WALKABILITY IN CITIES AS A STRATEGY TO PROMOTE EQUITY

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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INTRODUCTION

The ongoing coronavirus (COVID-19) pandemic has significantly affected the way people around the world live and work. Labor markets and supply chains were severely altered as cases rose and governments issued lockdowns to prevent medical facilities from being overwhelmed. Following the initial series of global lockdowns in March of 2020, (Dunford et al., 2020) the summer brought people out of their homes and cities back to life. As people started interacting again, there were concerns about keeping COVID-19 case numbers down which led public health officials to implement social distancing measures that required individuals to stay six feet apart (United States of America Department of Health and Human Services, n.d.). This led to issues in urban environments which are primarily designed around vehicles forcing pedestrians to crowd on sidewalks as small as four feet (Keen, 2018). To maintain social distancing measures, many city officials closed down entire streets for people to spread out and businesses to setup outdoor venues and seating (Diaz, 2020; Lazo, 2020). This strategy of closing streets for people to walk and play has become popular and in some US cities, permanent (Schmidt, 2022). Walkability as a design characteristic of urban environments goes beyond being able to eat outside at a nice restaurant and walk down a boulevard without cars whizzing by. A walkable city can serve as a gateway to previously inaccessible services and opportunities for individuals of lower economic status. To encourage more cities to embrace walkability as a means to promote social and economic equity, I conducted a case study analysis on three cities to determine what the best practices are for improving walkability in our urban environments.

Given the rise of car ownership in the 20th century (History.com, 2018) many existing cities in the United States of America (USA) have been designed or redesigned around automobiles. This car-centric design has lent itself to changing all aspects of daily life. Grocery stores, offices, and hospitals are spread out and require individuals to own a vehicle and drive to these locations for food, work, or medical care. This is a significant problem for people of lower economic status since car ownership and related expenses are second only to housing, making up 16.4% of average annual expenditure in the United States (D'Allegro, 2022; USA Department of Labor, 2022). Owning a car essentially becomes the bridge to accessing most goods or services in the United States and anyone who doesn't own a vehicle is left behind. A walkable city is the antithesis to this idea. In a walkable city, work, food, medical services, and more are all within immediate walking distance of a place of residence or at least close to public transportation systems. Accessing these essential goods and services becomes either free or significantly cheaper than it would be in a car-centric city due to reduced transportation costs (Victoria Transport Policy Institute, 2016).

However, there is significant opposition to urban walkability, particularly from the auto industry. Walkability as defined by Baobeid, Koç, and Al-Ghamdi is the, "quality of which the built environment enables the mobility of pedestrians" (2021, p. 2). This typically means reducing car dependency or in some cases, removing cars out of cities altogether as in the city centers of Oslo, Norway and Madrid, Spain (Williams, 2019). This is financially disastrous for automakers whose business model is based around manufacturing, marketing, and selling vehicles to consumers. Using their immense size and resources, these entities have successfully

lobbied for more spending on vehicular infrastructure and have pushed pedestrians out of public spaces (Mattioli et al., 2020).

Given the many stakeholders, conflicting viewpoints, and effects that car-centric infrastructure has on life in urban environments, the framework that is best suited to analyzing walkability and its relation with promoting social and economic equity is *technopolitics*. Technopolitics is the idea that technological systems are inherently political systems that exude their own agenda and influence on society (Winner, 1980). The political ideology that the technological system possesses is often inherited from the creators of the technology and can extend over long distances and durations of time. Individual decisions by an urban planner in one neighborhood can grow to affect the city as whole or even the surrounding metropolitan area for generations. This means that past decisions based on a certain set of beliefs will continue to impose their will on our societies even if the current population no longer supports those beliefs. The powers and beliefs of the original decision maker are essentially magnified such that it requires immense effort to change.

Given that walkability is a direct component of urban design and planning and that urban design is dictated by architects, engineers, and public officials, walkability is innately political since it is determined by people and is subject to their changing beliefs. Furthermore, the walkability of cities is tied to large physical elements such as sidewalks, pedestrian bridges, etc. and is inhibited by vehicular infrastructure such as highways, parking lots, etc. Regardless of changing stakeholders, these physical technologies will continue to exude their political influence until they are removed.

RESEARCH METHODOLOGY

To encourage more cities to embrace walkability as a means to promote social and economic equity, the following question was asked. What are the best practices for increasing walkability in urban environments? To answer this question, I performed a case study analysis of two walkable cities, Tokyo and Washington D.C., and contrasted them with a city deemed highly unwalkable, Houston. Each case city was first analyzed through Walk Score, a subsidiary service of Redfin that aggregates location, proximity, and route data on cities to determine how traversable the city is in terms of walkability, transit, and bikeability (Redfin, n.d.). Using this value as a baseline measure of the city's walkability, specific factors were analyzed to determine the extent of their effect on walkability. Each city's zoning policy, "municipal or local laws or regulations that govern how real property can and cannot be used in certain geographic areas" (Kenton, 2022, para 1.), was examined and compared. Ridership and infrastructure data was gathered on each city's public transit network to determine which system was the most efficient and utilized. A map analysis was conducted to determine differences in grid structure and automobile accommodation. Additionally, key historical events in each city's lifetime were identified for their impacts on changes in urban layout.

RESULTS

The case study revealed three key factors that distinguish walkable cities from others. First, walkable cities tend to have complex, interconnected mass public transit systems that reliably connect residents with desired goods and services. Second, is that walkable cities utilize an abundance of mixed-use zoning to diversify the types of facilities offered in a small area. Third, is that older cities designed and matured before the post-WWII car ownership boom are less likely to have strong attitudes leaning towards vehicular infrastructure and thereby

accommodate pedestrians better. Lastly, it was found that a rectangular grid structure did not have a significant effect on urban walkability.

Case 1: Tokyo, Japan

Tokyo, Japan is the largest city in the world by population serving as the home for more than 13 million people (Tokyo Metropolitan Government (TMG), n.d. c). "The metropolitan area is the largest industrial, commercial, and financial centre in Japan" (The Editors of Encyclopedia Britanica, 2022, para. 5), and also serves as the country's capital. Given the immense population, the city has had to adopt unique practices and policies to satisfy residents' needs and wants. These practices and policies have led Tokyo to be classified as one of the most easily traversable cities in the world. When analyzing Tokyo through Walk Score, the average Walk Score of all 23 special wards composing central Tokyo is roughly 95/100, indicating a "Walker's Paradise" (Redfin, n.d.; TMG, n.d. a). It is important to note that although Walk Score is primarily used to measure cities in the United States, research supports Walk Score as a valid measure in Japan as well (Koohsari et al., 2018). The following subsections detail specific elements that have contributed to Tokyo's high Walk Score.

Zoning. Given its vast size and many wards, one may assume that Tokyo has a very strict and complicated zoning policy to dictate the placement of buildings and infrastructure, however, this could be further from the truth. In fact, "The entire nation [of Japan] is governed by a single set of zoning regulations, from Shibuya in Tokyo to a suburb in a rural town - the distribution is different but the zones, and their rules, are standardized" (Galloway et al., n.d., para. 6). These national zoning regulations were developed by the Japanese Ministry of Land, Infrastructure, and Transport (JMLIT) are divided into 12 categories as shown in Figure 1. These regulations allow

for some flexibility beyond the standard 12 zones by granting municipalities the ability to create special use zones (JLMIT, 2003).

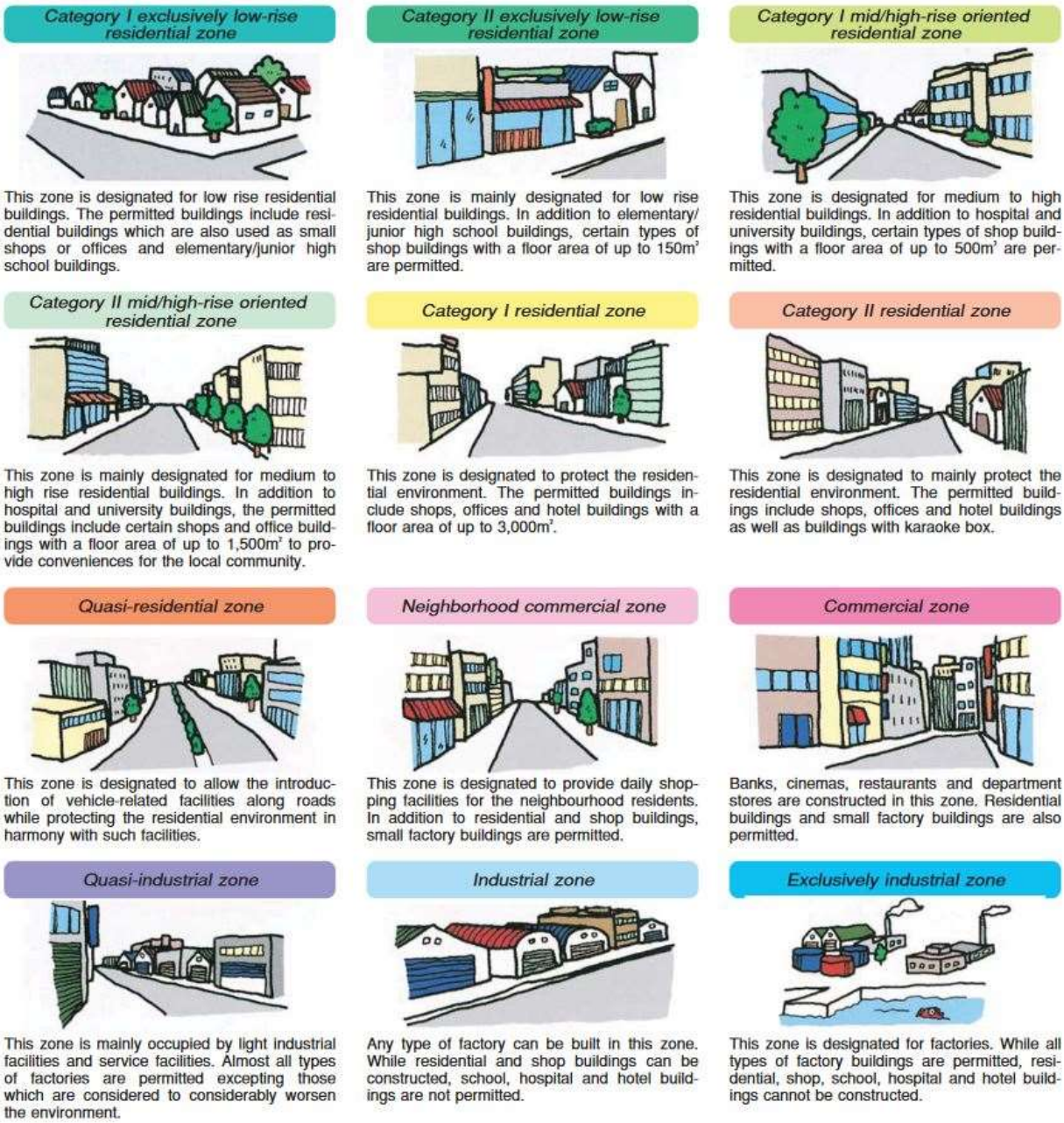

Figure 1. 12 Japanese Zoning Categories. *Note.* Infographic explaining the composition of the 12 major zoning categories (JMLIT, 2003, p. 4).

Table 1. Zoning Areas of Tokyo's 23 Special Wards. *Note.* Table listing the areas of each of the 12 major zoning categories in central Tokyo. The summation of the individual categories' areas is less than the indicated area of city planning due to the omission of special use zones which makes up the remaining 5% (TMG Bureau of Urban Development, 2019, p. 139-140).

Zoning Category	**Area (ha)**	**% of Total Area of City Planning**
Category 1 exclusively low-rise residential zone	11305.9	18%
Category 2 exclusively low-rise residential zone	575.2	1%
Category 1 mid/high-rise oriented residential zone	10361.4	17%
Category 2 mid/high-rise oriented residential zone	1067.2	2%
Category 1 residential zone	9475.1	15%
Category 2 residential zone	1174	2%
Quasi-residential zone	471.8	1%
Neighborhood commercial zone	4224.1	7%
Commercial zone	6456.6	11%
Quasi-industrial zone	10838.5	18%
Industrial Zone	1255.1	2%
Exclusively Industrial Zone	1018.5	2%
Area of City Planning[a]	61465	

Public Transportation. Tokyo possesses a robust public transportation system that is often considered to be one of the greatest in the world. The system is primarily rail based and is consistent of two separate entities operating in an integrated system, the Tokyo Metro and the Toei Subway (Tokyo Metro, n.d. b). The Tokyo Metro operates 9 lines with a distance of about 195km and the Toei Subway operates 4 lines with a distance of 109km (Toei Transportation, n.d. b; Tokyo Metro Ad Agency, n.d.). Normal fares for both systems vary by distance traveled but both start at ¥180 for adults (Toei Transportation, n.d. a: Tokyo Metro, n.d. a). As shown in Figure 2, the network coverage is vast with numerous transfer points that allow riders to easily

move from one ward to another. In addition to the rail network, Toei Transportation also operates a less utilized bus service (TMG Bureau of Transportation, 2018).

Age, History, Grid and Cars. Tokyo is an ancient city with its origins being that of a fishing village (The Editors of Encyclopedia Britanica, 2022). Following the establishment of the Shogunate in Tokyo in 1603 the city underwent rapid development (TMG, n.d. b). This along with various disasters such as earthquakes, fire, and war have been attributed as the cause for Tokyo's lack of long-term planning and therefore a traditional grid structure (Deseret News, 1999). As for vehicles in Tokyo, the city accommodates them but they are not the priority. This can be attributed to the decisions of policy makers whose main interest was rebuilding the country and economy following WWII. Choosing to rebuild their cities around cars would be costly given that Japan has no internal supply of oil and would have to import it from other countries (Tomlinson, 2019).

Figure 2. Tokyo, Washington DC, and Houston Public Transit System Maps (Rail). *Note.* WMATA (Top Left), METRO (Right), Tokyo Metro and Toei Subway (Bottom) (METRO, n.d. b; WMATA, 2022a; Tokyo Metro, n.d. b).

Case 2: Washington D.C., United States of America

Washington D.C is the capital city of the United States of America and serves as the home for many federal agencies and adjacent industries. The city has a population of roughly 689,000 and has hosted innumerable historic events during its lifetime (USA Census Bureau, 2020). The surrounding Northern Virginia and Southern Maryland areas also have a considerable impact on Washington, D.C. due to the fact that a significant portion of the labor force resides in those two states. In terms of mobility, Walk Score issued the city a 77/100 for walkability, 69/100 for transit, and 70/100 for bikeability (Redfin, n.d.).

Zoning. Washington D.C.'s zoning is composed of 5 major categories with various subcategories, Residential Zones, Mixed Use Zones, Downtown Zones, Production Distribution and Repair Zones, and Special Purpose Zones (District of Columbia Office of Zoning (DCOZ), n.d. b). The residential zones are single-use, exclusive in nature whereas the mixed-use and downtown zones allow for more flexibility by allowing commercial and other entities to coexist in the same area. It is important to note that significant portions of the city are un-zoned due to the presence of federal institutions, the National Mall, etc., see Figure 3.

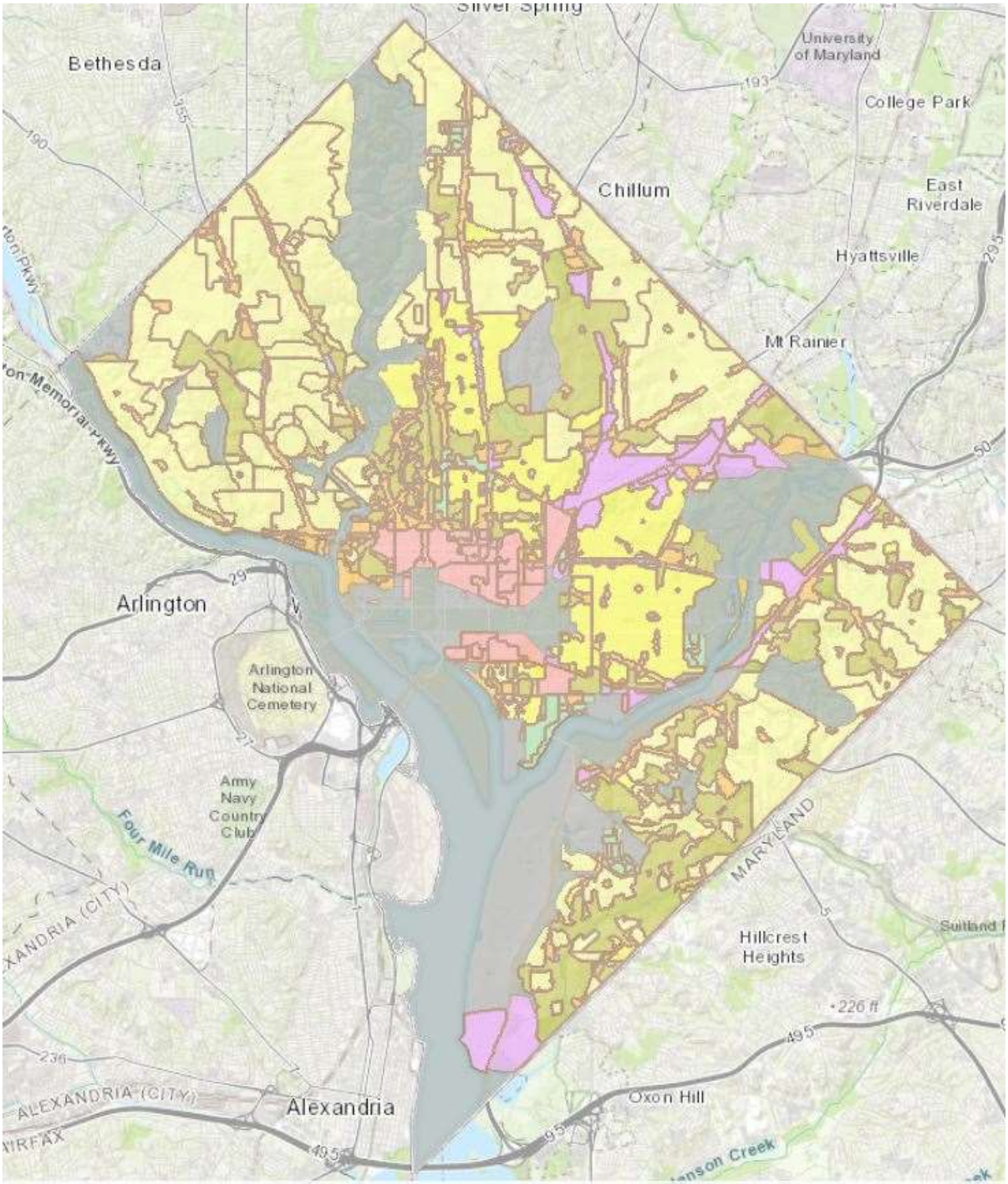

Figure 3. Washington D.C. Zoning Map. *Note.* This figure is a screenshot of the official Washington D.C. zoning map. Items in yellow are residential zones, items in orange are mixed use zones, items in red are downtown zones, items in purple are production and repair zones, and items in teal are special purpose zones (DCOZ, n.d. a).

Table 2. Land Use in Washington D.C. *Note.* Table detailing land use in Washington D.C. in 2005. Land use was utilized due to the absence of a zoning area data as in Table 1. Additionally, although the aforementioned zoning regulations are from 2016, land use has remained mostly the same (District of Columbia (DC) Office of Planning, 2005).

Land Use	Area (acres)	% of Total Land
Road Rights-of-Way	10017.7	25.5%
Single Family Detached Houses	4936.2	12.6%
Single Family Attached Homes/Row Houses	3873.6	9.9%
Low-Rise Apartments	1855.7	4.7%
High-Rise Apartments	402.3	1%
Commercial	1794.6	4.7%
Industrial	418.4	1.1%
Local Public Facilities	1190.9	3%
Federal Facilities (excl. parks)	2781	7.1%
Institutional	2262	5.8%
Permanent Open Space	7980.2	20.3%
Rail, Utilities and Communications	856.8	2.2%
Vacant	842.8	2.1%
Total Land	39225	

Public Transportation. Washington D.C.'s major public transit agency is the Washington Metropolitan Area Transit Authority (WMATA) which owns and operates the D.C. Metro rail and bus networks. The organization is a tri-jurisdictional agency that receives funding from Virginia, Maryland, Washington D.C., and the United States Federal Government (WMATA, 2023a). The, DC Metro, **"**is one of the busiest public transportation systems in the country [and] is heavily used by local commuters … [due to it being] convenient and affordable" (Destination DC, n.d. a, para. 1). As shown in Figure 2, the rail system is composed of 6 lines that connect Washington D.C. to the surrounding Virginia and Maryland areas allowing people to commute

easily to work every day. WMATA utilizes flexible fares in which the price of the trip is determined by the length of the journey. The bus system is also quite expansive covering 325 routes and over 11,500 bus stops to provide consistent, quality service to areas that do not have easy or immediate access to the rail network (Maryland.gov, 2019).

Age, History, Grid and Cars. Compared to capital cities in other countries, Washington D.C. is relatively young given that it was established in 1790. The city was planned by the visionary Pierre Charles L'Enfant who sought to build the city on a grid with grand boulevards converging and diverging from various circular intersections (Destination DC, n.d. b). Although this was not the initial intention, this design lent itself well when streetcars and automobiles starting growing in popularity as the large roads easily accommodated the new machines. Today, the city still boasts expansive boulevards and ornate intersections but the design is inclusive of vehicular lanes, bike lanes, and plenty of large sidewalks for pedestrians.

Case 3: Houston, Texas, United States of America

Houston is a major city in the eastern part of Texas that serves as an important aerospace and medical center in the United States (The Editors of Encyclopedia Britanica, 2023). The city has a population of roughly 2.3 million making it one of the largest cities in the United States (USA Census Bureau, 2020). Although Houston has been characterized as a pleasurable place to live especially for those seeking a culturally rich and diverse city (Perrottet, 2013), the city has been criticized for its car-centric design. Walk Score assigns Houston scores of 47/100 for walkability, 36/100 for transit, and 49/100 for bikeability (Redfin, n.d.).

Zoning. Interestingly enough, although it is an urban metropolis, "The City of Houston does not have zoning, but [instead] development is governed by ordinance codes that address how property can be subdivided" (City of Houston Department of Planning & Development, 2023, para. 1). This doesn't mean anything can be built anywhere, the city, "regulate[s] a myriad of land use issues such as density, buffering, lot size, and historic preservation" (Zoning Research Group, 2019, para. 1). Additionally, in the absence of traditional zoning, deed restrictions or, "written agreements that restrict, or limit, the use or activities that may take place on property in a subdivision" (City of Houston Department of Planning & Development n.d., para. 1), control land use. This practice of utilizing deed restrictions to "zone" the city can leave some areas perpetually locked especially when many deed restrictions automatically renew (City of Houston Department of Planning & Development n.d.).

Public Transportation. Similar to Washington D.C., the city of Houston has one transit agency to oversee its public transportation system, the Metropolitan Transit Authority of Harris County, also known as METRO. METRO has established three major transit networks in the region consisting of light rail, local bus, and the park and ride commuter bus. The light rail network is composed of 3 lines, 41 stations, and covers a total a distance of 36.53km (METRO, 2012; METRO n.d. b). As shown in Figure 2, light rail coverage is centered around downtown Houston with the Red Line extending further beyond. The largest and most utilized portion of the METRO transit network however, is the local and park and ride bus lines (METRO, 2019). The local bus operates 81 lines extending all over the city while the park and ride service operates 19 lines for commuters outside interstate 610 (METRO n.d. a; METRO n.d. c).

Age, History, Grid and Cars. Houston, Texas is relatively new city. The city got its start as a shipping and rail port during the 1800s but upon discovery of oil in 1901 the city expanded rapidly (The Editors of Encyclopedia Britanica, 2023). WWII further developed Houston's industrial sectors and eventually the National Aeronautics and Space Administration (NASA) established a major presence in the city (The Editors of Encyclopedia Britanica, 2023). The city's massive post-war growth combined with abundant oil led the city to favor the car and design/redesign the environment around it. Today Houston is composed of a strict grid surrounded and cut by a multitude of interstates and highways (See Figure 4).

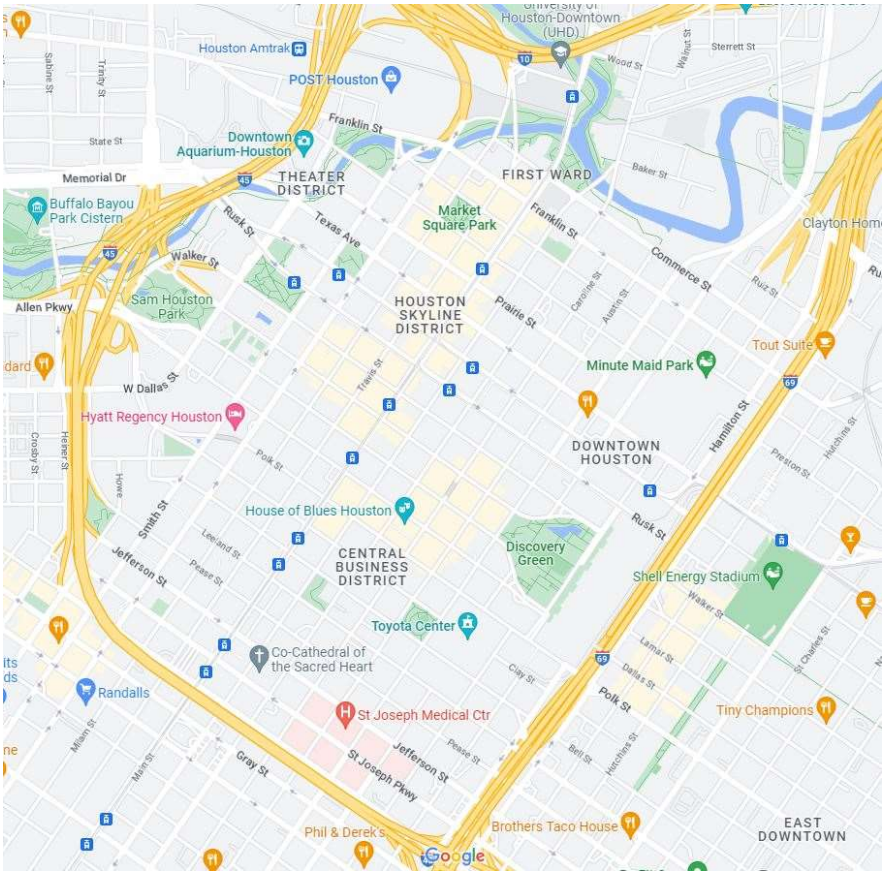

Figure 4. Map of Downton Houston, Texas. *Note.* Map of Houston showcasing car-centric design via strict grid like pattern of city streets and significant presence of highways/interstates (Google Maps, 2023).

Case Comparison

As previously established both Tokyo and Washington D.C. are considered walkable cities while Houston is not. Utilizing Walk Score as a general rating, Tokyo scores the highest in terms of walkability at 95/100 followed by Washington D.C. at 77/100 and Houston at 47/100 (Redfin, n.d.). By cross examining each city against one another, it can be determined to what extent zoning, public transit, age, history, grid structure, and automobile integration has on a city's walkability.

Zoning. The defining characteristic of Tokyo's zoning policy is that every zoning category, except exclusive industrial zones, is capable of housing residents and small stores. This effectively turns almost the entire city of Tokyo into mixed-use, specifically 93% (See Table 1). Tokyo residents can purchase land and/or live almost anywhere they would like and will most likely continue to have access to nearby small stores to fulfill daily needs. Compared to Washington D.C. which still utilizes exclusive single-family residential zoning for 22.5% of the city (See Table 2) Japanese zoning is ahead. Interestingly, due to the fact that Houston has no official zoning laws technically the entire city can be mixed-use. However, the prevalence of deed restrictions on many properties prevents this from occurring and instead puts the city in a similar position to Washington D.C. since "A primary purpose of most deed restrictions is preserving the residential character of a subdivision by keeping out commercial and industrial facilities" (City of Houston Department of Planning & Development n.d., para. 2).

Public Transportation. By far Tokyo has the superior public transportation network compared to Washington D.C. and Houston. As shown in Table 3, Tokyo exceeds both Washington D.C. and Houston in almost every public transit metric except the number of bus routes. This vast public transportation network contributes to the walkability of Tokyo in two ways. One is by establishing train stations in many parts of the city which act as focal points in a neighborhood concentrating residential and commercial entities into a walkable distance. Two is by providing a cheap, easy method of travel that allows residents around train stations access to other parts of the city that have goods or services that are not available in their immediate vicinity ("home train station"). Drawing from firsthand experience living in Navy Yard, Washington D.C. without a car, WMATA's Metro system can also improve walkability in a similar method as long as the zoning areas around the metro station permit concentrated development. Regarding Houston's public transit system, the light rail system most likely improves walkability in the same method as previously mentioned however, the bus system is different. Due to the nature of the bus being a non-static public transportation element and having much more stops than that of a rail system, it cannot benefit in the same way. Residential and commercial development around a bus stop is not enough for most things to be within walking distance of a nearby residence. The bus system can somewhat alleviate this by providing access to areas that have the desired goods and services unavailable in an initial area but it is not as efficient or effective as rail.

Table 3. Transit Data Across Three Case Studies. *Note.* Various metrics on transit in Tokyo, Washington D.C., and Houston (Ikezoe, Kiriyama, & Fujimura, 2021; Maryland.gov, 2019; METRO, 2019, 2012, n.d. a, n.d. b, n.d. c; TMG Bureau of Transportation, 2018; Toei Transportation, n.d. b; Tokyo Metro Ad Agency, n.d.; Vanderbilt, 2019).

Metric	Tokyo	Washington D.C.	Houston
Average Daily Ridership (Subway/Rail)	10,840,000	626,000	60,621
Length of Rail/Subway Network (km)	304	190	37
Number of Rail/Subway Stations	285	91	41
Average Daily Ridership (Bus)	634,880	350,000	221,777
Number of Bus Routes	129	325	100
Percent of Households with a Vehicle	32%	62.7%	91.9%

Age, History, Grid and Cars. The grid structure of a city does not affect the walkability of the environment significantly. Both Washington D.C. and Houston utilize a rectangular grid structure as the basis for their cities but Washington D.C. is more walkable than Houston. Furthermore, other cities such as New York City utilize a rectangular grid and still receive a high Walk Score (88/100) (Redfin, n.d.). What certainly affects the walkability of a city is its age, history, and relationship with the automobile. In the case of Washington D.C., the city was designed before the popularization of the car and merely accommodated it. In the case of Tokyo, the post-war environment, economic ruin, and lack of natural resources needed for a car-centric city led Japan to shy away from automobiles. Both of these are reflected in Table 3, specifically "Percent of Households with a Vehicle". On the other hand, Houston, Texas grew with the car in mind. The post-war economy and abundance of oil fueled the decision to develop a car centric city and neglect walkability. Even Houston's public transit system is the product of its

relationship with the automobile since bus service and ridership is much higher than their light rail network due to the abundance of vehicular infrastructure.

DISCUSSION

Following this case study analysis, the values that the planners, policymakers, designers and engineers imparted into these three cities is clear. For Houston, the values that compose the city are that of individualism and opportunity. Throughout its relatively short history, the city has pivoted numerous times from industry to industry. The countless interstates, highways, and streets that streak across the city are representative of this as each path leads to new and different opportunities encouraging people to seek out who they are and what they want to do.

For Tokyo, Japan the values imparted into the technologies that make up the city are that of resilience and collectivism. Following the war, leaders came to the realization that for the country to recover, it needed to move fast and with the support of the people. Tokyo is the culmination of their work. The city was rebuilt quickly with little concern for a standard rectangular grid structure, and instead of following suit in the shift to individualistic automobiles, Tokyo opted for a collectivist public transportation system to unite people in the rebuilding effort. Today the city continues to exude these values to its residents who are quick, efficient, and supportive of one another.

For Washington, D.C. grandiose, caution, and liberty were the values gifted by planner Pierre Charles L'Enfant. The city's architecture assimilates the grandiose of the European cities from which the Founding Fathers originated, encouraging residents to hold themselves high and with grace. The carefully laid out grid reminds those in office of the powers that they possess and encourages them to act with caution when making decisions for the nation. Lastly, the grand

boulevards call people to commune together as equals and protest when unsatisfied as it is their right to exercise this liberty.

Limitations and Future Work

The major limitation of the research presented in this paper are that of uniform applicability. Given the number and complexity of cities around the world, a one size fits all approach, utilizing the identified best practices will not be effective. One cannot simply ask tax payers to hand over their land and capital to redesign a city from scratch. Instead, the best practices for walkability should be considered more as a guideline for city planners to keep in mind while they design new cities or modify existing ones. Future research on walkability should expand on this seeking to identity additional best practices perhaps on a city-by-city basis. Additionally, working with local officials to understand the role of culture and geographical identity is important and not covered in this paper.

CONCLUSION

As the focal points for culture, technology, and opportunity, it is important that cities continue to evolve to meet the demands of society. With walkability continuing to gain support from the general public, it will be up to designers, engineers, and policymakers to lead and implement change to meet this demand. The solutions they come up with might be similar in nature but must be tailored to fit each individual city. When implementing these solutions however, they must be cognizant of the mistakes made by their predecessors, and chose to imbue values that foster equity into their technologies. There is no doubt that these leaders certainly have a difficult road ahead in improving walkability, but by conducting research, considering multiple solutions, and listening to their constituents, they will be successful in creating better cities of tomorrow.

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