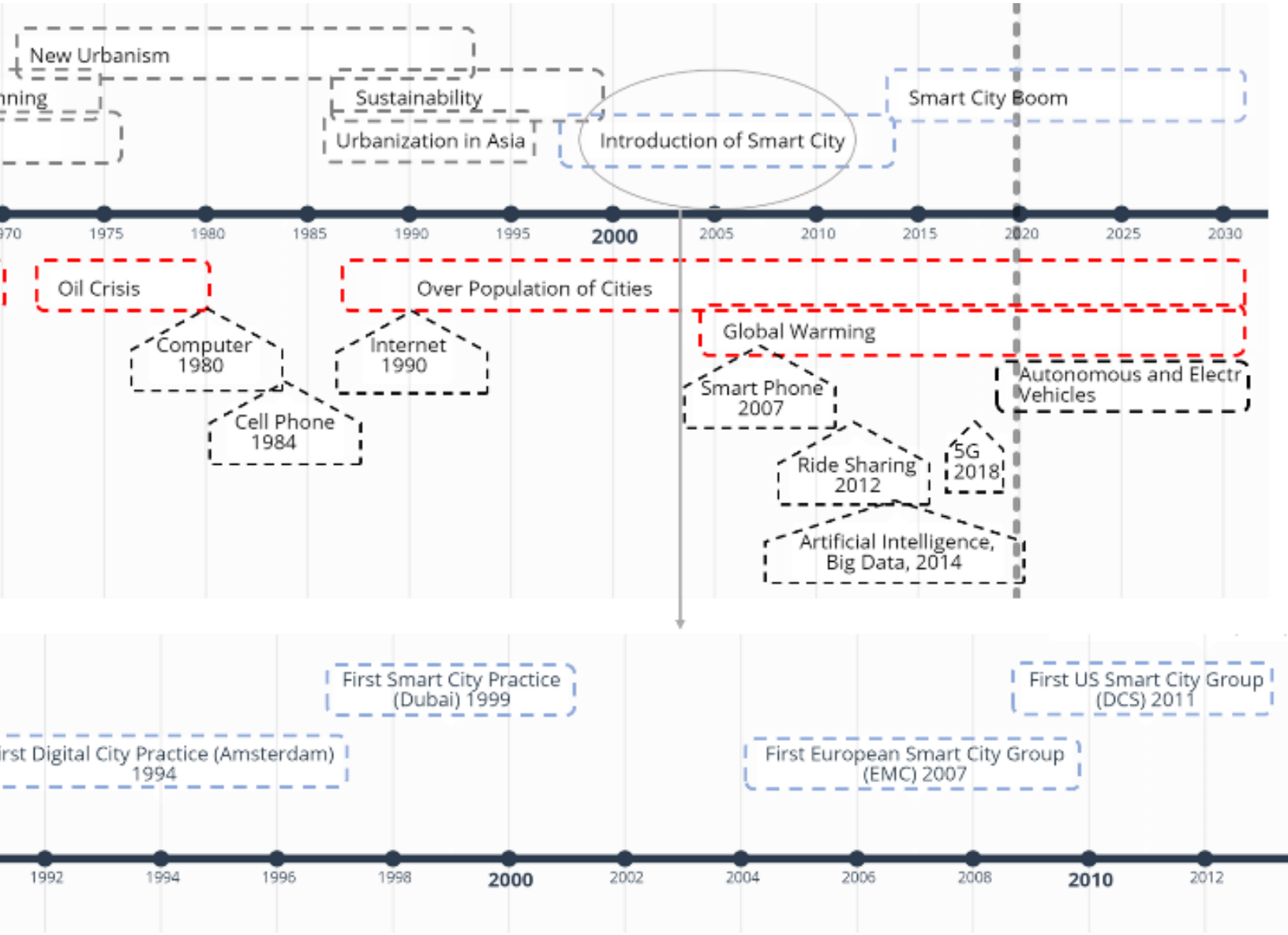


Figure 2-1: development of technology, urban challenges, urbanism types and smart city evolution during tim

Several smart city projects were reviewed in this section and the projects were distinguished in three categories: 1- planning for a new city, 2- physical development in an existing city and 3- technological development in an existing city [5].

In Figure 2-2, several smart city projects around the world are shown in the map.


New Urbanism
Sustainability
Urbanization in Asia
Introduction of Smart City
Smart City Boom
1975
1980
1985
1990
1995
2000
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2010
2015
2020
2025
2030
Oil Crisis
Over Population of Cities
Computer 1980
Internet 1990
Cell Phone 1984
Global Warming
Smart Phone 2007
Autonomous and Electr Vehicles
Ride Sharing 2012
5G 2018
Artificial Intelligence, Big Data, 2014
First Smart City Practice (Dubai) 1999
First US Smart City Group (DCS) 2011
irst Digital City Practice (Amsterdam) 1994
First European Smart City Group (EMC) 2007
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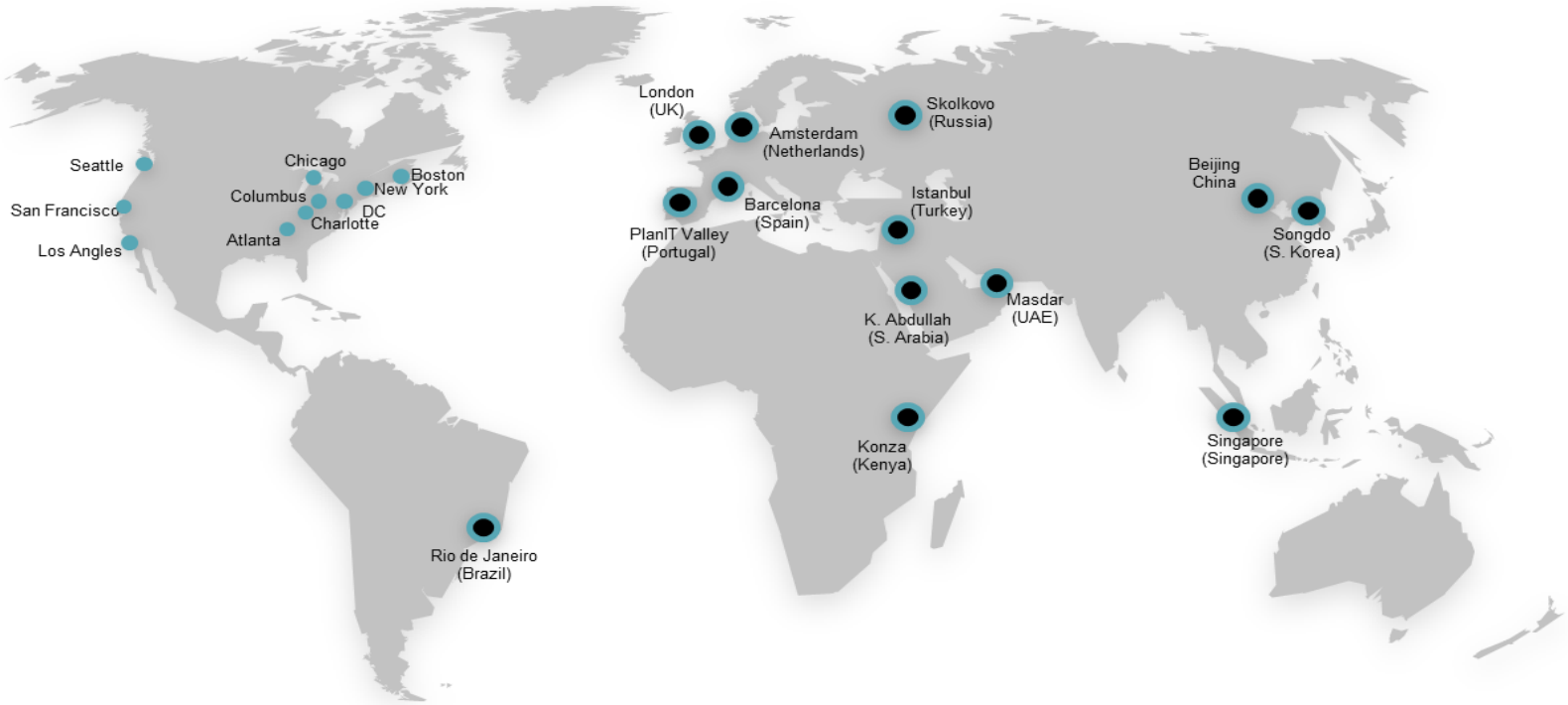


Figure 2-2: Smart city projects around the world

2.1. Planning for Konza Technology City (KTC) in Kenya (Planning a new city) [10]

Through KTC, the Kenyan Government aspires to transform Kenya into a knowledge-based economy and establish it as a global ICT hub in Africa. Konza is a flagship project of the Kenyan government's "Vision 2030", which is a long-term economic development plan introduced in 2010. The purpose of this project includes:

- establish a modern ICT Park in Nairobi with reputable local and international Business Process Outsourcing (BPO) suppliers
- promote Kenya as a BPO destination to increase demand of BPO services from Kenya globally
- increase Kenya's ICT talent pool to meet the increasing demand and provide a set of BPO specific incentives to attract investments

The city will focus on four economic sectors that will advance technology growth in Kenya: education, life sciences, telecom and Information Technology Outsourcing (ITO) and Business Process Outsourcing

Figure 2-3: Plan for Konza Technology City (KTC) in Kenya [11]

(BPO). Target population for this project is 250.000 inhabitant deliver almost 100.000 jobs by 2030.

The city will focus on four economic sectors that will advance technology growth in Kenya:

- education,
- life sciences,
- telecom and Information Technology Outsourcing (ITO)
- Business Process Outsourcing (BPO)

Target population in this project is 250.000 inhabitants and the plan is to deliver almost 100.000 jobs by 2030. This project also includes:

- Central Business District (CBD): easily accessible to all residents and workers by public transport, walking, cycling and by car. It will contain commercial offices, shops, market, a district hospital, hotels, restaurants, leisure and entertainment facilities, etc.
- University campus, with a capacity of 1.500 students and promoting excellence in research and technology.
- Residential community, occupying 920 ha and providing 37.000 homes for a resident population of 185.000 people. This includes space for schools, primary health care facilities, churches and other religious facilities, local recreation space and play space, as well as local shops.
- Parks and wildlife, with green corridors occupying 624 ha, safeguarding the unique ecology of the Savannah.

Architecture is based on the concept of high-tech ribbons of development. These ribbons will be occupied by high-density developments, open spaces and transportation infrastructure, all equipped with intelligent infrastructure. One of the ribbons serves as the core of the office district.

The weakness of the project is mainly the funding. Kenya is a country with significantly bureaucratic procurement procedures in government. Although some funds have already been allocated for Konza, they were not spent due to the strict procurement laws. What is more, the necessary funds are dispersed in various ministries, including the ministry of ICT, the ministry of water and the ministry of energy.

2.2. Planning for Toronto Tomorrow Project (physical development in an existing city) [12]

Sidewalk Labs, the smart-city startup from Google parent company Alphabet, has developed a master innovation and development plan to turn a sizable swath of Toronto's Lake Ontario shoreline into "the most innovative district in the entire world". This project is expected to result in more than 44,000 direct jobs (and 93,000 total jobs) stimulated by the Innovative Design and Economic Acceleration (IDEA)

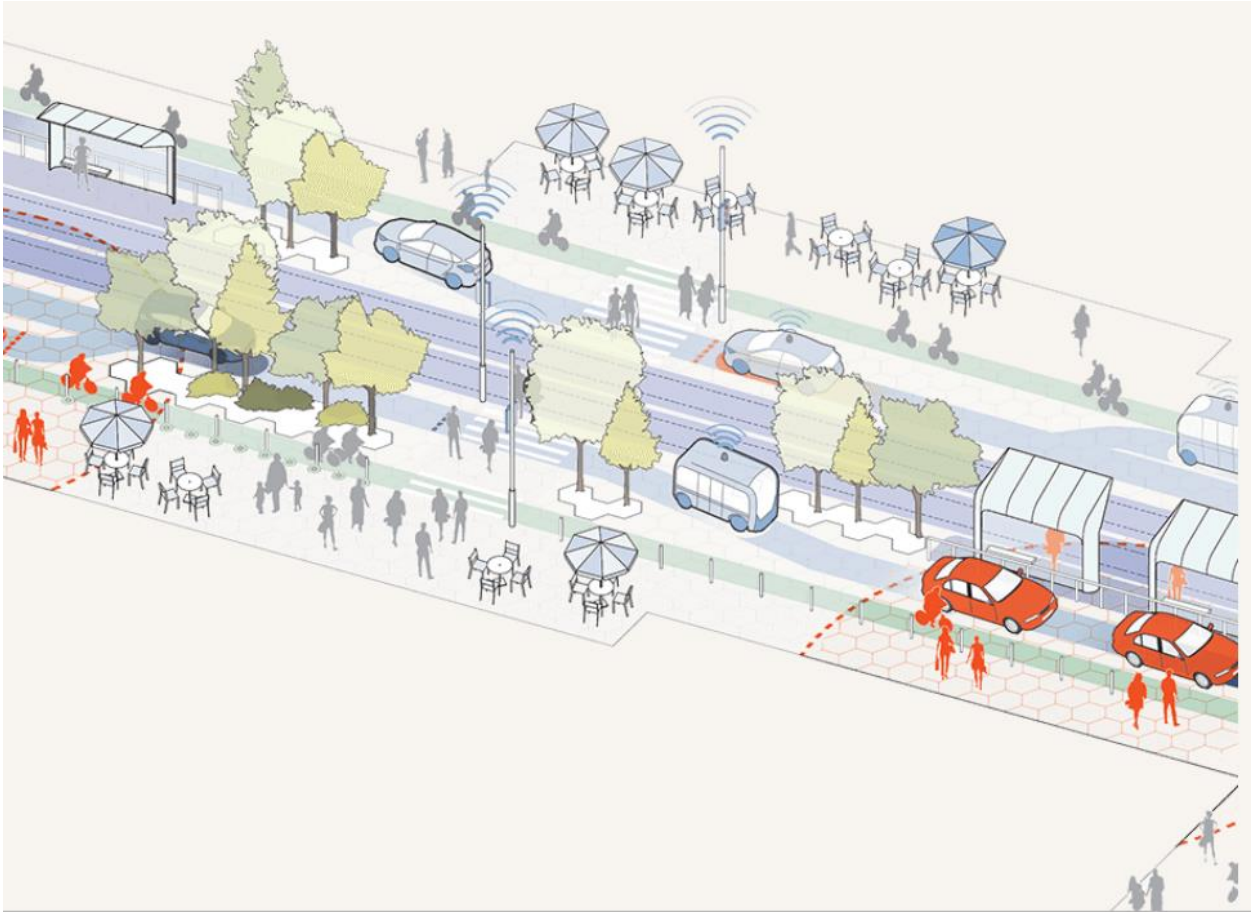


Figure 2-4: Street Design in Toronto Tomorrow Project [12]

District by 2040. The goal of project is incorporating innovations into the development designs with an eye towards achieving Waterfront Toronto's priority outcomes and improving quality of life for all. This goal is reflected in the vision statements for each of the urban innovation areas:

- *Public Realm:* A system of streets, parks, plazas, and open spaces that encourages people to spend more time outdoors, together.
- *Buildings*: Sustainable buildings that can be constructed and adapted far more quickly and support a lively mix of uses.
- *Housing*: A program with 40 percent below-market units to improve affordability and expand options for all households.
- *Sustainability*: A new standard of sustainability that creates a blueprint for truly climate-positive communities.

- *Social Infrastructure:* Health, civic life, learning, and workforce initiatives and facilities that enable people to thrive.
- *Digital Innovation:* Catalyze digital innovations that help tackle urban challenges and establish a new standard for the responsible collection and use of data in cities.

Toronto smart city plan has not been implemented yet. That is mainly because of the privacy concerns raised but the residents about the data gathered by different sensors mainly cameras.

2.3. Technological development in the city of Rio de Janeiro [13]

The city of Rio de Janeiro has attempted to implement the concept of a smart city. An unusually strong rainstorm hit the city of Rio de Janeiro on the 5th of April 2010 which left thousands homeless and resulted in 68 deaths within city limits. The incident convinced city officials that the city needs to improve its crisis response capacity, especially in light of the city's upcoming role hosting the 2014 World Cup and the 2016 Summer Olympics. The centerpiece of this response is the Rio Operations Center, or Centro de Operações, which opened in December 2010 at a reported cost of $14 million. At the center, representatives from city departments monitor the city in a large control room, where city employees have access to 560 cameras and other sensors, and monitor a detailed weather forecasting computer model. For IBM, the lead contractor on the project, the control center is a key

achievement of its smart cities initiative. However, this expensive control center does not solve the root cause of Rio's problems which is mudslides. Rio has the Smart Living and Smart Governance characteristics of smart city.

There are some weaknesses for Rio's smart city plan. The initial development of the operations center was very dynamic and took place in a very short period of time. Since then, however, its advancement has been slow in fulfilling the programmed goals, especially regarding user engagement and open data. Rio Smart City is a local government-led project, funded by municipal and private capital thus has insufficient stake backing.

Figure 2-5: Rio's Operations Center in action [13]

2.4. New York Digital Roadmap, Technological Development [14]

The city of New York followed a well-articulated demand-driven strategy (2011-2013) for its transformation into a digital city. The project was initiated with a 90-day assessment of the city's digital status. The study continued to determine the demand for specific improvements and solutions that would enhance the digital status of the city through a citywide engagement process, which involved residents, city employees from 52 agencies and technologists. The progress report of 2012 found that in just one year the city had already realized 75 percent of the engagement, access, open government, and industry goals that had been set, with the remainder in progress. It is estimated that 40 digital learning programs have served over 1.000.000 New Yorkers so far. $100 million of capital for world-class institutions were used to build or grow an applied sciences campus for postgraduate students in New York City in this project.

The mission of the project was to create a healthier civil society and stronger democracy through the use of technology.

The Road Map's four core areas are Access, Education, Open Government, Engagement, and Industry:

Access:

- Connect high-needs individuals through federally funded NYC Connected initiatives
- Launch outreach and education efforts to increase broadband Internet adoption
- Support more broadband choices citywide
- Introduce Wi-Fi in more public spaces, including parks

Education:

- Introduce Applied Sciences NYC, an initiative to bring more science, technology, engineering, and mathematics (STEM) institutions to New York City
- Introduce the Cornell-Technion Innovation Institute on Roosevelt Island - Introduce the Center for Urban Science and Progress, led by NYU and NYU-Poly
- Introduce the Academy for Software Engineering, a high school that teaches software development and design
- Increase number of participants in Innovation Zone from 80 schools to over 250
- Develop Digital Ready, a digital literacy curriculum for middle and high school students

Open Government:

- Develop NYC OpenData, an Open Government framework featuring APIs for City data
- Launch a central hub for engaging and interacting with the developer community
- Introduce visualization tools that make data more accessible to the public
- Launch app wish lists to support a needs-based ecosystem of innovation
- Launch an official New York City apps hub
- Host New York City' first hackathon: Reinvent NYC.gov
- Host New York City's first sustainability hackathon: Reinvent Green
- Launch Code Corps initiative linking volunteer technologists with lifesaving civic digital projects

- Host Reinvent Payphones Design Challenge on future of public payphones
- Introduce DART, a team of the City's data experts

Engagement:

- Expand 311 Online through smartphone apps, Twitter and live chat
- Implement a custom bit.ly url redirection service on NYC.gov to encourage sharing
- Launch official Facebook presence to engage New Yorkers and customize experience
- Launch @NYCgov, a central Twitter account and one-stop shop of crucial news and services
- Launch a New York City Tumblr vertical, featuring content and commentary on City stories
- Launch a Foursquare badge that encourages use of New York City's free public places
- Integrate crowdsourcing tools for emergency situations
- Introduce digital Citizen Toolkits for engaging with New York City government online
- Introduce SMART, a team of the City's social media leaders
- Launch ongoing listening sessions across the five boroughs to encourage input
- Relaunch NYC.gov to make the City's website more usable, accessible and intuitive
- Expand workforce development programs to support diversity in the digital sector
- Support technology startup infrastructure needs
- Support small businesses through streamlined online resources and digital training
- Continue to recruit more engineering talent and teams to New York City
- Promote and celebrate NYC's digital sector through events and awards
- Pursue a new .NYC top-level domain
- Develop the Made in NY Media Center, a facility in DUMBO dedicated to the future of storytelling in a digital age
- Launch We Are Made in NY, an economic development initiative celebrating New York City's tech sector opportunities

Figure 2-6: Cornell Tech campus on Roosevelt Island [14]

- Expand the Made in NY Mark of distinction to digital companies that base at least 75% of development in NYC

Two of the main axes of New York's Digital strategy are accessibility to digital assets and digital literacy. For the success of the strategy, it was important that that all of the city's constituents would have online access and that they had the required training and knowledge to use digital tools once they were online.

To help the development of startups and companies, programs to expand expertise and train employees were offered, as well. These programs were focused around business training programs and technology support and training on using blogging platforms and e-commerce solutions. Incentives in the form of real estate grants were offered to growing technology companies for relocating designate the Lower Manhattan area as a business district. Overall, these services were provided to over 1.000 local small businesses.

The city's technology companies are reported as having experienced powerful growth, with over $8.3 billion of acquisitions. They bolstered the city with 8.700 new technology jobs in 2012 alone. Some problems regarding the integration of the different platforms that were used by the City's agencies were reported, but they were solved.

2.5. Istanbul Smart City Project (physical development in an existing city) [15]

Smart city projects in Istanbul which is focused on smart mobility are guided by Turkish Ministry of Development. Smart city project which started in 2017 mainly addressed traffic and mobility problems to improve the quality of life of 15 million people. Traffic congestion problem in Istanbul is among the 6th worst in the world according to global Tomtom Traffic Index. The main goals of this project were listed as:

- Facilitating access to urban services,
- Supporting entrepreneurs to develop and commercialize their ideas via incubator centers,
- Providing faster and more comfortable door-to-door urban mobility services,
- Promoting use of alternative energy resources and reducing carbon footprint,
- Promoting efficient use of resources for urban economic growth,
- Providing healthcare to old and disabled people with high quality smart healthcare services,
- Offering real-time data through open data platforms to developers, citizens and researchers,
- Increasing the mobility and social inclusion of disabled people,

Smart city project in Istanbul is composed of 8 phases and planned to complete in 2018. In order to put forward the strategies, key performance indicators (KPIs) and the roadmap, benchmarking studies with 9 cities have been carried out, which include many global cities around the world: New York, San Francisco, London, Barcelona, Copenhagen, Seoul, Singapore, Berlin and Paris. The main strategies include:

- the transformation of infrastructure and operations by connecting systems, data and people from different municipal departments to offer accessible information and affordable services,
- providing real-time communication through mobile applications, devices and interactive platforms to ensuring the engagement of citizens and businesses,
- fostering innovativeness and competitiveness of the local economy by enhancing the entrepreneurial skills of the young workforce.

Figure 2-7: Istanbul smart city project [15]

The activities set out in the smart city project mainly include the followings:

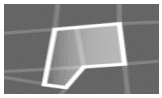
- Building smart city system architecture incorporating city strategies, business capacities, business services, application architecture, data architecture and infrastructure architecture,
- Establishing a City Management Center to collect, analyze and manage the big data generated from all data sources and offering open-data platforms, • Building Living Labs for ensuring the engagement of the community and citizens,
- Regarding urban mobility; offering bike sharing platforms (stations and bicycles), iTaksi mobile application (online taxi management platform), IBB Navi mobile application (online real-time navigation platform), vehicle-to-vehicle and vehicle-to-infrastructure communication systems, transport demand management solutions such as congestion charging and high-occupancy vehicle lanes,
- Focusing on technology-oriented projects: cloud and hybrid cloud technologies, storage, analysis and processing of big data, business intelligence and decision support systems, Internet of Things (IoT) and Machine-to-Machine (M2M) technologies, cyber security including Network Operations

Center (NOC) and Security Operations Center (SOC), mobile communication technologies (5G), augmented and virtual reality applications, wearable technologies, deep learning and artificial intelligence systems.

– For energy dimension; distant reading electric meter data, smart city lighting, smart energy demand management, solar power plants.

2.6. Columbus smart city Project

One of the most successful smart city project is in Columbus. The focus of this project is on connected transit system,



Develop smart corridors to improve transit service and efficiently

Enhance the timeliness and quality of the traffic condition data for the movement and delivery of freight

Push real time information to users on traffic to minimize the impacts of concentrated travel

Develop communication technology solutions to address the obstacles that low-income cash-economy based residents face in accessing the app-based services

Expand the usage of electric and smart vehicles in order to serve our energy and climate change objectives

integrated data exchange, enhanced human services and improving infrastructure for electric vehicles. One of the important elements of this project is smart interactive boards so the residents can get access to mobility solutions and have real time information about transportation network even without using mobile apps. The important elements can be summarized as:

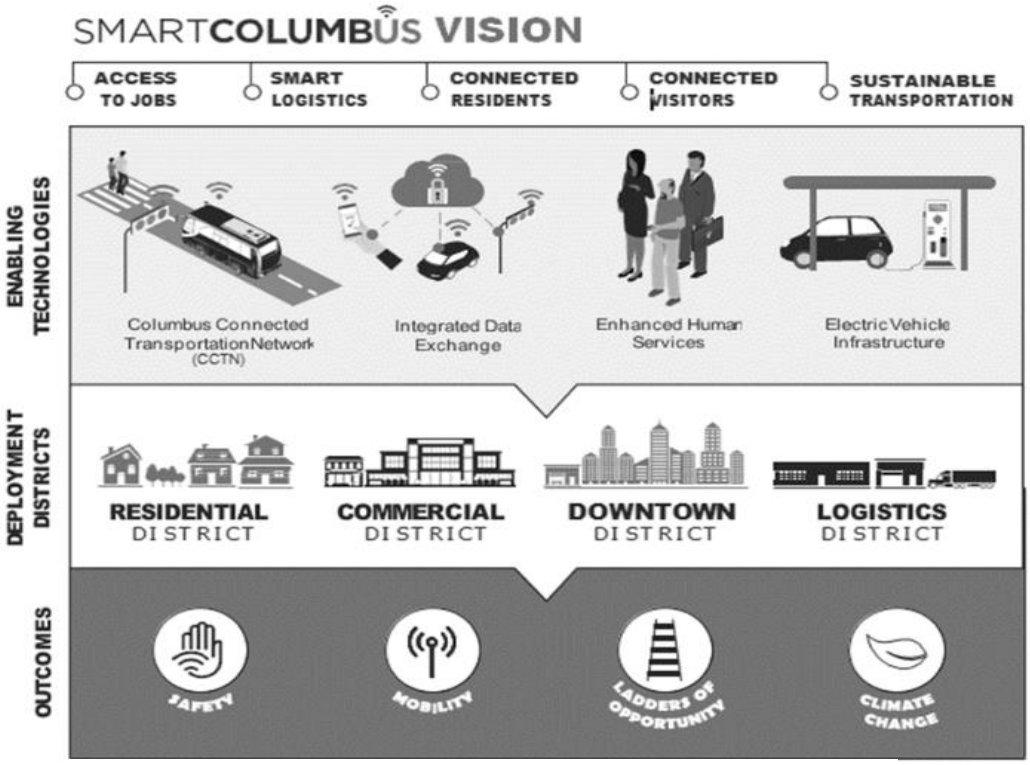


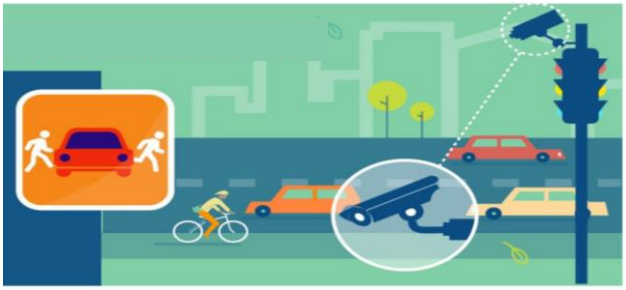
Figure 2-8: Columbus smart city challenge implementation vision [16]

Figure 2-9: An interactive smart board in the city of Columbus [16]

In Figure 2-8 the vision for Columbus Smart City Project is shown. In Figure 2-9, a smart interactive board is shown.

2.7. Boston Smart City Project

Boston Smart City Project heavily relies on cameras and sensors to learn about how people navigate. Bike sharing program has also been extensively developed with 180 stations. City also offers free outdoor wireless which can be used by the people who do not have access to high speed internet. Main Elements in this project are [17]:



Combining data from city-owned traffic cameras and crowed source data to improve the movement of emergency vehicles

Boston's bike share program has annual rideshare taking over 1.1 millions trip and traveling over 2.5 millions mile.

Boston StreetShare envisions a digitally-enabled StreetCase that optimizes currently idle curbside, travel lanes or sidewalks

Chapter 3
Corktown Neighborhood

3. Corktown Neighborhood

Corktown is the oldest existing neighborhood in Detroit, Michigan. Named by the Irish immigrants who settled there in the mid-19th century, it has since gone on to have a rich and diverse history. Given Corktown's history and surviving stock of Victorian homes, much of the neighborhood is listed on the National Register of Historic Places and has been designated a historic district by the city of Detroit. Founded in 1834, Corktown began as a neighborhood of largely Irish immigrants and has been home to a diverse population of many ethnicities and nationalities, drawn in part by its proximity to automobile industry jobs [18, 19].

Over the past several years, Corktown has experienced a resurgence of interest, particularly with the addition of new businesses along Michigan Avenue. In addition to its established historic housing stock, a few development projects in and immediately around Corktown are also adding residences, among other uses. Corktown is surrounded by several neighborhoods, including Mexican Village,

Figure 3-1: Corktown sign as the oldest neighborhood in Detroit [19]

Figure 3-2: Corktown neighborhood in 1950s [19]

Mexicantown, Hubbard-Richard, and North Corktown across Interstate 75/Fisher Freeway.

Following World War II, city planners proposed demolishing large swaths of the neighborhood for factories. 75 acres of Corktown homes and businesses were demolished and hundreds of residents were displaced in preparation for industrial expansion. The planned industrial development never came to fruition, however, and there were no plans to build new homes in the area. Residential section was listed on the National Register of Historic Places in July of 1978 [19].

In 2018, Ford purchased the iconic Michigan Central Station and several other properties in the Corktown neighborhood of Detroit. Ford is considering expanding its mobility and autonomous vehicle teams to the area and partnering with the community to foster an environment that inspires the future of mobility. Michigan Central Station began operating as Detroit's main passenger depot in 1913.The station service stopped on 1988 and the station planned to reopen in 2023 by Ford Motor Company [20].

Figure 3-3: Michigan Central Station [19]

3.1. Corktown Neighborhood Connections

In Figure 3-4, an aerial view of Corktown neighborhood and its connections to Midtown and Downtown Detroit are shown. In addition, some of the main important buildings in this neighborhood and sites such as Michigan Central Station, Roosevelt Park, Motor City Casino, Nagel Park, Police Athletic League, West Waterfront Park and Ambassador Bridge are shown in Figure 3-4. Michigan Avenue is the main corridor for connecting the Michigan Central Station to Midtown and Downtown.

Corktown has connections with downtown and midtown Detroit, Mexicantown and Woodbridge neighborhoods which are shown in Figure 3-5. For the smart city plan development, considering the existing plans for these neighborhoods and connection to these neighborhoods are very critical. Significant portions of Corktown is the areas of public ownerships. These areas have good potential for redevelopments for residential and commercial usages.

3.2. Greater Corktown Area Existing Development Plans

There are three different master plans for Greater Corktown Area. The first plan is by the City of Detroit [20]. This is a Comprehensive Neighborhood Framework Plan for the Greater Corktown area, which consists of the historic Corktown neighborhood, North Corktown, and adjacent communities, particularly Hubbard Richard. This plan is in the Development Phase with RFP at January 2019.The framework will identify the challenges and opportunities around key planning strategies of: 1-Urban Design & Development (Zoning and Landscape), 2-Streetscape and Connectivity, 3-Historic Preservation and 4- Housing Development and Rehabilitation.

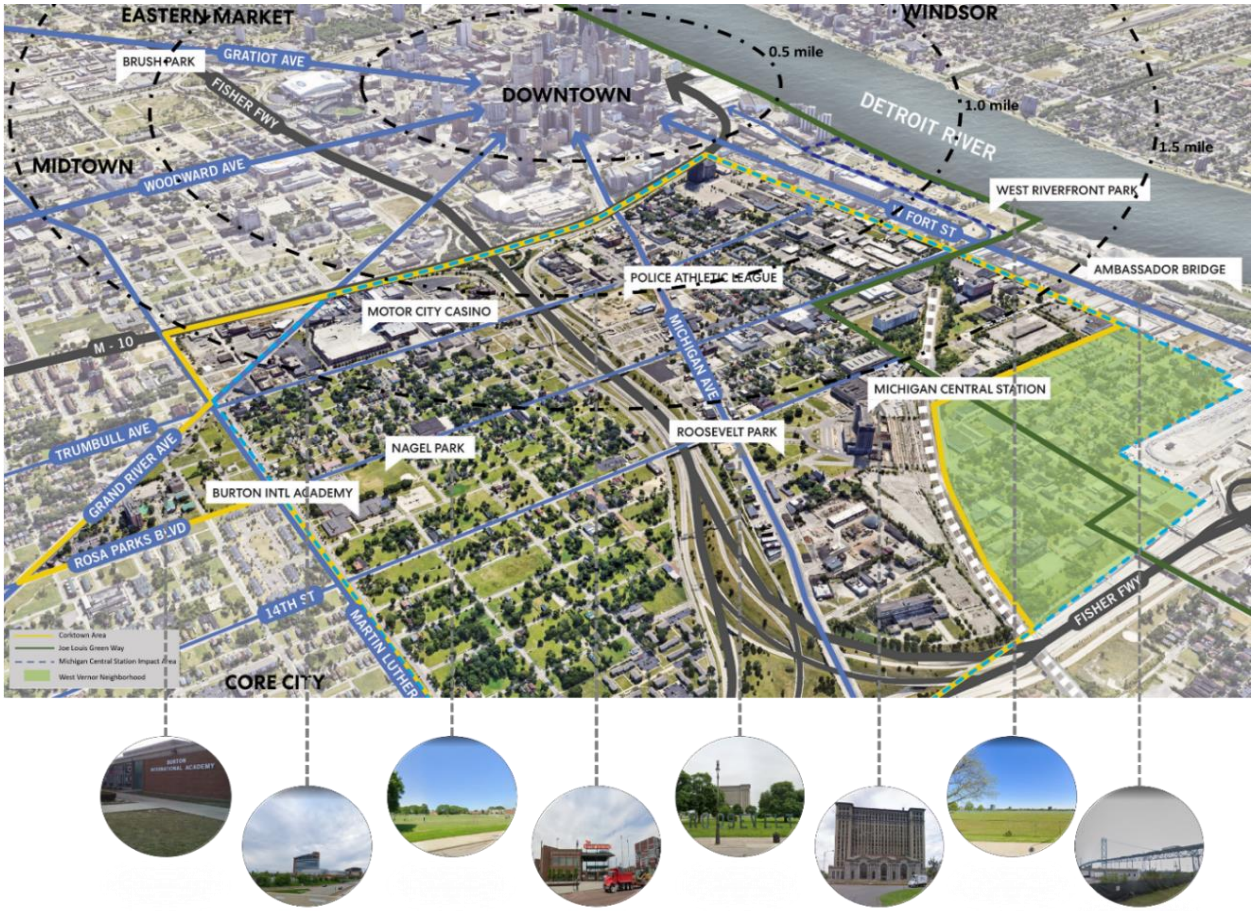


Figure 3-4: Greater Corktown neighborhood and its connections to Downtown and Midtown

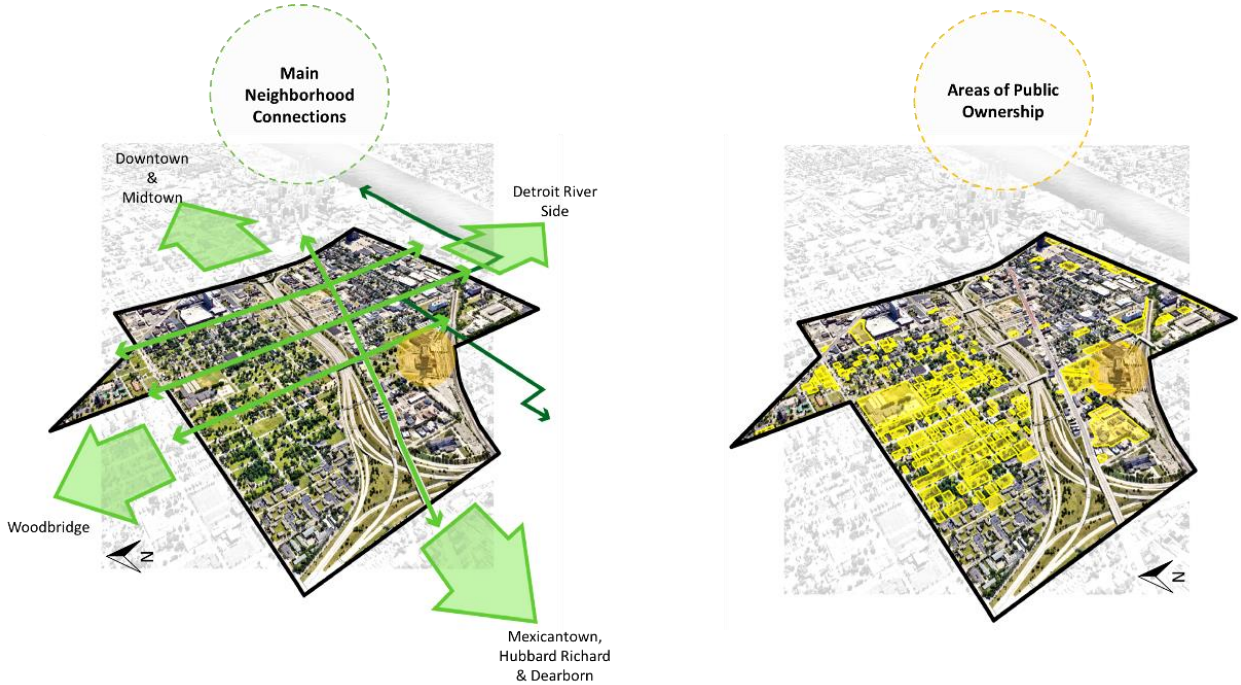


Figure 3-5: (a) Neighborhoods surrounding the Corktown; (b) Public ownership sites [20]

Ford is completing its master planning efforts for its development at Michigan Central Station. Ford has a Community Benefits Agreement (CBA) with the Greater Corktown Neighborhood for City One Challenge (October 2019) [18]. The opportunity areas in City One Challenge includes: 1-Improve Access to Mobility Information, 2- Make Mobility More Affordable3- Build an Inviting Environment and 4- Connect People, Places, and Opportunities.

The third plan is from Michigan Department of Transportation. The Michigan Department of Transportation is conducting a Planning and Environmental Linkages (PEL) study for the Michigan Avenue Corridor between Campus Martius and Interstate 96. The purpose of this study is to develop a long-term vision for the corridor [21].

3.3. Corktown Neighborhood Zoning

The area commonly known as North Corktown has a relative abundance of public and private vacant land (which are shown in Figure 3-6) that appears to be the prime location for future urban dense growth opportunities. There are some possible opportunities to change zoning ordinance which is confirmed by the city: [20]

"The City of Detroit understands that much of the design recommendations for Corktown that will come forth require many modifications and variances to our city's zoning ordinance and established land uses"

3.4. Building Footprint

North Corktown is mainly residential with limited access to business and shopping centers. North Corktown has a relative abundance of public and private vacant land that appears to be the prime location for future urban dense growth opportunities. These could be seen in Figure 3-7.

Figure 3-6: Properties and lands categories in Corktown [20]

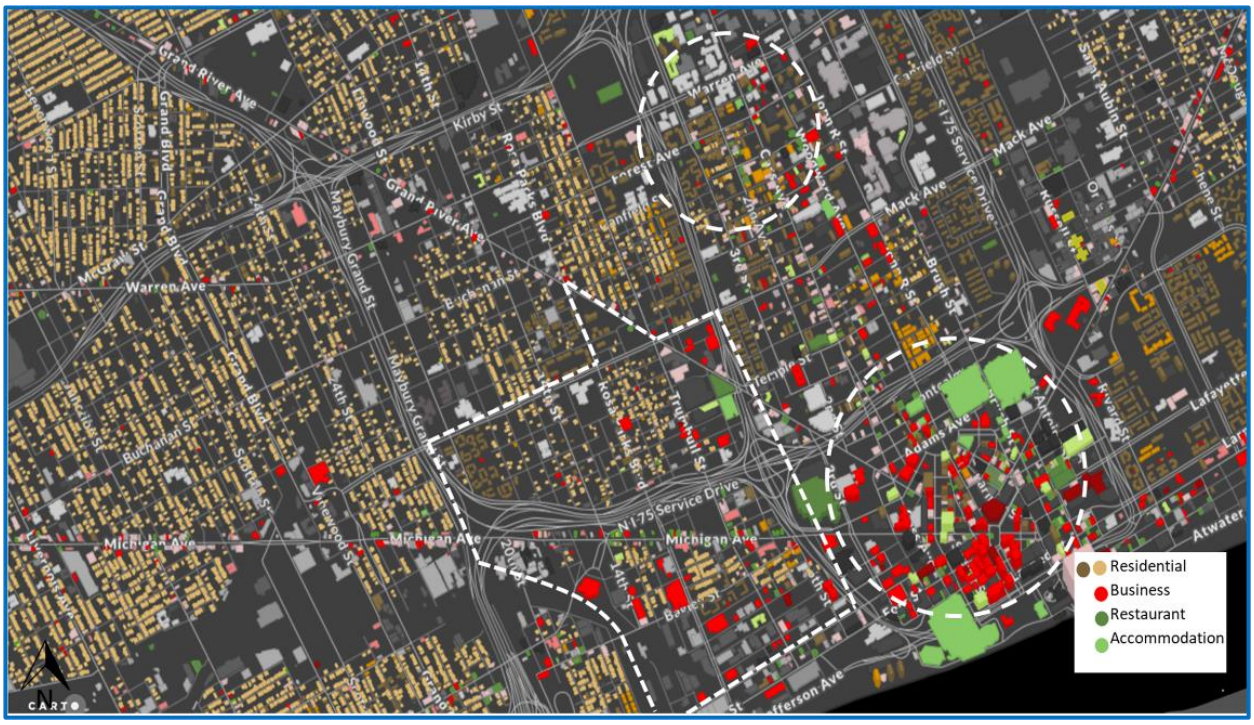


Figure 3-7: Building footprint in Corktown [22]

3.5. Corktown Neighborhood Demographic Data Analysis

Greater Corktown has an estimated current population of 2,922. Of the estimated 696 occupied housing units, the vast majority (72 percent) are rentals, compared with 54 percent in Detroit overall. The current median household income is an estimated $54,527, more than $20,000 higher than that of Detroit ($29,175). Most of the current residents (87 percent) in the Corktown census tract are either white (48 percent) or black (39 percent), and an estimated 21 percent of the population is of Hispanic origin. Moreover, 34% of total population need affordable mobility and 16% of total population are elderly people who are vulnerable to adapt to smart mobility. Summary of this data are shown in graphs in Figure 3-8.

According to the data provided in Figure 3-9, 32% of low-income residence do not have access to smart phone. Also, 28% of low-income residence do not have credit card.

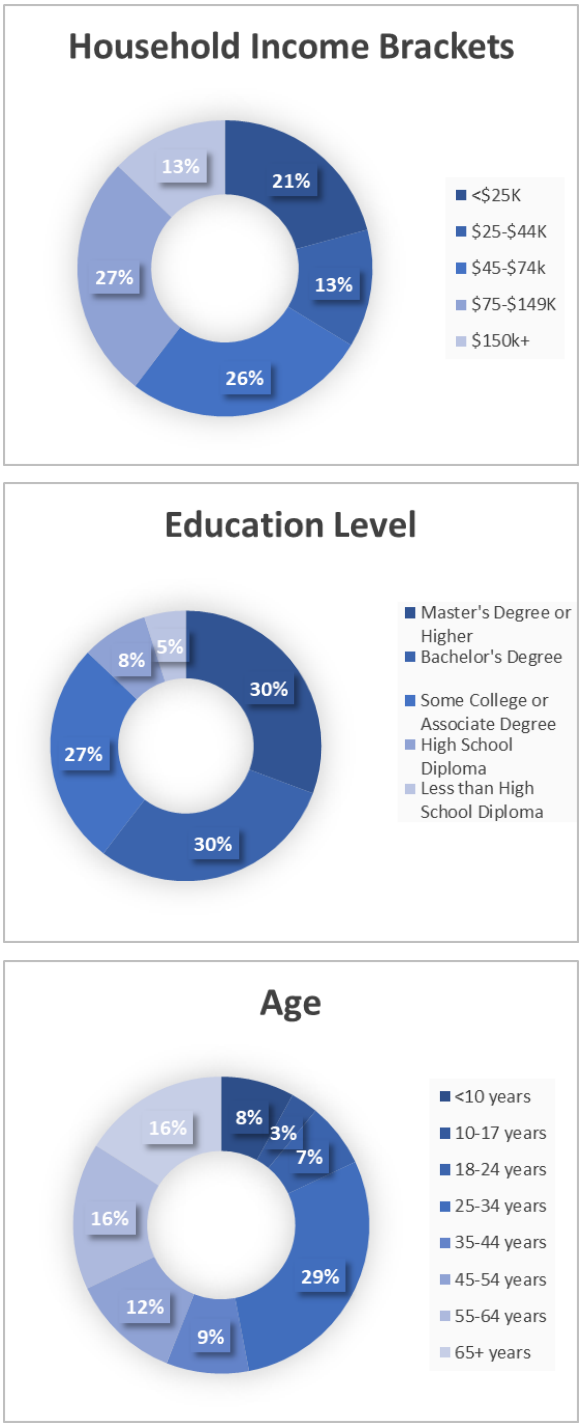
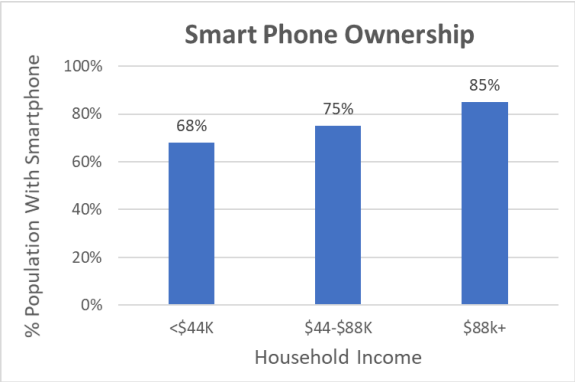


Figure 3-8: Corktown demographic data [20]



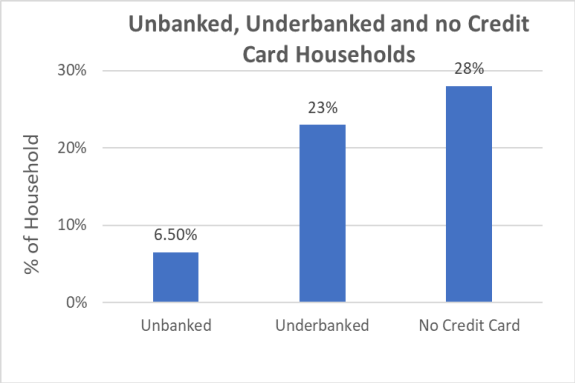


Figure 3-9: Access to smart phone and credit card in Corktown [23]

Based on the data in Figure 3-10 and Figure 3-11, bike access and walking access to grocery stores is very limited while of an average of 30% of households do not own a vehicle. This data show importance of an affordable mobility plan in this neighborhood.

As shown in Figure 3-12, it is estimated that 20-40% of Detroit residence do not have access to high speed internet. It is very important information which must be considered for any smart city plan for Detroit and its neighborhood since these plans will be based on the ICT network access.

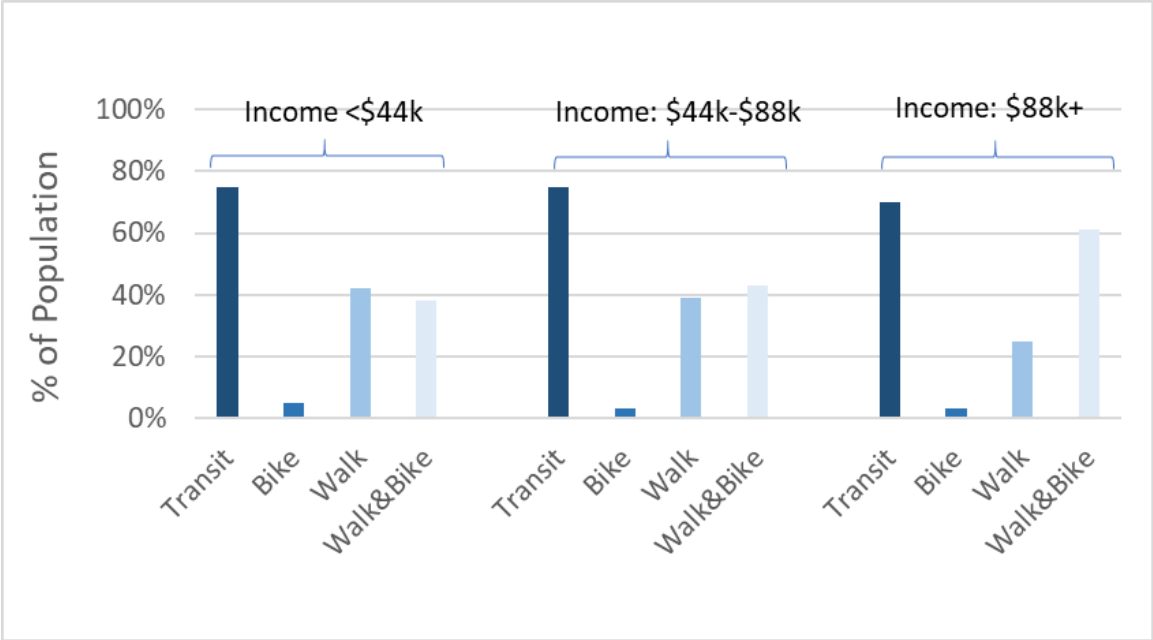


Figure 3-10: Access to grocery stores [23]

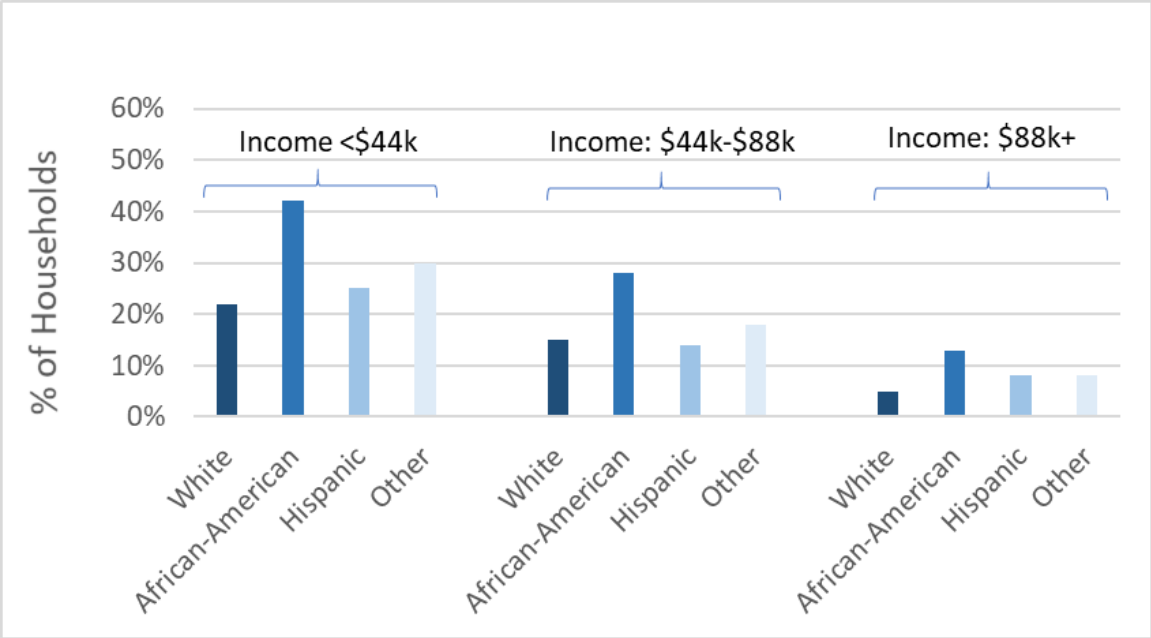


Figure 3-11: Households without vehicle [23]

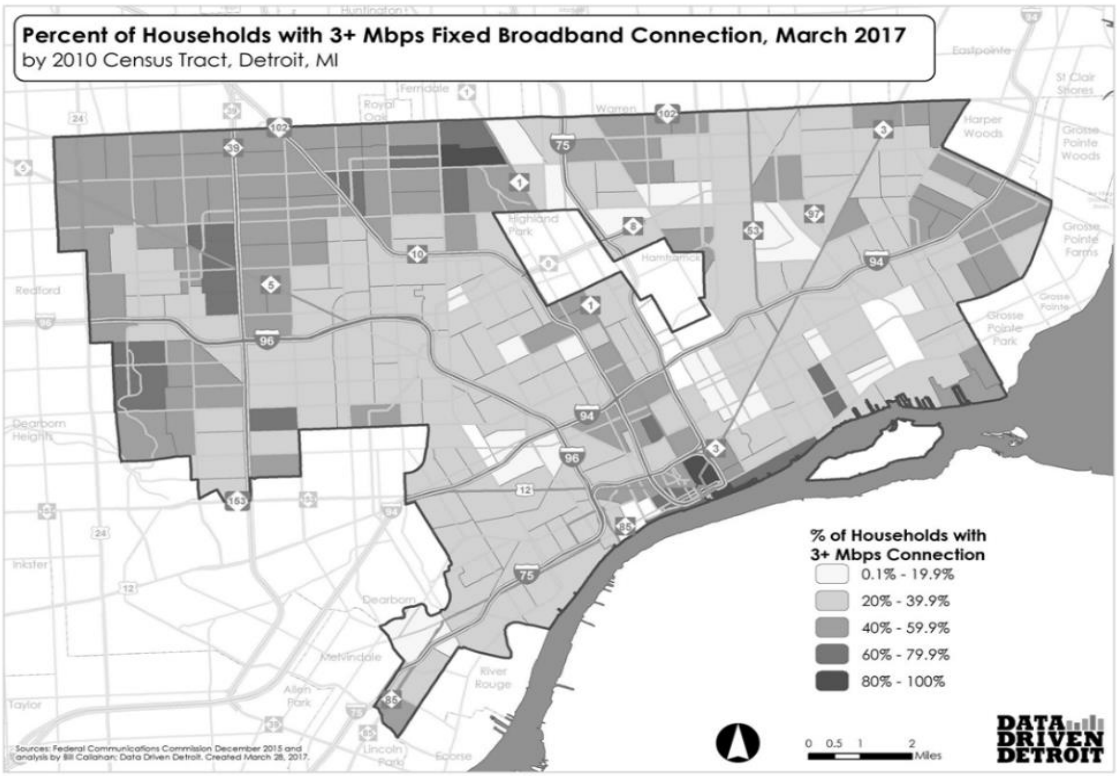


Figure 3-12: Internet access of South East Michigan residence [20]

The most important data which will be used for smart mobility plan are:1- 32% of low-income residence do not have Smart Phone, 2- 28% of low-income residence do not have credit card, 3- 30% of households do not have access to high speed internet and 4- 34% of total population need affordable mobility.

3.6. Walkability in Greater Corktown Area

There are some major gaps in Corktown neighborhood walkability:

1- The freeways

2- Rail underpasses

3- Around large institutional users such as area schools and several vacant lands

4- Width of Michigan Ave. (limited crosswalks and no median)

There is a significant need for improvement of walkability in Corktown since there are several businesses and will be more due to Michigan Central Station redevelopment.

3.7. Bus Access in Greater Corktown Area

There are several bus routes and stations in Corktown and near the Michigan Central Station. However, due to several issues such as Unreliable cellphone application, Safety, Long wait time (more than 10 min) and Hard to get access to Detroit suburb not many people use the public transportation.

The cost of public transportation is reasonable and has not been reported to be an issue. Currently the ticket could be bought using TRANSIT mobile phone application.

Figure 3-13: Limited crosswalks and no median in Michigan Ave.

Figure 3-14: Short term solution for the limited cross walk in Michigan Ave.

Figure 3-15: Bus stations and their usage in Corktown and Detroit [22]

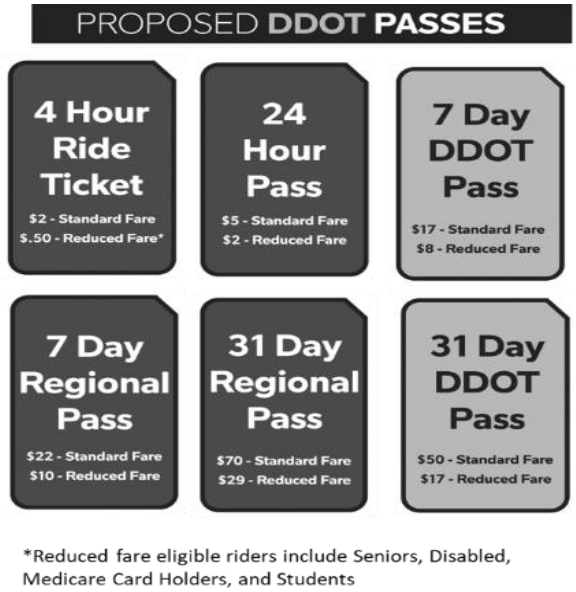


Figure 3-16: Cost and passes for DDOT [20]

As shown in Figures 3-17, 3-18 and 3-19, bus stop shelters should be added in Corktown neighborhood. Internet stations could also be added to show the wait time for the next bus and these Internet stations could be used for people without smart phone or Internet to pay the ticket or find their routes.

3.8. Walking Time to Transit Station

As shown in the Figure 3-20, walking time in Corktown area to the nearest bus station is less than 10 minutes.

3.9. Bike Access in Greater Corktown Area

There are limited dedicated bike routes in this neighborhood, as can be seen in Figure 3-21. MOGO bike has offered shared bike access which is relatively expensive with limited rental stations in Corktown. In general bikeway network needs significant improvement for future use of micro-mobility.

Figure 3-17: Roosevelt park bus stops @ Michigan Ave.

Figure 3-18: Martin Luther King Jr Blvd & Trumbull Ave.

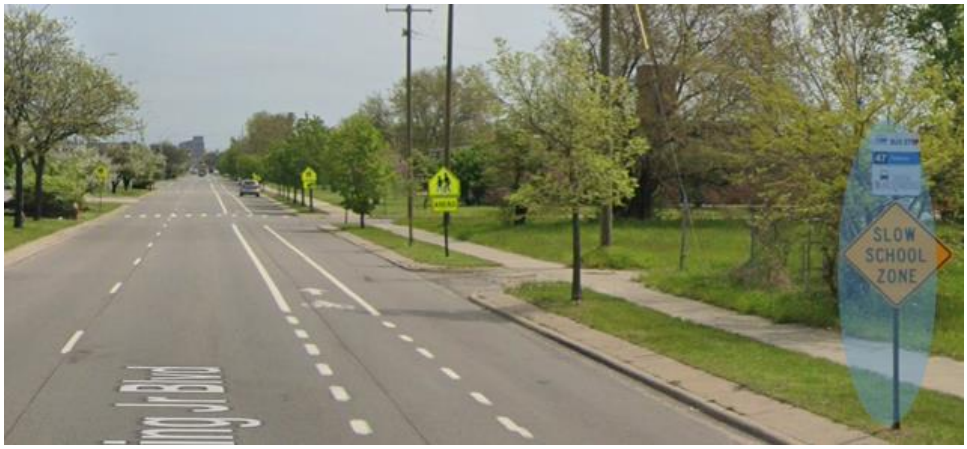


Figure 3-19: Martin Luther King Jr Blvd & 14th St.

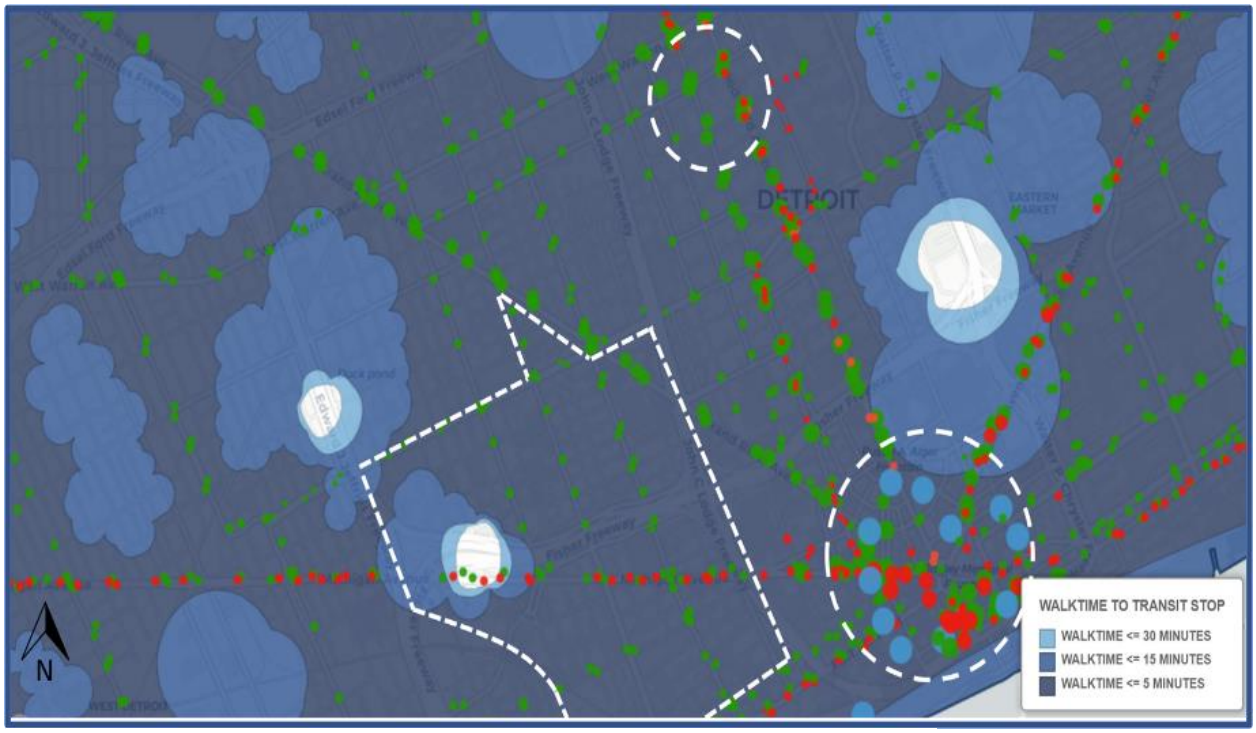


Figure 3-20: Walking time to transit station [22]

Figure 3-21: Bike routes and MOGO rental stations in Corktown

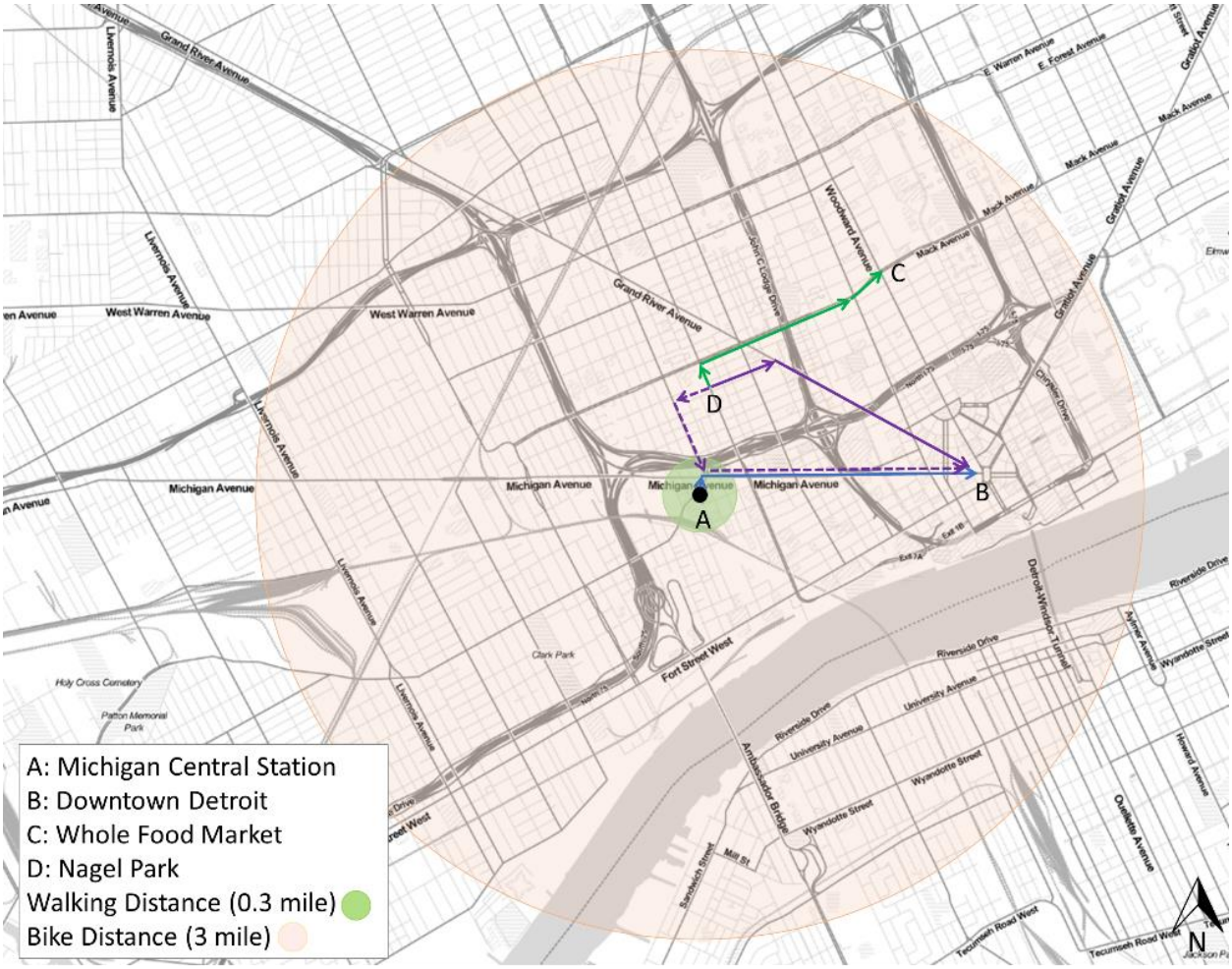
Figure 3-22: Traffic volume [22]

3.10. Traffic Volume

Michigan avenue. is the main corridor to connect Corktown to Downtown and Midtown Detroit. The average daily traffic of Michigan avenue. in Corktown area is 16000, as can be seen in Figure 3-22. Michigan ave. bus stations will have significant more trip per day by the opening of Michigan Central Station. Dedicated bus routes, dedicated bike routes and center island to improve safety of pedestrians should be considered for redevelopment of Michigan avenue in Corktown area.

3.11. Mobility in Corktown

In Figure 3-23, different scenarios for mobility in Corktown and near Michigan Central Station is considered. The wait time is a big challenge for using the bus. For Walking, safety is a big concern. Currently using the bike is the best option, however, the rental station should be improved.



					Total	Comment
A-B	5 min	-	10 min	8 min	23 min	During Pick time
	6 min	8 min	-	-	14 min	Using Mogo
D-C	-	10 min	-	-	10 min	Personal Bike, safety concern
	30 min	-	-	-	30 min	Safety concern
D-B	-	10 min	-	-	10 min	Personal Bike, safety concern
	6 min	-	15 min	10 min	31 min	During Pick time

Figure 3-23: Different scenarios for mobility in Corktown

Chapter 4
Proposed Smart Mobility Plan

4. Proposed Smart Mobility Plan

Smart Mobility could provide equitable transportation systems for Corktown by incorporating technology to increase access to mobility options, enhancing opportunity in low income communities and supporting a clean environment. Based on the information provided in the previous chapter the challenges for Corktown mobility can be summarized as:

- 5,000 Ford employees to start working in Michigan Central Station
- Unreliable public transportation and mobility options of Corktown mainly in residential area
- Limited access of residence to high speed internet, credit card and smart phone
- Infrastructure (e.g. Michigan Ave.)
- Safety
- Access to Detroit Suburbs

The main elements of smart mobility plan which consider the props and cons of similar plan which were reviewed in Chapter 2 are:

- Improve equitable and affordable mobility options
- Provide reliable smart mobility service
- Retain and attract residents
- Connect key destinations:

A conceptual proposal for the smart mobility with the smart mobility opportunities are presented in Figure 4-1.

4.1. Smart Hubs

The main element of this plan is Smart Hub. Smart hub is an integrated bus station and bike and scooter sharing stations which has an interactive smart board, as well. The main functions are connection, communication and navigation.

Connection:

- Connecting people to the smart mobility systems and the businesses
- People with no access to smart phone, credit card or high-speed internet could use the smart hub to get access to the public smart mobility system

Communication:

- Communicating important information and resources to the public and allow for the immediate broadcast of emergency messages and critical updates from governmental authorities.
- Offering free public WIFI

Navigation:

- Display real-time transit feeds and route schedules, as well as mapping and directions, for bus and bike/scooter/ride share services, thereby encouraging the use of public transportation and increasing mobility for all citizens.

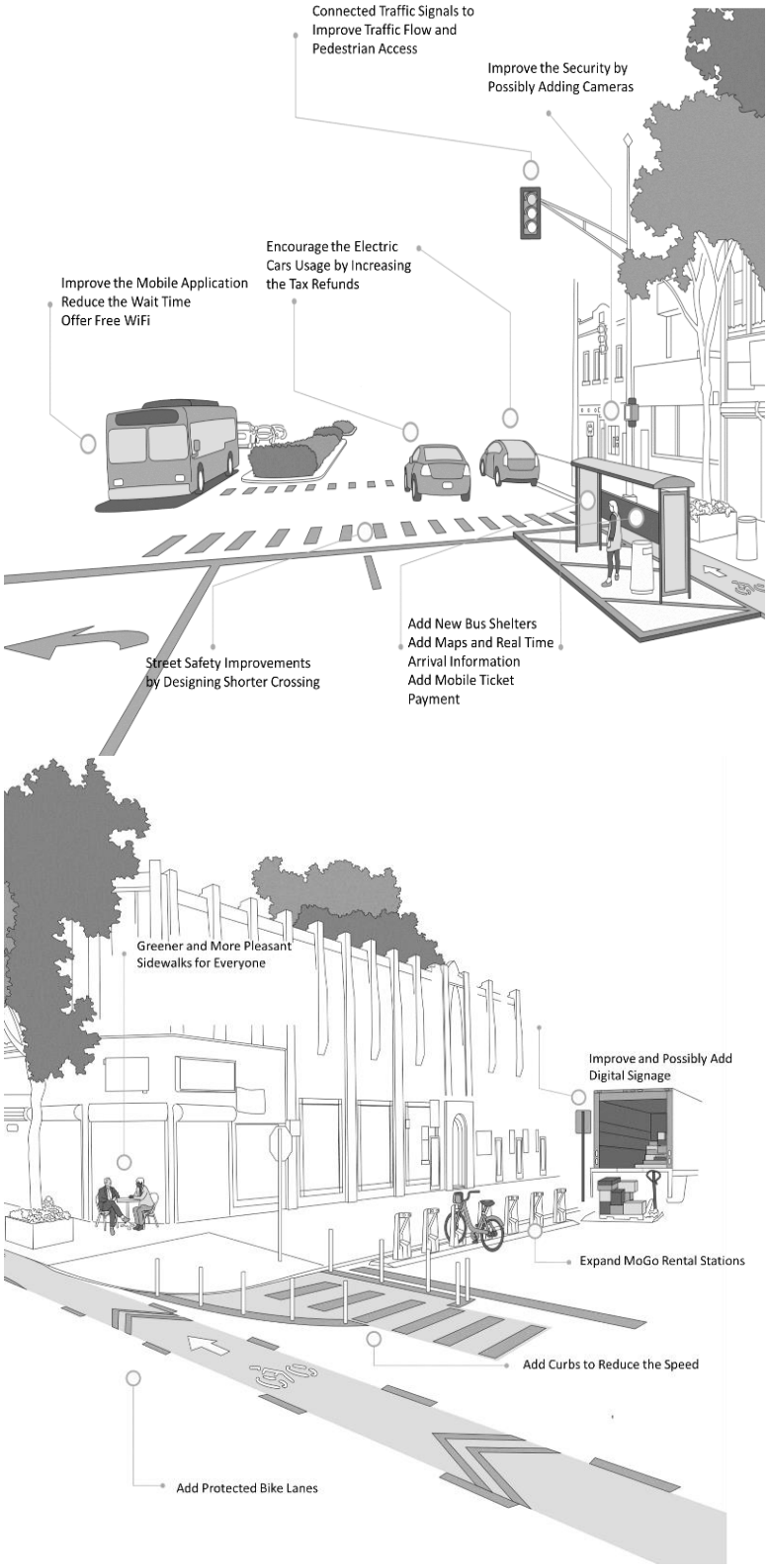


Figure 4-1: Smart Mobility conceptual proposal for Corktown

Smart Hub communicates important information and resources to the public and allow for the immediate broadcast of emergency messages and critical updates from city authorities. It will offer free public WIFI, as well. Smart Hub will connect people to the smart mobility systems and the businesses. People with no access to smart phone, credit card or high-speed internet could use the Smart Hub to get access to the public smart mobility system.

Based on the need of the neighborhood, three types of smart hubs were designed. Type 1 which is a large hub. Type 2 is the medium one and type 3 is the small one and will be used in residential areas, which are shown in Figure 4-2, 4-3 and 4-4.

4.2. Development Plan for Michigan Avenue

Development plan of Michigan avenue is necessary, based on the information provided in chapter 3. Proposed plan includes dedicated bus routes for Michigan avenue since it will have significant more traffic per day and need a reliable public transportation. Three plans were considered for the bus routes based on the National Association of City Transportation Officials guides [24]. Side running, center running (with median lanes) and center running (with left lanes). By reviewing all pros and cons of each, which are provided in Table 4-1, center running (with left lanes) will be the suitable one. A conceptual design is shown in Figure 4-6. The advantages are, more reliable than side running, more visible, more refuge for pedestrians, less capital cost than center running (with median lanes) option.

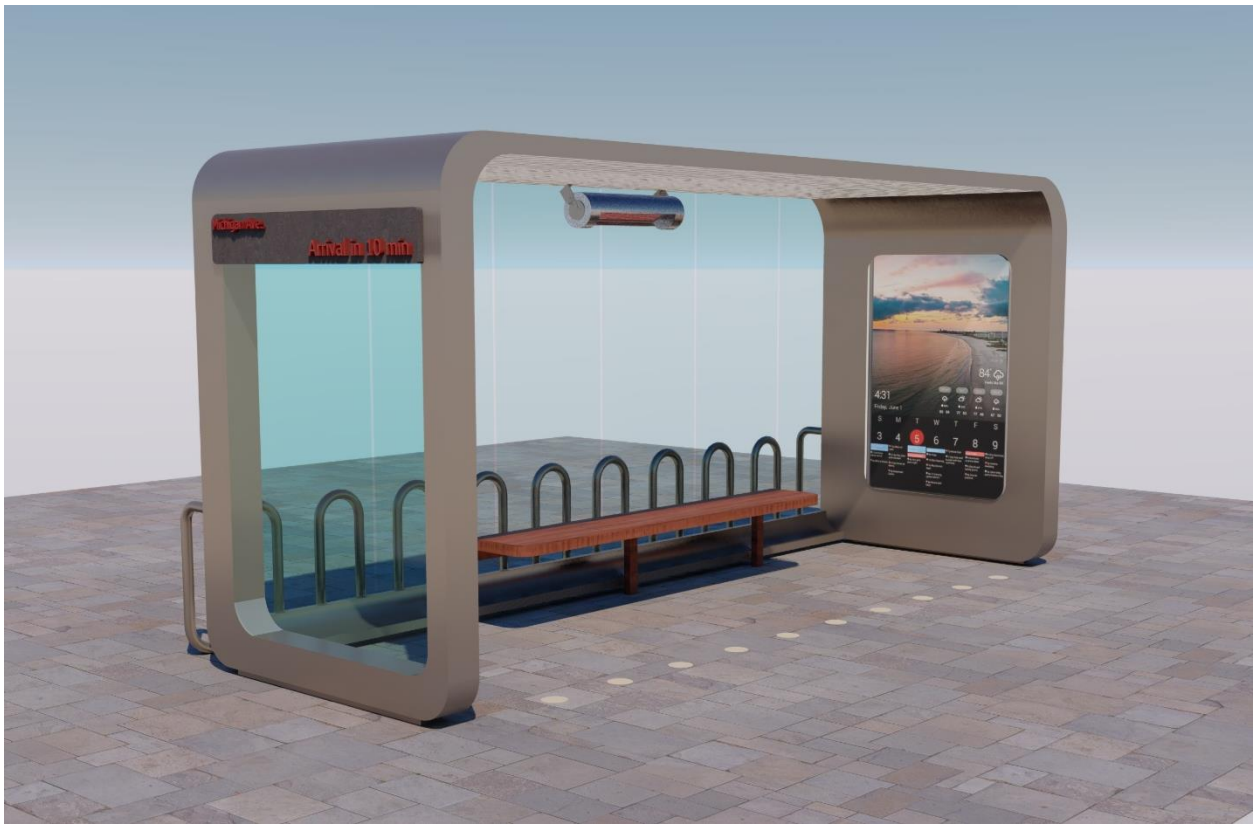


Figure 4-2: Smart Hub type 1 (large)

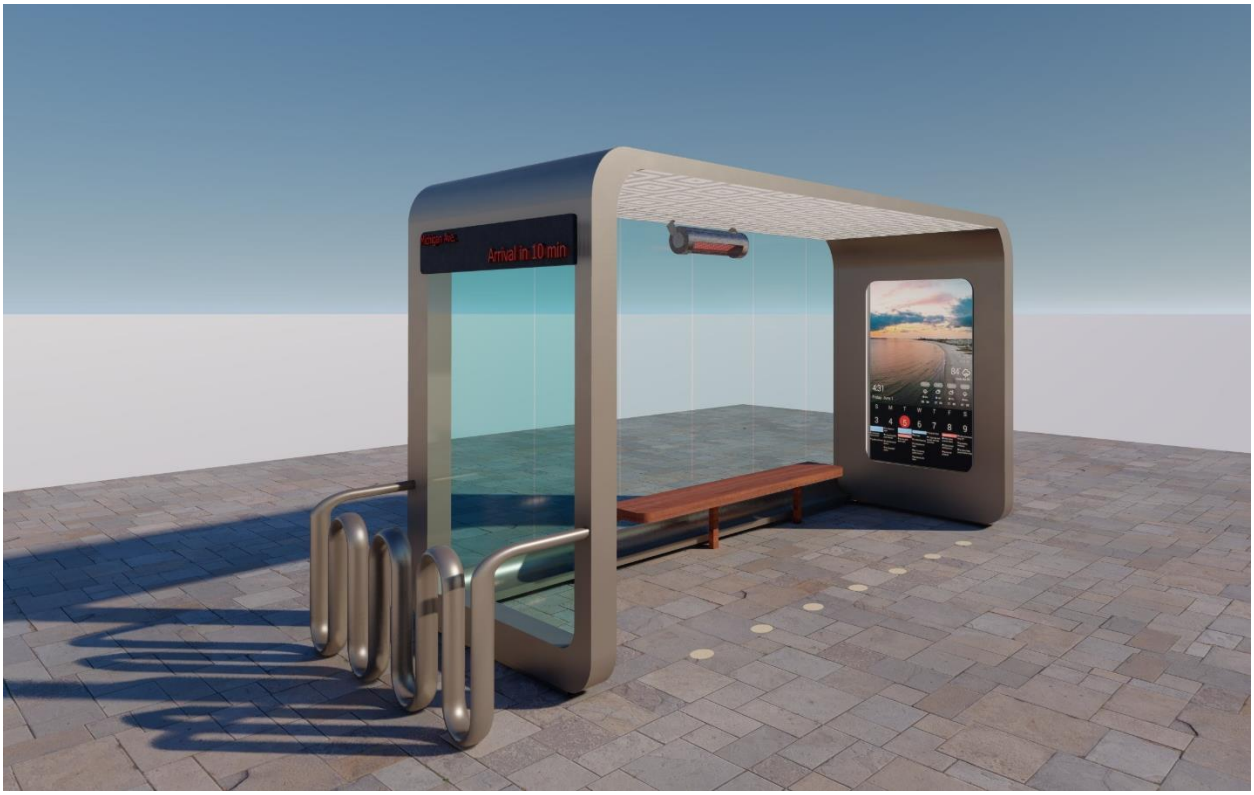


Figure 4-3: Smart Hub type 2 (medium)

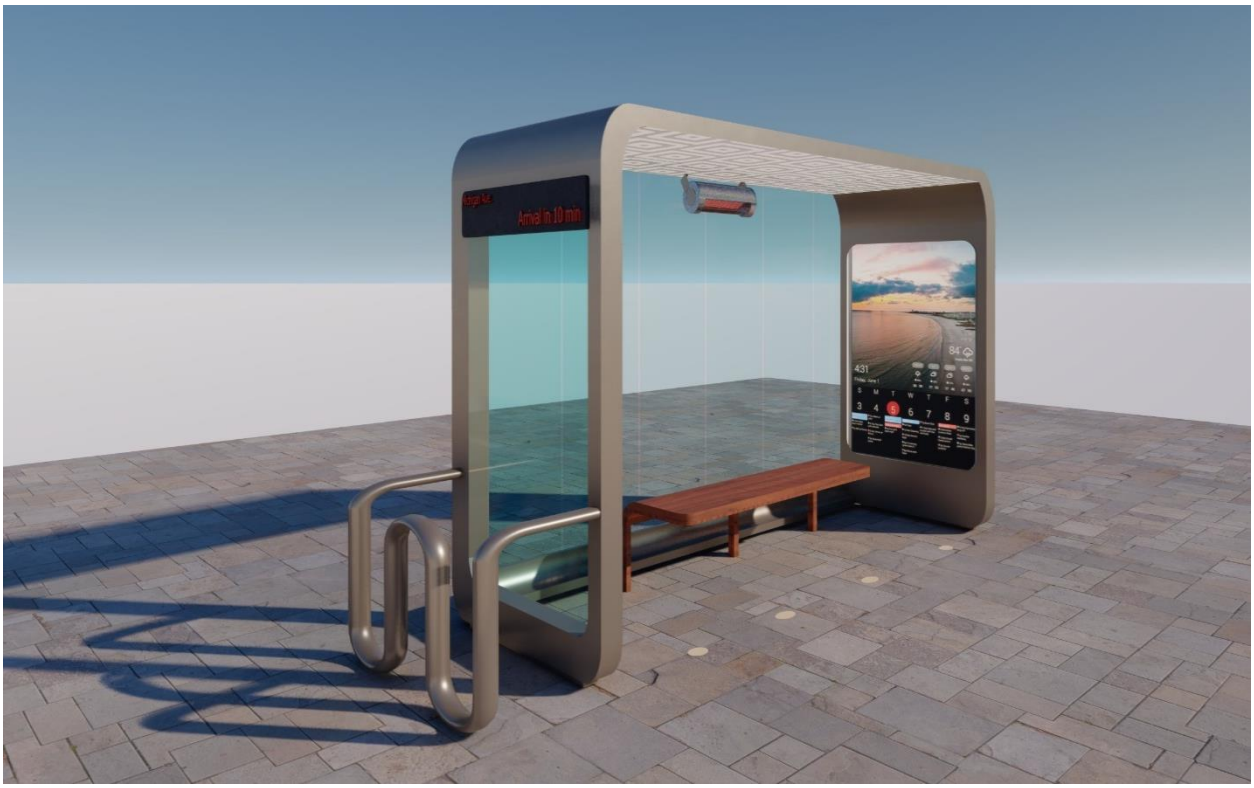


Figure 4-4: Smart Hub type 3 (small)

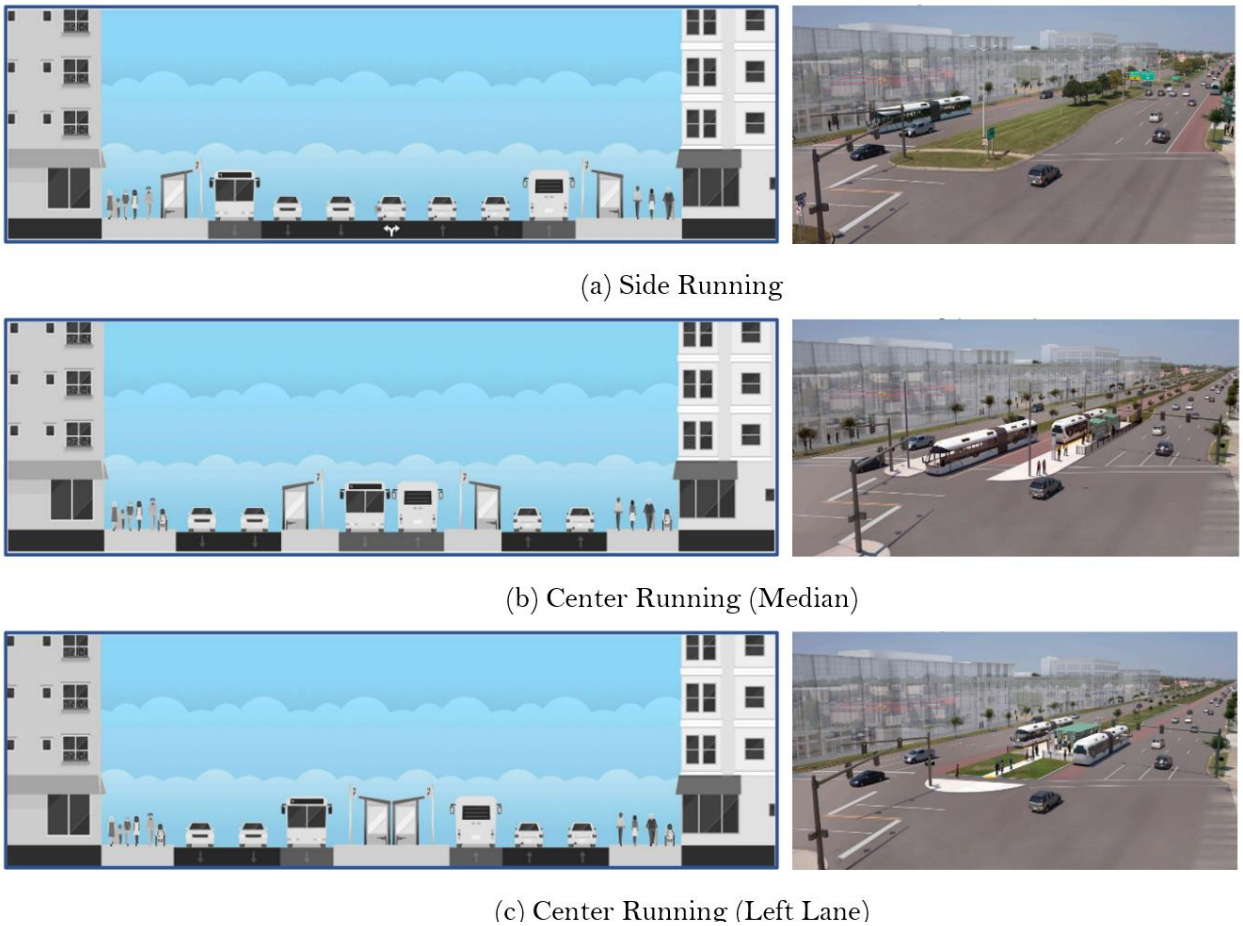


Figure 4-5: Bus routes options for Michigan ave.

Table 4-1: Pros and cons of each option for bus routes

	Side Running	Center Running (Median)	Center Running (Left Lane)
Pros	• More familiarity among transit users • More space on sidewalk at stations • Less impact to center turn lanes / medians • Less left-turn restrictions	• Most reliable • More exclusive through physical separation (median) from traffic • More visible, split platform stations • More refuge for pedestrians crossing the street	• More reliable than side running • More visible, shared island platform stations • More refuge for pedestrians • Less capital cost than center running (median) option
Cons	• Less reliable than center running • More conflict between right-turning automobiles and local buses	• Some conflict with left-turning automobiles • More expensive than side running and center running (left lane) options	• More conflict with left-turning automobiles • More expensive than side running

Figure 4-6: Michigan ave. with Center Running (Left Lane) bus routes option

Chapter 5
Design

5. Design

5.1. Smart Hub Elements

The elements of designed Smart Hub is shown in Figure 5-1. These elements are designed and selected based on the needs of Corktown neighborhood. The Hub has an interactive smart bord which will offer ticketing (cash or credit card), safety by noise and sound monitoring and free Wi-Fi. The Hub has parcel delivery boxes which vendors such as Amazon can use to deliver packages to residence or employees. The Hub has bike station, information system, solar panel, modular frame, heated seat, and heating system, as well. Type 1, 2 and 3 have the same elements. The only difference is the size and location of the bike station. A comparison of the Hubs is shown in Table 5-1.

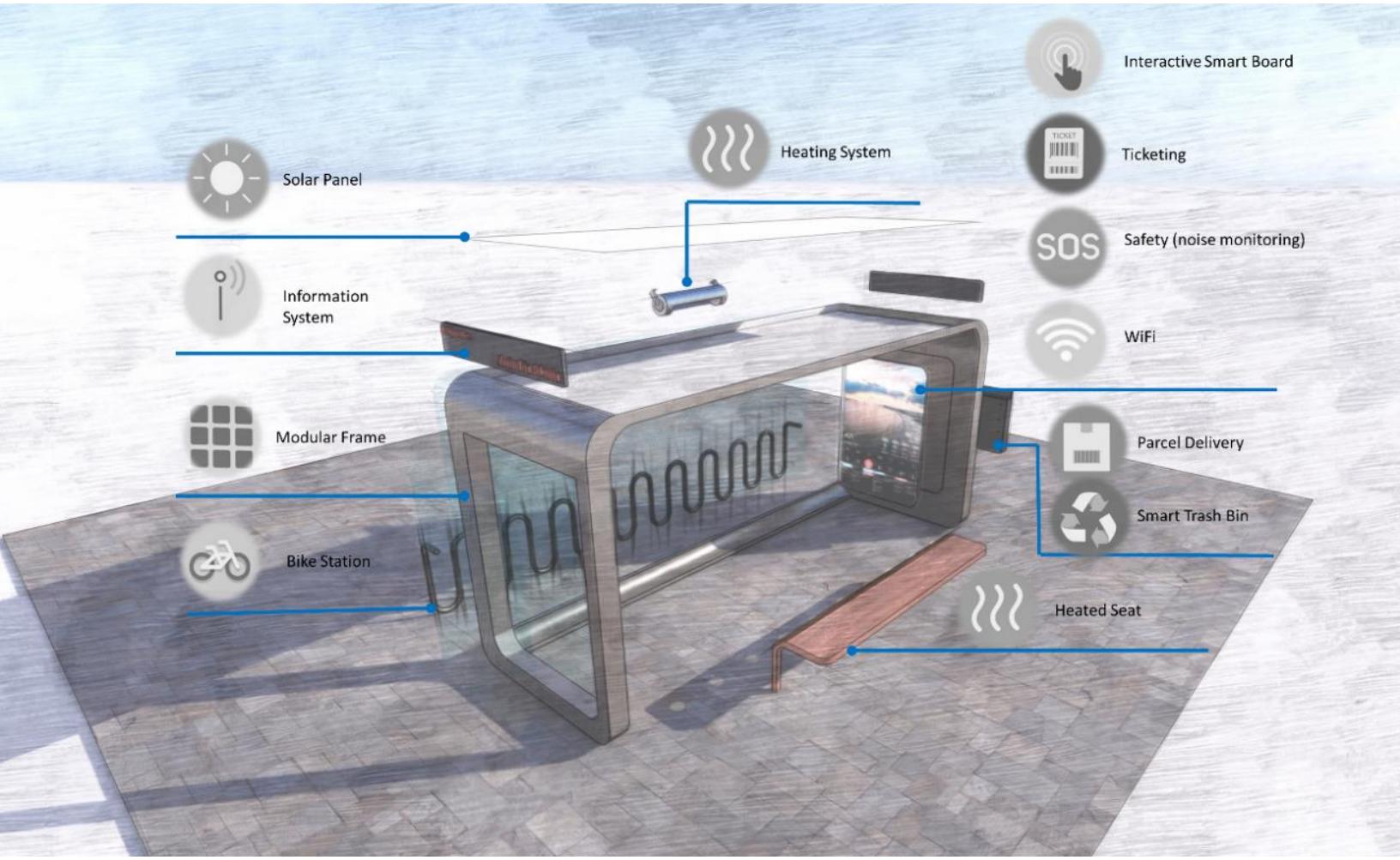


Figure 5-1: Smart Hub elements

Table 5-1: Comparison of Smart Hubs

Hub	Size	Location	Access	Flexibility	Estimation of Number of Uses/Day	Bus/Bike/Scooter Sharing Stations
Type 1	Large			✓	800	✓
Type 2	Medium			✓	300	✓
Type 3	Small			✓	100	✓

5.2. Location of Smart Hubs

Location of smart hubs is based on the usage of the existing bus station. They are in the places with highest need for transportation. They are also placed in a way that there will be 10 min walk to each Hub. So, in the neighborhood if a person just walk for a maximum of 10 min, he or she will see one of the Hubs and will have access to all modes of transportation, such as bus, bike, scooter and even ride sharing such as uber and lyft. Also, that person does not need to have smart phone or internet to use the mobility system. Location of the Hubs is shown in Figure 5-2. Connections of Smart Hubs, 10-minute walking access and 5 minute bike access diagrams are shown in Figure 5-3, 5-4 and 5-5.

Figure 5-2: Location of Smart Hubs

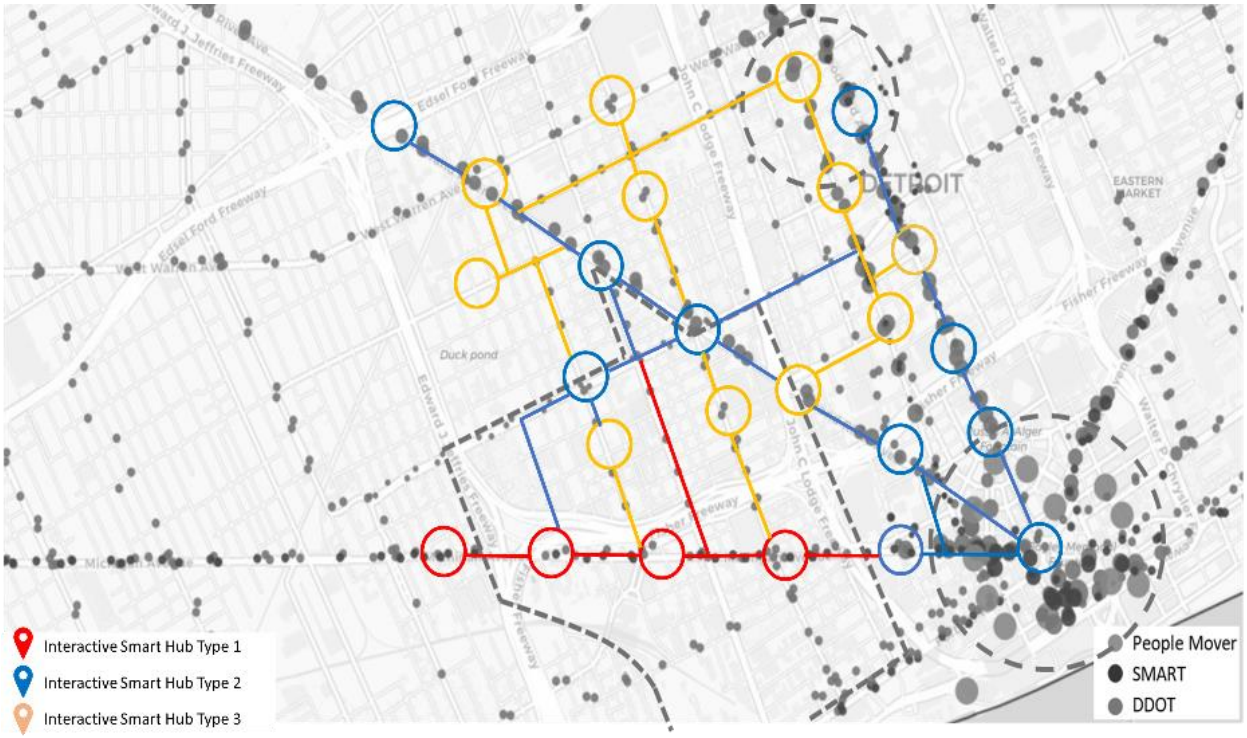


Figure 5-3: Smart Hub connections

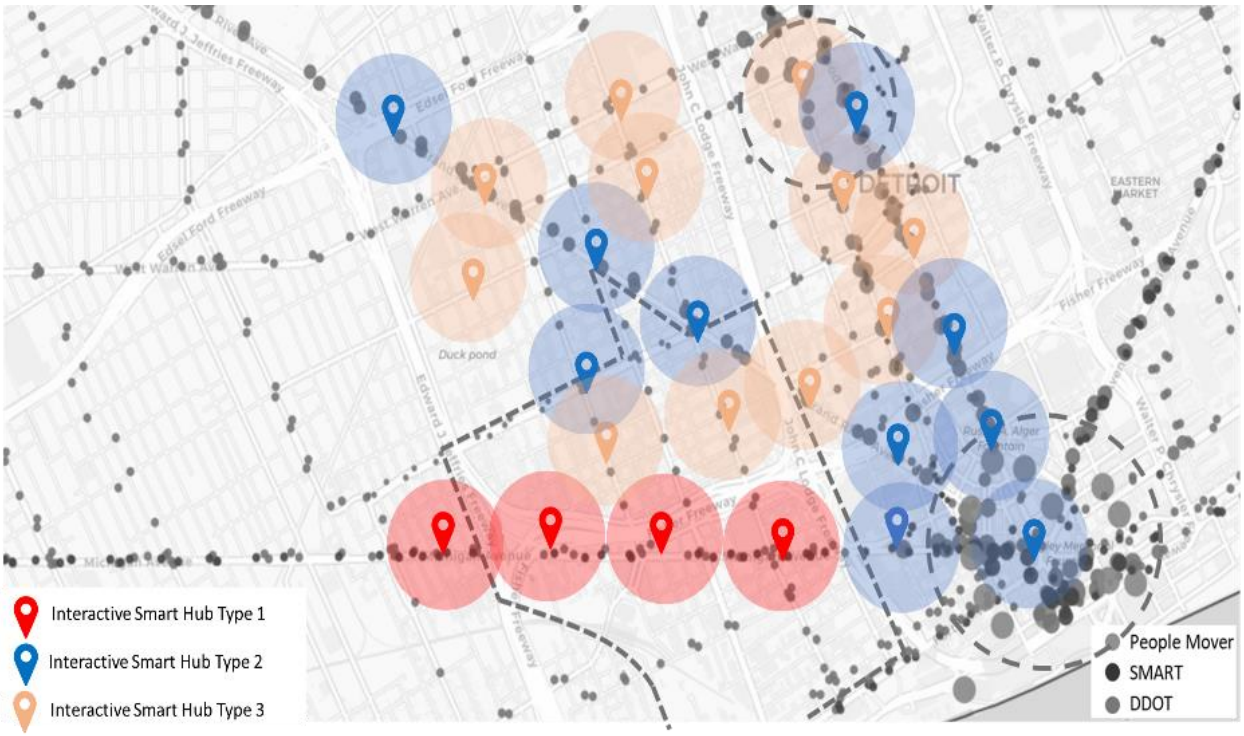


Figure 5-4: Smart Hub locations with 10-minute walking access diagrams

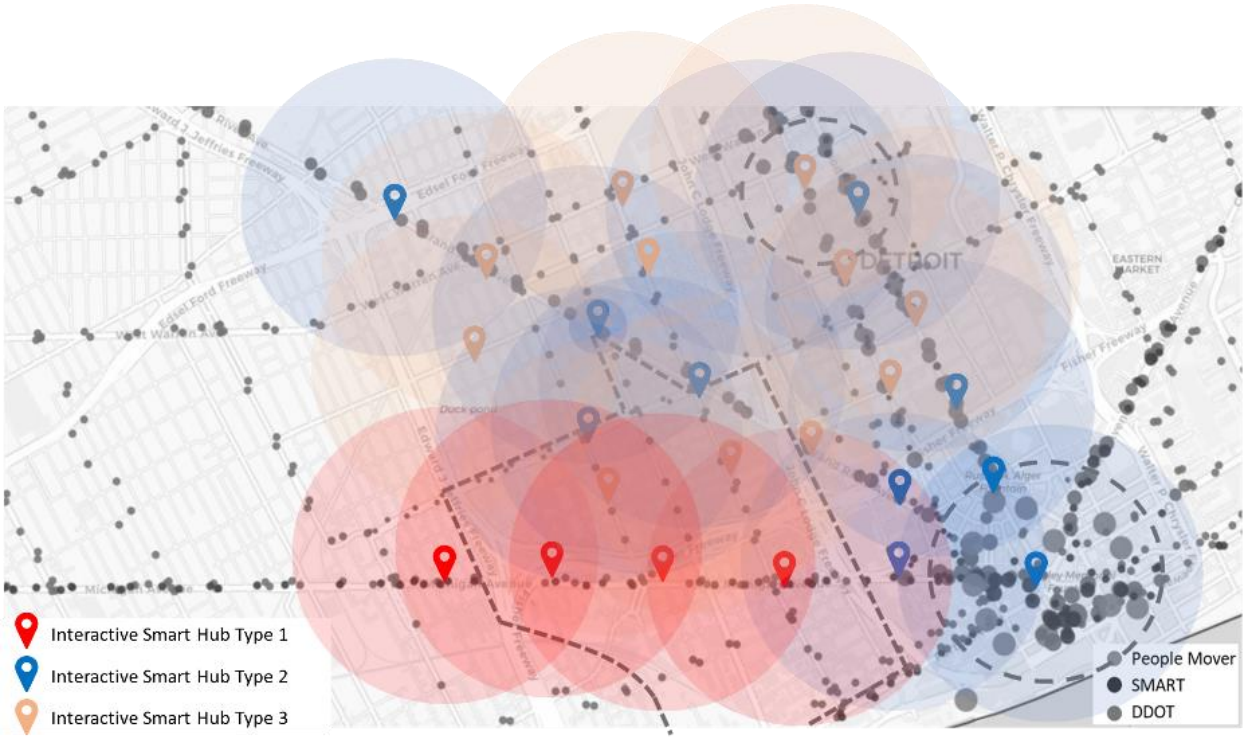


Figure 5-5: Smart Hub locations with 5-minute biking access diagrams

5.3. Type I Smart Hub (14th St. & MICHIGAN Ave)

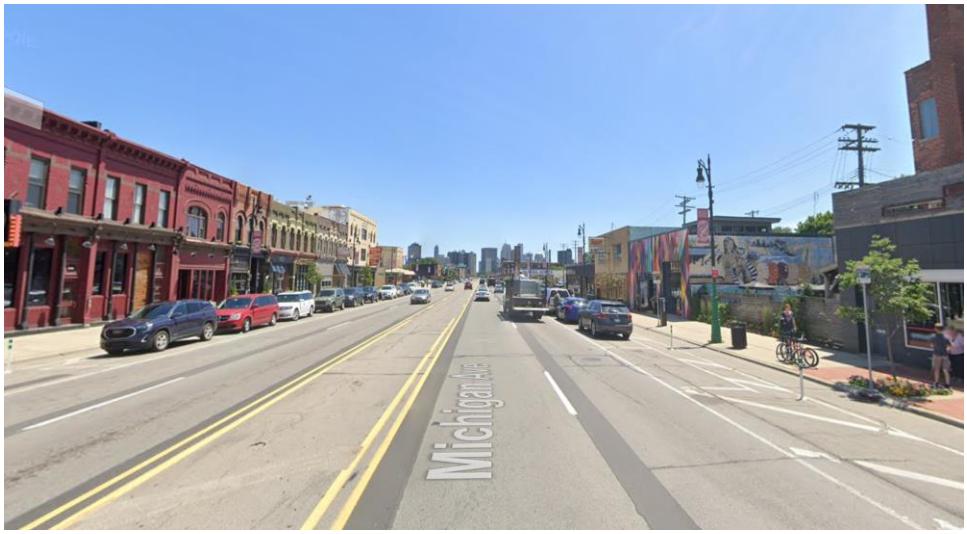
In this section, design for Michigan avenue in front of central station (location can be seen in Figure 5-6) is shown. Smart hub type 1 is used which can be seen in the middle island from different views. You dedicated bus routes and bike routes in the design can also be seen in Figure 5-7, 5-8 and 5-9.

In Figure 5-8, the existing condition and proposed design for Michigan ave. with dedicated bus routes is shown. Here, you can see the details of the existing condition in the top left and proposed improvement in the top right for Michigan avenue. Smart hub type 1 is at the center.

A section view is also shown in Figure 5-9. This design is based on the National Association of City Transportation Officials guides [24].

Figure 5-6: Location of design for Smart Hub type 1

Figure 5-7: Smart Hub type 1 in Michigan ave.



Existing Condition

Proposed Plan

Figure 5-8: Michigan ave. existing condition and proposed plan

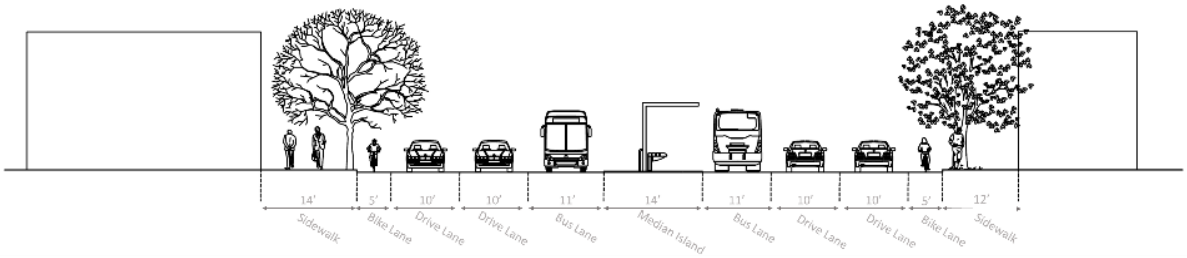


Figure 5-9: Section view of proposed design for Michigan ave.

The median island is wide enough to be used as a green space by residence and employees who works at central station for example during the lunch time. Therefore, there is opportunity for landscape design or design for this space. These designs are shown in Figure 5-10.

Figure 5-10: Landscape design for median island in Michigan ave.


ONLY
BUS

5.4. Type II Smart Hub (Martin Luther King Blvd. & 14th St.)

Smart hub type 2 is shown in Martin Luther King Blvd. The Hub will be placed in the existing bus stop in the parking lane and there will not be significant changes here (see section view in Figure 5-11).

The Hub from different views is shown in Figure 5-13. This part is a mixed of residential and business areas with less users compared to Michigan avenue.

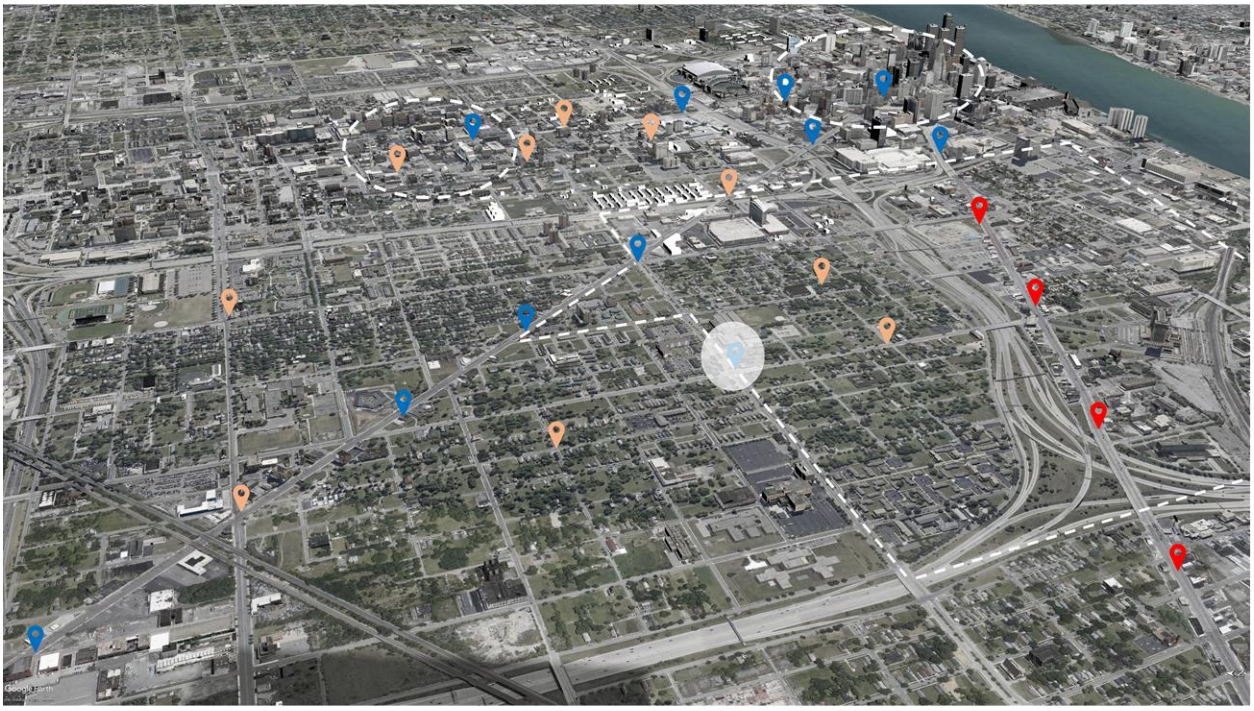


Figure 5-11: Location of design for Smart Hub type 2

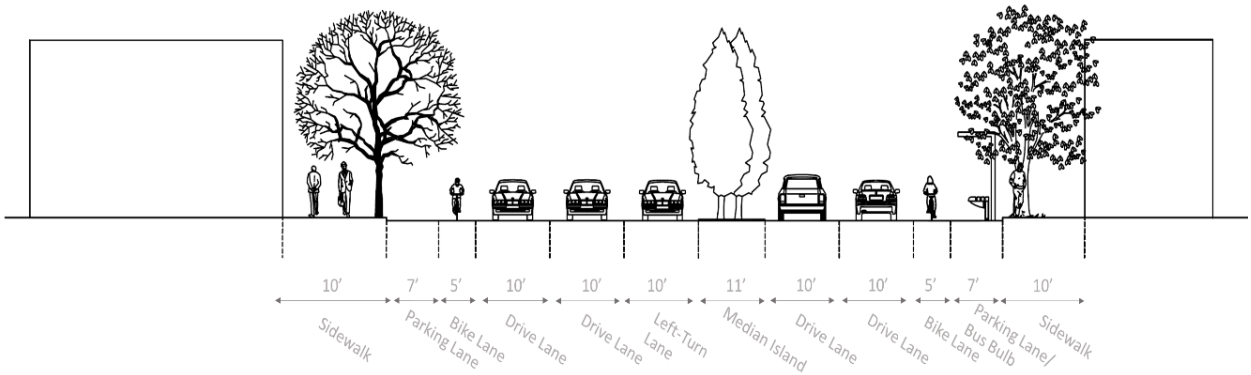


Figure 5-12: Section view of proposed design for Martin Luther King Blvd. & 14th St.

Existing Condition

Proposed Plan

Figure 5-13: Martin Luther King Blvd. & 14th St., existing condition and proposed design

Figure 5-14: Smart Hub type 2 in Martin Luther King Blvd. & 14th St.

5.5. Type III Smart Hub (14th St. & Temple St.)

Hub type 3 in 14th street in north Corktown is shown here. Again, the Hub will be placed on the location of the existing bus stop in the parking lane. This part of Corktown is in the residential area.

Figure 5-15: Location of design for Smart Hub type 3

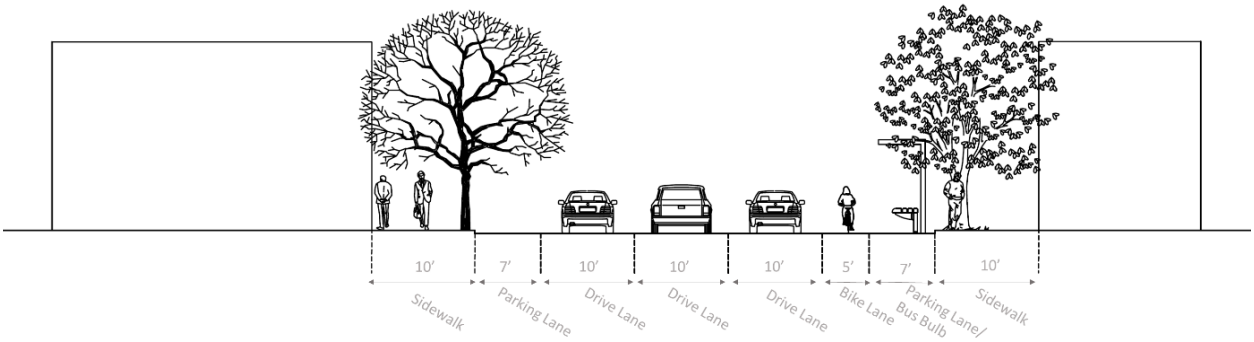


Figure 5-16: Section view of proposed design for 14th St. & Temple St.

Existing Condition

Proposed Plan

Figure 5-17: 14th St. & Temple St.: existing condition and proposed plan

Figure 5-18: Smart Hub type 3 in 14th St. & Temple St.

5.6. Summary of Smart Mobility Elements

In this section, all the smart mobility element that are used in this plan are shown in Figure 18. Interactive smart board is the main element of the Hub. Integrated bus, bike and scooter sharing station were proposed. Solar panel and dedicated battery to improve sustainability is used. Lighting system will be smart to save energy. All the Hubs and buses are connected through a wireless network to be able to manage them from an ICT center. Parcel delivery box for the same day delivery by amazon is also included in the Hub. These same delivery boxes have been placed in many locations and very common these days which help the same day delivery option. Smart trash bin is used to improve sustainability and smart traffic lights are also used to improve traffic condition.

A. INTERACTIVE SMART BOARD (SMART HUB TYPE I)
- Review Bus Routs
- Show Active Bus Location with Anticipated Wait Time
- Pay for Mobility Systems:
  - Bus, Bike , Scooter, Ride Sharing (Uber, …)
- Review the Nearby Restaurants
- Emergency Call Button
- Sound Sensor to Detect Shooting
- No Security Camera

B. BUS, BIKE & SCOOTER SHARING STATION
- Combined bike rental station with bus station to improve connectivity of mobility system

F. SMART TRASH BIN
- Reduction of cost
- sustainability

C. SOLAR PANEL & BATTERY
- Improve sustainability and reliability of smart hub

G. SMART TRAFFIC LIGHT
- Improve efficiency of traffic network

D. SMART LIGHTING SYSTEM
- Improve efficiency
- Air quality, wind speed & temperature reading Sensors
- WiFi routers to extend internet access

E. CONNECTED BUS SYSTEM
- Connection of SMART & DDOT to a central hub and mobile application
- Improve reliability of bus network

H. PARCEL DELIVERY BOX

Figure 5-19: Smart Mobility plan elements

Chapter 6
Critical Discussion

Strategic planning for urban growth has been oriented towards making cities more sustainable, livable and inclusive, both in a social and a physical sense during the past twenty-five years. A Smart city is an urban area that uses different types of technology to reach the mentioned goals. The smart city concept has been developed as a strategy for working with cities as they face more challenges and become systematically more complex through interconnected frameworks, and increasingly rely on the use of Information and Communication Technology (ICT) to meet the needs of their citizens.

There are several smart city projects around the world. Each project has its own success and challenges. Improving the quality of life of residence, safety, sustainability, economy, education are the most important successful aspects. The main challenges are privacy concerns, adaptability with new technologies and significant capital needed from the public budgets. Columbus, Boston and New York city projects were among the most successful ones. Not all the smart city projects have been successful. For example, Toronto smart city project which was developed by Side Walk labs which is Google's Company for Cities was not implemented due to privacy concern of residence about how the data gathered will be used. Therefore, having a good knowledge and understanding of the details of the pros and cons of each project is vital for the development of a successful smart city plan.

In this project, several smart city projects were reviewed and pros and cons of each were listed. Then, challenges of the Corktown neighborhood which the smart mobility plan is going to be developed for have been determined. To do that, many data including, demographic, financial, access to mobility options, credit card, smart phone and internet for the residence were analyzed. Also, the existing condition of mobility systems, infrastructure and walkability were reviewed. According to the captured challenges and opportunities that smart mobility plan can provide a detailed smart mobility plan were developed. To develop the plan, all the pros and cons of the existing smart mobility projects in similar cities were considered. For example, due to experiences for privacy concerns in other cities, surveillance cameras were not considered for this plan. Or interactive smart boards which were successfully used in Columbus with some changes was considered for this plan.

The main element of the developed plan is Smart Hub which is an integrated bus, bike and scooter sharing stations. Residence can use this hub to get access to mobility options by using smart interactive smart board even without having credit card, smart phone or high-speed internet.

Chapter 7
Conclusions

In chapter one, definition for the Smart City concept was provided. The six conceptual characteristics of the smart city which are smart economy, mobility, governance, environment, living and people were explained. The main purposes of a smart city are defined as environmental sustainability, functionality of urban systems, quality of life for all, knowledge-based development and community-driven development.

In chapter two, a comprehensive literature study for several smart city projects around the world is conducted. The cities are Konza in Kenya, Toronto, Rio de Janeiro, New York city, Istanbul, Columbus and Boston. Successful aspects and challenges of each project were reviewed.

In Chapter three, the existing condition of Corktown neighborhood was reviewed. Extensive data including, demographic, financial, access to mobility options, credit card, smart phone and internet for the residence were analyzed. Also, the existing condition of mobility systems, infrastructure and walkability were reviewed. The existing development plan by the city of Detroit, Ford Motor Company and Michigan Department of Transportation were also reviewed.

In chapter four, the comprehensive smart mobility plan for Corktown neighborhood was proposed. The plan is based on the data analyzed in Chapter three and is based on the lessons learned from similar smart mobility plan reviewed in chapter two. The main goals of the plan include improve equitable and affordable mobility options, provide reliable smart mobility service, retain and attract residents and connect key destinations.

Chapter five presents the final design for this project. The design for three smart hubs were provided in detail. The locations of the smart hubs which were selected based on the analyzed data in chapter three were shown. For each type of hub (type 1, type 2 and type 3) and example was designed. The existing condition and proposed plan were compared.

List of Figures

Figure 1-1: Strategic planning for urban growth 13

Figure 1-2: The main aims of the smart city 13

Figure 1-3: Clovity's smart city vision [9] 15

Figure 2-1: development of technology, urban challenges, urbanism types and smart city evolution during time 18

Figure 2-2: Smart city projects around the world 20

Figure 2-3: Plan for Konza Technology City (KTC) in Kenya [11] 21

Figure 2-4: Street Design in Toronto Tomorrow Project [12] 23

Figure 2-5: Rio's Operations Center in action [13] 25

Figure 2-6: Cornell Tech campus on Roosevelt Island [14] 28

Figure 2-7: Istanbul smart city project [15] 30

Figure 2-8: Columbus smart city challenge implementation vision [16] 32

Figure 2-9: An interactive smart board in the city of Columbus [16] 32

Figure 3-1: Corktown sign as the oldest neighborhood in Detroit [19] 35

Figure 3-2: Corktown neighborhood in 1950s [19] 36

Figure 3-3: Michigan Central Station [19] 37

Figure 3-4: Greater Corktown neighborhood and its connections to Downtown and Midtown 38

Figure 3-5: (a) Neighborhoods surrounding the Corktown; (b) Public ownership sites [20] 38

Figure 3-6: Properties and lands categories in Corktown [20] 40

Figure 3-7: Building footprint in Corktown [22] 40

Figure 3-8: Corktown demographic data [20] 41

Figure 3-9: Access to smart phone and credit card in Corktown [23] 42

Figure 3-10: Access to grocery stores [23] 42

Figure 3-11: Households without vehicle [23] 43

Figure 3-12: Internet access of South East Michigan residence [20] 43

Figure 3-13: Limited crosswalks and no median in Michigan Ave. 44

Figure 3-14: Short term solution for the limited cross walk in Michigan Ave. 44

Figure 3-15: Bus stations and their usage in Corktown and Detroit [22] 45

Figure 3-16: Cost and passes for DDOT [20] 45

Figure 3-17: Roosevelt park bus stops at Michigan Ave. 46

Figure 3-18: Martin Luther King Jr Blvd & Trumbull Ave. 46

Figure 3-19: Martin Luther King Jr Blvd & 14th St. 46

Figure 3-20: Walking time to transit station [22] 47

Figure 3-21: Bike routes and MOGO rental stations in Corktown 47

Figure 3-22: Traffic volume [22] 48

Figure 3-23: Different scenarios for mobility in Corktown 49

Figure 4-1: Smart Mobility conceptual proposal for Corktown 52

Figure 4-2: Smart Hub type 1 (large) 54

Figure 4-3: Smart Hub type 2 (medium) 55

Figure 4-4: Smart Hub type 3 (small) 55

Figure 4-5: Bus routes options for Michigan ave. 56

Figure 4-6: Michigan ave. with Center Running (Left Lane) bus routes option 57

Figure 5-1: Smart Hub elements 59

Figure 5-2: Location of Smart Hubs 61

Figure 5-3: Smart Hub connections 62

Figure 5-4: Smart Hub locations with 10-minute walking access diagrams 62

Figure 5-5: Smart Hub locations with 5-minute biking access diagrams 63

Figure 5-6: Location of design for Smart Hub type 1 64

Figure 5-7: Smart Hub type 1 in Michigan ave. 65

Figure 5-8: Michigan ave. existing condition and proposed plan 66

Figure 5-9: Section view of proposed design for Michigan ave. 66

Figure 5-10: Landscape design for median island in Michigan ave. 67

Figure 5-11: Location of design for Smart Hub type 2 70

Figure 5-12: Section view of proposed design for Martin Luther King Blvd. & 14th St. 70

Figure 5-13: Martin Luther King Blvd. & 14th St., existing condition and proposed design 71

Figure 5-14: Smart Hub type 2 in Martin Luther King Blvd. & 14th St. 72

Figure 5-15: Location of design for Smart Hub type 3 73

Figure 5-16: Section view of proposed design for 14th St. & Temple St. 73

Figure 5-17: 14th St. & Temple St.: existing condition and proposed plan 74

Figure 5-18: Smart Hub type 3 in 14th St. & Temple St. 75

Figure 5-19: Smart Mobility plan elements 77

List of Tables

Table 4-1: Pros and cons of each option for bus routes 56

Table 5-1: Comparison of Smart Hubs 60

References

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Appendix
Space for Mobility

A space was created to inspire feeling for mobility in Detroit

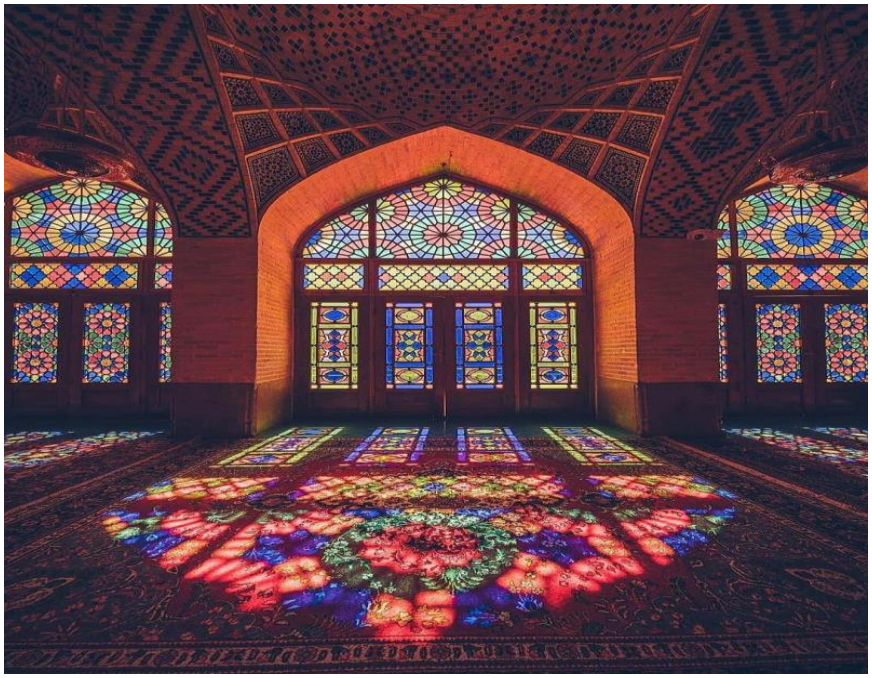
"The City of Detroit is prepared to again play a national leadership role with a new vision for equitable mobility, transforming Detroit from Motor City to Mobility City"

U.S. Department of Transportation

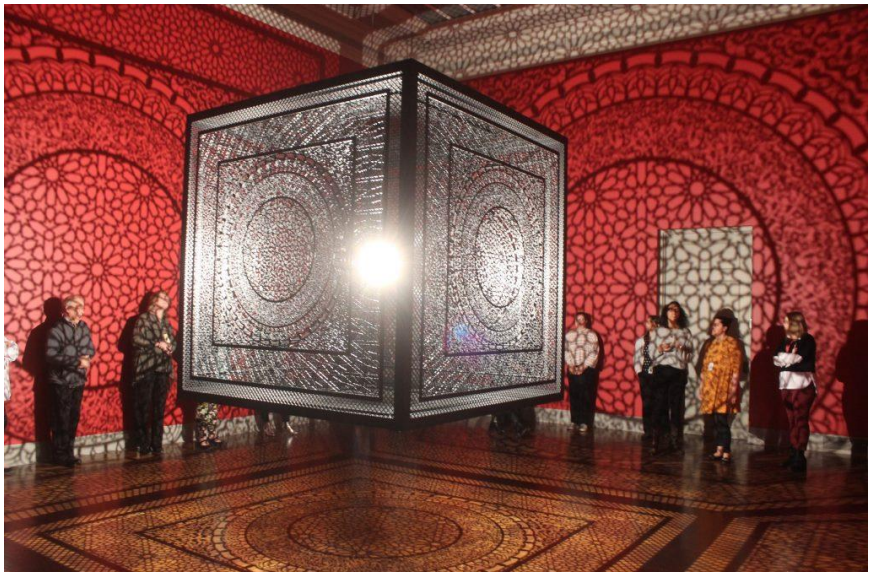
IDEA - I

Projection of Shadow to Make Space

Creating Shadows by using either natural or artificial lights has been used in architecture to create space. For example, this method has been extensively used in Islamic architecture in mosques.



Shiraz historical city, Iran



Anila Quayyum Agha: Between Light and Shadow, Toledo Museum of Art, US

IDEA - II

Use Street Map to Show Mobility

Projected big maps for the cities on the walls or on the ground are used to show the mobility in the cities.

IBM THINK Exhibit's Digital Wall at Lincoln Center, US

Venice 2012 Architecture Biennale, Italy

PROPOSED IDEA

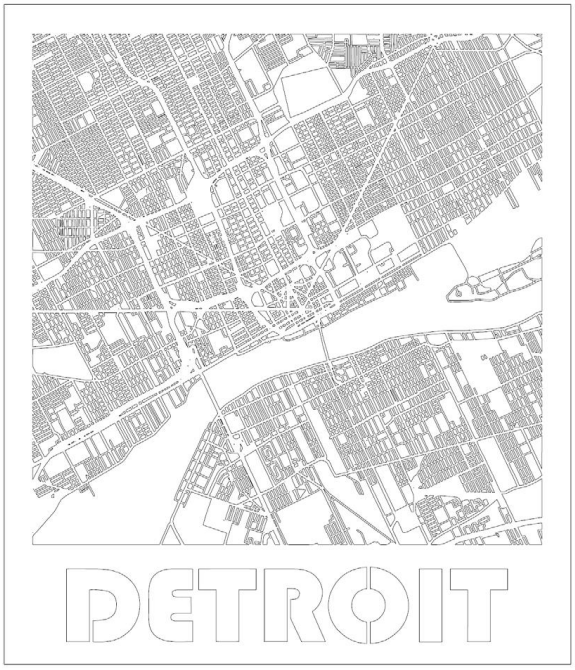
Laser Cut Map

By combining the previous ideas, a shadow of Detroit city street map will be used to create a space that give us feeling of mobility in the city. A laser cut map of the city of Detroit is prepared.

Prepared Map (Approx. 2'×2')

PROCESS

Laser Cut Process



Laser Cut Input

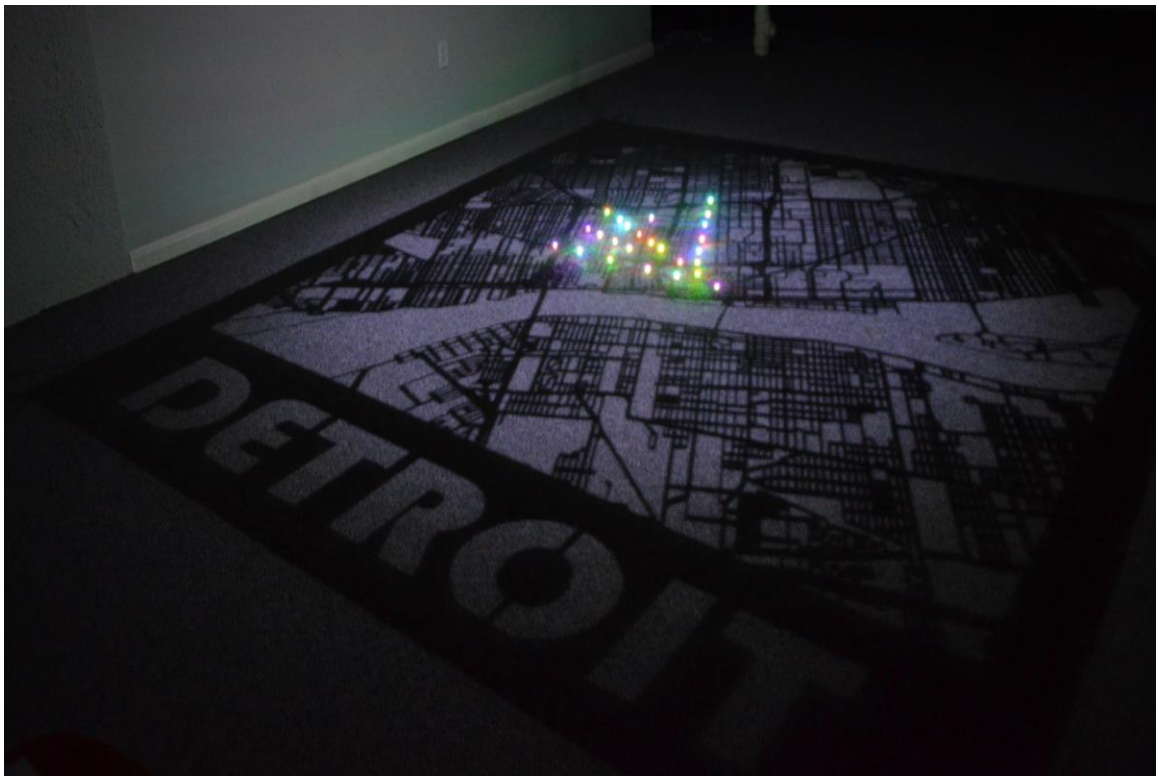
Remaining Material

INSTALLATION

To have sharp shadow without having blur, the size of light source and the distance between object and light source is critical. The further away the light source is from the object, the better. And having smaller light source is also better.

Installation

Projected Detroit Mobility Space by Shadow



LED Lights Show the Location of Smart Hubs in Detroit

Motion in the city