Reimagining Streets through the Autonomous Car
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Autonomous Cars as a Key Element in Reclaiming the Street Space

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abstract
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ABSTRACT

The widespread adoption of autonomous cars has the potential to revolutionize urban transportation, but what impact will it have on urban form? This thesis examines the hypothesis that adopting autonomous cars can transform street space into a more human-centric purpose, leading to more livable and sustainable cities. The research was conducted through a literature review, analysis of case studies, and the development of specific street designs in order to reveal possible scenarios.

The literature review suggests that adopting autonomous cars can reduce the need for parking and increase the efficiency of transportation. Furthermore, the rise of shared cars is expected to revolutionize the way people move. With the advent of autonomous cars, it is possible that personal cars will become less necessary as people can rely on these constant-moving vehicles for transportation. These changes will impact our cities creating new opportunities to improve the urban space.

The thesis explores these challenges and opportunities through design for the actual urban environment of Washington D.C. As the capital of the United States, the country where cars have significantly shaped its cities, it is also home to influential political and policy-makers. As a result, the city offers a good opportunity to rethink the future urban environment when this technology will be widely adopted.

The findings of this thesis suggest that the adoption of autonomous cars has the potential to transform urban form reclaiming street space for people, but also requires careful planning and design to ensure that the benefits are distributed equitably and the negative impacts are minimized. The thesis concludes with four street proposals, each performing a different role in the city, and the results provoke a reflection of the role of the street in our cities.

Keywords: autonomous cars, urban form, livable cities, sustainable cities, shared cars, transportation, parking, urban space, street design, Washington D.C.
audience abstract
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GENERAL AUDIENCE ABSTRACT
The widespread use of self-driving cars can potentially transform how we live in cities. This new technology could lead to a more human-centered urban environment, where streets are designed for people rather than cars. The use of self-driving cars could also reduce the need for parking and improve the efficiency of transportation. However, this transformation requires careful planning and design to ensure that the benefits are distributed fairly and that negative impacts are minimized.

A recent study looked at the potential impact of self-driving cars in Washington D.C., and suggests that the adoption of this technology could transform urban form and make cities more livable and sustainable. The study concludes with several street design proposals that could help shape the future of our cities.

The findings of this thesis suggest that the adoption of autonomous cars has the potential to transform urban form reclaiming street space for people, it concludes with street proposals, each performing a different role in the city.
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I would like to begin by expressing my heartfelt gratitude to my wife, Agustina, for her unwavering support, love, and patience throughout my academic journey. Her belief in me, encouragement, and sacrifices have been the foundation of my success. This thesis would not have been possible without her constant presence and understanding.

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introduction
This thesis begins with research focused on the innovation of transportation technology as the key to re-thinking the urban environment, more specifically streets (chapters 1 to 3). The second part is an existing analysis of the urban reality considering the street as a principal element (chapters 4 to 8), and the third part is the design approach of four types of streets and how transportation technology can be a solution to develop a human-centric design (chapters 9 to 13).

In the first chapter, background, I show that the idea to have self-driving cars everywhere in cities is not just utopian in 2023, because automobile technology has made big steps in reaching the auto-mobility in the last 5-10 years. The impact of this technology in our urban environment could be huge, and the goal of this thesis is to explore these new variables. Furthermore, I will explain how the automobile industry has been shaping our cities in the last century and the consequences in the city. As in the past, important car industry events promoted car-dependent cities, and in this thesis, I try to propose solutions where the human is in the center and the car is in second place.

In the next chapter, I reflect on the role of streets and how this element could be the key to improving the quality of our cities. The street has many purposes to serve human lives but most of this space is designated to carry cars. With autonomous car technology, this aspect could be reduced and the role of the street could be mutated.

In the second part, design, I start with the current condition of the urban environment. The thesis analyses Washington D.C. to show different realities and characteristics. Moreover, the capital of one of the most car-dependency countries of the world is an accurate case study to explore different concepts and thoughts.

The next chapter will explain each type of street with their uses and users to understand current proposes and aspects that the design should consider to reach an efficient result.

The last chapter in the design part is the design itself. Each type of street focused on human-centric design as a reality and is demonstrated through four design proposals.

The last part of the thesis is the conclusion where the role of the street is not just a connection. It could be more than a space to carry cars which is the goal of this chapter.
terms
Autonomous cars: Vehicles equipped with advanced technology that can operate and navigate without direct human intervention.

Self-drive cars: Automobiles that have the capability to operate and navigate on their own, without human control or input.

Auto Pilot: A system in vehicles that can automatically control certain aspects of driving, such as steering, acceleration, and braking.

LIDAR: Light Detection and Ranging, is a remote sensing technology that uses laser beams to measure distances and create detailed 3D maps of the surrounding environment.

Futurama: Referring to the exhibit at the New York World's Fair in 1939 and 1964-65 called "Futurama," showcased a visionary display of the future, featuring urban planning and transportation concepts ahead of its time.

Car dependency: Reliance or dependence on personal automobiles for transportation, often resulting in diminished use of alternative modes of transportation.

General Motors: A major American automotive corporation that designs, manufactures, and sells a wide range of vehicles globally.

Tesla: An electric vehicle (EV) manufacturer known for producing innovative and high-performance electric cars.

Leon Batista Alberti: An Italian Renaissance architect and polymath who made significant contributions to various fields, including architecture, urbanism, and art theory.

NACTO: National Association of City Transportation Officials
background
Transportation shapes cities

The relationship between transportation and cities spans history, and it is essential to recognize the role of transportation and mobility as key drivers in the development and location of cities. From ancient water routes to modern automobile-dominated landscapes, different modes of transportation have profoundly shaped cities. This chapter explores the historical significance of automobile transportation in city formation and highlights how the automobile has contributed to the spatial configuration and public realm roles within urban areas.

Transportation and mobility have consistently played crucial roles in the growth and placement of cities. The existence of water routes greatly influenced the establishment of old European cities, enabling commercialization and trade along navigable channels. Additionally, cities were often settled at strategic distances from one another, allowing horse-drawn carriages to reach them within a day. Moreover, the presence of train stations served as focal points for the creation and expansion of new urban centers. These examples underscore transportation’s fundamental role in shaping the development and expansion of cities.

Transportation not only contributes to the genesis of cities but also significantly molds the urban landscape and defines public space roles. The arrival of horse-drawn carriages in cities had a tremendous impact on street design, leading to the designation of central areas for carriages and the emergence of sidewalks for pedestrians, trains brought about another transformative shift, reorganizing cities to accommodate new commercial focuses and necessitating adaptations in urban functions and land use. Bicycles, although exerting a comparatively minor impact, have been influenced by promoting smoother surfaces and dedicated clearance areas for cycling. It becomes evident that different transportation modes shape cities by reshaping their physical layout and influencing the utilization of public space.

Of all transportation technologies, the automobile stands out as the most influential force in shaping contemporary cities, particularly in the context of American urban development throughout the last century. The widespread adoption of automobiles has left an indelible imprint on urban planning, land use, and transportation infrastructure.

Historic Shifts: The Influence of Automobiles on Urban Development

The invention of the automobile is considered when Benz Patent-Motorwagen, the first proper car, was created in 1886. Carl Benz built an entirely new vehicle around an internal combustion engine and used bicycle parts to do it. In 1908, Henry Ford introduced the Ford Model T, and it was very popular in North America. After this popular car invention, the car became widespread. The insertion of this new transportation in cities was abrupt, in the 1920s all Americans desired to have a car to move.

The big problem with this new technology in cities was pedestrian safety and congestion. These two aspects worried three big stakeholders, the government, car developers, and gas companies. Cities were unwelcoming environments for drivers, parking was scarce and the speed limit was low. The consequences were not attractive for potential car users. It is for that reason that automobile companies organized auto clubs in order to influence the government to improve driving conditions.

The widespread of the automobile was fast and car developers started to think about how they can continue selling cars if the demand was satisfied as the long duration of automobiles was a reality. It is there when General Motors decided to redesign each model every year, it induced each consumer to return to the showroom sooner. This technique was known as “Keep the Consumer Dissatisfied” by Charles Kettering in 1929. The marketing campaign was very successful and the automobile sales grew more and generated more popularity.

When cars were everywhere, automobiles and gas companies had huge power in the United States, but the cities are not the best ones for this individual combustion transportation. It is in 1939 when General Motors and Shell gas company developed the first New York fair called “Futurama I - World of Tomorrow”. The popularity of this fair was unbelievable, thousands of visitors every day, and the general feeling was that they were looking to the future. In this fair, the goal was to show how could be the future of cities where freeways permit high-speed and free congestion, at the same time safety for pedestrians. The proposal showed the use of highways as a solution reshaping the idea of a compact city.
It is during this period when suburban areas started to be more popular in the United States as the use of cars and highways was a solution to live outside the cities and have the opportunity to commute easily. Living in suburbs for Americans was really attractive as the desire to have your individual house with a front and back yard and at the same time have the possibility to drive to their jobs easily was enough to promote this new area.

Some years after the first fair in New York, in 1964 General Motors and Shell joined again in order to produce **Futura II**. The highways were a reality at that moment but some issues existed yet. The new slogan for this fair was “The City of Tomorrow” where they showed electronic highways guaranteed collision-free, congestion-free, and drive anywhere. This transportation infrastructure needed the support of a new participant and it is the Radio Corporation of America (RCA) where the purpose should give some instructions via radio to the drivers. We can consider the beginning of the current way that Google Maps, Waze, or Apple Maps among us organize the best route for us. It is in Futurama II that the desire to develop more highways in the United States was confirmed and consoled.

Another important event to add to this brief story of cars and the urban environment was **Demo 97’** where the Congress of the United States promoted a program to improve the car capacity on highways. The result was successful as with the use of magnets and radio transmissions controlled by automated breaks and accelerators, they should increase the capacity of highways between 2000 cars per hour to 6000 cars per hour. Another small step is to consolidate the automatization of cars. This project was dismissed with the spread of GPS as a tool for automobiles at the end of 20 century. GPS is a critical tool that allows for the possibility of autonomous cars operating.

The last important event that I would like to highlight is the Shanghai Expo in 2010 developed for General Motors and SAIC from Shanghai, China where they presented the predicted future of cities in 2030. At this fair, they showed the potentiality of autonomous vehicles everywhere. One sentence that could define this fair was “emission-free, accidents-free, congestion-free and at the same time fun. This new aspect appears with the automatization of drive action the idea to have fun inside an automobile.
In conclusion in this research, inspired by the visionary showcases of the Futurama fairs and the Shanghai Expo, the emphasis shifts from placing cars at the center stage to prioritizing the role of humans. Instead of envisioning scenarios solely focused on cars, this research explores the potential of a better future by placing humans at the forefront. The aim is to understand how advancements in transportation, including autonomous cars, can be harnessed to enhance human experiences, promote sustainability mobility, and foster more inclusive and livable cities.

(LEFT)
The futuristic model city showed freeways crossing through the cities.

Futurama I. Skyscrapers and roads diorama. (Richard Garrison / Wikimedia Commons)

(RIGHT)
The technology started to show solutions to urban issues in Futura II, where the automatization of freeways was the core of the fair.

Autonomous Cars

Looking ahead, through incremental advancements and taking small steps, the journey toward the automation of cars began, eventually leading to the development of what we now recognize as autonomous vehicles. But what technical aspects define an autonomous car?

An autonomous car incorporates a range of sophisticated technologies that work in tandem to enable self-driving capabilities. These technologies typically include advanced sensors such as LiDAR, radar, and cameras, which provide the car with a detailed understanding of its surroundings. Notably, Tesla has made significant strides in this field with its advanced reader environment developed for autonomous driving.

Additionally, autonomous cars utilize powerful onboard computers and artificial intelligence algorithms to process sensor data and make real-time decisions based on the environment.

Furthermore, autonomous vehicles often rely on high-precision mapping systems to navigate their surroundings accurately. These maps contain detailed information about the road network, traffic signs, and other crucial elements, aiding the car's decision-making process.

Moreover, communication technologies play a significant role in autonomous cars. Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication systems enable cars to exchange information with other vehicles and traffic infrastructure, enhancing safety and efficiency.

Autonomous cars trust on a combination of sensors, computing power, AI algorithms, mapping systems, and communication technologies. Tesla, for instance, has been at the forefront of pushing the boundaries with their advanced reader environment for autonomous driving.

In addition to Tesla’s advancements, other notable companies have made significant contributions to the development of autonomous vehicles. Waymo, a subsidiary of Google, stands out for its expertise in sensors, AI algorithms, and mapping systems. They have conducted extensive real-world testing, more than 1,000,000 miles, making substantial progress in bringing self-driving vehicles closer to widespread adoption. Today, you can use their service in Phoenix, Arizona, and Los Angeles.
Similarly, Uber, renowned for its ride-sharing platform, has heavily invested in autonomous vehicle technology. They have developed their own self-driving cars and actively tested them on public roads. Uber’s focus lies in integrating autonomous vehicles into their transportation network, envisioning a future where passengers can conveniently hail self-driving cars for their transportation needs. The main point developed for Uber is shared routes and choosing the most efficient route.

Tesla, Waymo, and Uber have played instrumental roles in pushing the boundaries of autonomous vehicle technology, contributing to its ongoing development and wider adoption.

References:

https://www.tesla.com/ (official website)

https://waymo.com/ (official website)


(Article Harvard University)
Light Detection and Ranging (LIDAR)

Two 360-degree sensors use light beams (millions of laser pulses per second) to determine the distance between the sensor and other objects. LIDAR measures the time it takes for light to reflect off a surface and return. There are three main types of LIDAR for AVs: short, mid and long range. These sensors together provide a surrounding view of their environment to process the objects and events immediately in front or further afield.

Ultrasonic Sensors

Vehicle-mounted sensors provide information about nearby objects. This data is typically used in parking assistance and backup warning systems.

Infrared Sensors

Infrared sensors detect lane markings, pedestrians, bicyclists, and objects that other sensors can find difficult to identify in low light and certain environmental conditions.

Reimagining Streets through the Autonomous Car
NACTO. “Blueprint for autonomous urbanism”. How Autonomous vehicles work.
the role of the street
As I mentioned earlier, the primary function of streets is currently focused on transportation, prioritizing efficient vehicle movement. It is the result of several years of working on moving vehicles and prioritizing this function. However, in this research, I aim to delve deeper and explore various layers to encompass a broader scope of investigation.

Traditionally, the emphasis has been placed on optimizing streets solely for efficient transportation by accommodating cars. Unfortunately, other essential aspects of streets tend to be overlooked or neglected.

By considering multiple dimensions and perspectives, this research strives to produce a comprehensive understanding of streets beyond their transportation role. The intention is to uncover additional layers of significance that contribute to the holistic nature of streets and their impact on communities.

**Mobility**

The initial aspect I want to explore regarding the role of streets in cities pertains to their substantial contribution as the primary component of public space. By examining figure-ground maps of American cities, mostly downtown areas, it becomes evident that streets constitute the most prominent public infrastructure. This observation prompts the need to reconsider the utilization and role of streets within our urban environments, primarily focusing on the allocated space. This space is mostly designated for transportation, that is cars.

**Vibrancy**

The community and social value in cities are important aspects that human beings look for in an urban environment, it is for that reason that public space should provide this opportunity to connect with people in the city like plazas, parks, and community yards.

During and after the pandemic time, many people in the United States chose to leave the city to move out to the suburbs, promoting more sprawl in cities, due to the availability to work remotely from home without transportation necessities. This phenomenon has many negative consequences for the environment and it is important to try to keep compact cities.

Following this line, trying to promote the use of cities to live, many cities government are working in Downtown areas trying to attract people again to the city. These efforts have
different edges: on one hand, re-thinking the use of office buildings as most of this space is empty, and on the other hand, improving urban infrastructure to create better public attractions.

**Symbolism**

Streets transcend their physical boundaries as mere spaces between buildings; they hold significant meaning and serve as integral components of something much larger. An exemplary illustration of this concept is Pennsylvania Avenue NW in Washington D.C. This iconic street represents far more than the area it occupies. It stands as a symbol of freedom for the entire nation, having witnessed historic moments such as presidential inaugurations and being the site of influential Afro-American protests during the 1950s, for example. Pennsylvania Avenue's historical significance and its role as a conduit for important events make it a poignant embodiment of the broader societal fabric.

**Ornament**

Another point of view about street roles is ornamentation. In recent years, the ornamental significance of streets in the United States has been overlooked, as the emphasis on efficient transportation has taken precedence over their aesthetic value. The beauty of streets has been disregarded in the pursuit of promoting transportation efficiency. Today, street design is predominantly governed by standardized regulations that fail to consider beauty as a fundamental aspect. Furthermore, the standardization of streets views the individualization of street aesthetics as conflicting with the goal of city development, thereby neglecting the importance of embracing and celebrating their unique characteristics.

The first argument to consider ornamentation vital: the ornament enhances the aesthetic appeal of streetscapes, making them visually engaging and inviting. Ornamental elements such as decorative facades, intricate detailing, public art, and landscaping can create a sense of beauty and charm. This, in turn, contributes to the overall character and identity of a city or neighborhood, fostering a sense of pride among residents and attracting visitors.

Secondly, ornamentation in streets can have a positive impact on the psychological and emotional well-being of people. Furthermore, the role of ornament in streets can foster a sense
of community and social interaction. Ornate streetscapes provide opportunities for people to gather, meet, and engage in various activities.

Leon Battista Alberti, the Italian Renaissance architect, believed that streets should serve as elements of ornamentation within cities. According to Alberti, streets were not merely functional spaces for transportation, but an essential component of urban design and aesthetics. He emphasized that streets should be visually appealing, harmoniously integrated with the surrounding architecture, and contribute to the overall beauty and splendor of the city. For Alberti, streets were meant to evoke a sense of delight and admiration among inhabitants and visitors alike. By promoting the ornamentation of streets, Alberti aimed to elevate the urban experience, creating a sense of civic pride and cultural identity. He believed that well-designed streetscapes could contribute to the overall well-being and happiness of the city’s inhabitants.


Attractor

After the pandemic, many downtown areas have become empty and desolate, leading to various issues. One main reason is the availability of remote work, which allows people to work from home instead of going to the office. Another factor is the fear of COVID-19, which has made people reluctant to use public transportation, resulting in increased traffic congestion as more people opt for personal cars. Additionally, the lack of mixed-use development in downtown areas, with an emphasis on office buildings rather than housing, needs to be reconsidered to adapt to the changing circumstances.

Considering these factors, the role of the streets becomes crucial in reimagining the future of cities with a focus on the well-being and happiness of its users. Streets, being the largest public spaces in cities, should contribute to creating a sense of community and identity. Governments should prioritize combating urban sprawl as a key element in urban planning to address these challenges.
principles of future urbanism
Move people not cars

Considering that there is too much space designated for vehicles in our cities, the first aspect that we should re-think is how could we use this space in a better way.

The first aspect could be prioritization of the use of alternative transportation as more sustainable. This is the current way that urbanism is working in the last decades, the use of mass transportation instead of individual cars or promoting the use of bikes to commute.

According to the manual “Blueprint for Autonomous Urbanism” (second edition) by the National Association of City Transportation Officials (NACTO) to move 10,000 people in an hour we need:

- One sidewalk of 12-15’
- One protected bike lane of 12-15’
- Two bus-only lanes (around 23’)
- 13 cars conventional arterial lanes

To prioritize efficient space utilization and prioritize the movement of people over cars, the current/future transportation organization should adhere to the following tiers:

- Pedestrians
- Cyclist and scooters users
- Massive transport users
- Autonomous vehicles users
- Deliveries vehicles (users/autonomous)

From Car Ownership to Subscription-based Mobility

The transportation system could undergo significant changes with the widespread adoption of autonomous vehicles. One plausible scenario entails the replacement of private, individually-owned cars with shared vehicles facilitated by subscription services. This potential transformation fundamentally alters the way Americans navigate their streets, as the concept of cars shifts from being products to services. Based on my research, it is feasible that within a few
years, individuals may opt to forgo purchasing their own cars and instead subscribe to autonomous vehicles through a mobile application similar to hailing a ride-share. The impact of this new-based mobility will be huge in our cities as we can consider that most parking space designated for cars will not be necessary, garage parking buildings could be transformed, off-street parking spots could be used for other uses, and furthermore, garages in homes will be available space.

Enhanced Pedestrian Safety

The widespread adoption of autonomous cars will increase pedestrian safety notably, an aspect really important to promote living in urban areas. According to researchers autonomous cars with their advanced sensors, cameras, and algorithms, autonomous vehicles can detect and respond to pedestrians more accurately and quickly than human drivers. They can anticipate and react to potential risks, such as jaywalking or sudden movements by pedestrians, helping to prevent accidents. Furthermore, autonomous cars are designed to strictly adhere to traffic laws, reducing the likelihood of speeding or reckless driving behaviors that can endanger pedestrians.

NACTO guidelines for autonomous urbanism explain that Federal and State governments adopt objective and verifiable safety performance tests that set a high-performance bar that protects all right-of-way users, including those in urban areas. Autonomous vehicles, programmed to travel at 25 mph or less depending on the street context, dictate the speed of traffic for all motorized vehicles, reducing the overall speed on urban streets and, as a result, reducing the frequency and severity of crashes.

The consequences in an urban environment could be enormous as the effort to cohabitate with cars and people in the same environment has been enormous in the last century. We can imagine hiding the differentiation between streets and sidewalks or re-think the street intersection promoting walkability among other solutions.
Data-driven decisions

The significance of data as a powerful tool in today's world cannot be overstated. Real-time data, made possible by the invention of the cell phone, play a crucial role in understanding the present and anticipating the future. The recent advancements in internet technology have further amplified the importance of data, enabling powerful multiprocessors to integrate vast amounts of information simultaneously and provide accurate analysis. This significant progress in data processing has paved the way for the potential of autonomous vehicles to effectively reduce urban street space.

One aspect contributing to the utility of autonomous vehicles is the utilization of GPS technology, which enables them to determine the optimal routes to their destinations. This capability becomes particularly evident when using map applications that are connected to real-time traffic conditions.

Another aspect of autonomous car systems is their ability to facilitate shared rides, thereby reducing the reliance on individual cars for transportation. By integrating and combining multiple users' trips, autonomous vehicles can serve as a valuable tool for decreasing the number of cars in urban environments.

A noteworthy aspect deserving attention is the utilization of LIDAR sensors and connectivity, which can significantly enhance route efficiency. Through vehicle-to-vehicle communication and considering multiple factors, such as distance between cars, informed decisions can be made. An illustrative example is Demo 97', which employed magnetism to control car spacing and resulted in a threefold increase in the number of cars accommodated. Similarly, leveraging LIDAR sensors and connectivity has the potential to yield comparable outcomes, optimizing street capacities and reducing the required space to transport the same number of people.
PART II
Washington D.C. as a case study
The widespread adoption of autonomous cars has the potential to revolutionize urban transportation, but what impact will it have on urban form? Why chose the urban environment of Washington D.C. valuable?

Washington D.C. is the capital city of the United States, it is home to some of the most influential political and policy-making institutions in the world. Moreover, the United States has a long history with cars and could be considered the most car-dependent country in the world, with its cities having been designed around automobile use for the past century. By examining the urban design and transportation infrastructure of Washington D.C., we can gain valuable insights into the challenges and opportunities of designing a sustainable urban environment in a car-oriented society.

Secondly, Washington D.C. is a diverse city with a significant population of diplomats and foreign nationals, making it an ideal location for exchanging ideas and best practices in urban development. Lessons learned from the city’s experiences can be applied to communities around the world to promote more effective and sustainable urban development practices.

Thirdly, for the last two years as a resident of the Washington D.C. region, I have had a personal perspective on the city and its urban environment. Living in the heart of the nation’s capital provides a unique opportunity to witness the intersection of transportation, urban planning, and policy decisions firsthand. By experiencing the daily challenges and advantages of navigating the city’s streets and infrastructure, I can offer insights and observations that contribute to the broader discussion on the impact of autonomous cars on urban form. This personal connection allows me to understand the specific needs and dynamics of Washington D.C., offering a valuable perspective on how autonomous vehicles can potentially shape and enhance the urban landscape.
To conduct in-depth research encompassing various aspects of an urban environment, I have selected four specific streets as focal points to explore potential future scenarios. By examining these streets, I aim to delve into a range of factors and variables that influence urban development, transportation, and overall livability.

**Street Brief Description**

**Symbolic Street: Pennsylvania Avenue NW**

This street is characterized to attend several propose in their space, it is a traditional street most of the time but in a special event, the street mutates to receive this new purpose. The important events for the Nation are festivals, parades, protests, and ceremonies.

**Transit street: K Street NW**

The main purpose of this street is to permit efficient transportation through the city, it is an important arterial for the whole north area of Washington D.C.

**Downtown street: 7th Street, NW**

7 Street Downtown is a typical street with 5-6 car lines, narrow sidewalks, and medium-scale buildings. The building height in this area is around 90-110 ft.

**Neighborhood street: Corcoran Street NW**

This street is a conventional American urban neighborhood with row houses and narrow sidewalks.
Symbolic Street: Pennsylvania Avenue NW
Transit street: K Street NW
Downtown-type street: 7th Street
Neighborhood-type street: Corcoran Street
human-centric mobility
The primary role of these current streets is transportation and I would like to highlight the space designated for automobiles instead of people. In this simple diagram, it becomes evident how cars have overwhelmingly dominated the landscape, necessitating individuals to adjust to this prevailing condition.

The prioritization of vehicles over people has become commonplace in our cities. The evidence is apparent in these four examples, where the allocated space for cars consistently surpasses that for humans. The most extreme case is observed in the transit street (K Street), where a staggering 73% of the total space is dedicated to accommodating vehicles. In the multi-use and neighborhood streets, the space designated is balanced but the impact is huge too as it is a lot of impervious space.

This variable should change in order to prioritize again people through cars. As mentioned previously in the chapter “Principle for a future urbanism”, the new mobility organization should be reflected in these four types of streets.
vibrancy and symbolism
In this second analysis, I would like to explore the concept of alternative uses for streets, highlighting how certain thoroughfares can serve as dynamic spaces beyond their traditional roles. A prime example of this is Pennsylvania Avenue, a street that actively participates in numerous events throughout the year. From parades and festivals to rallies and public gatherings, Pennsylvania Avenue transforms into a vibrant stage that engages and captivates both residents and visitors. This versatility and adaptability demonstrate the potential of streets to evolve beyond mere transportation corridors and become vibrant hubs of community interaction.

Reimagining Streets through the Autonomous Car
ornament
According to the previous analysis presented in the "Role of the Street" chapter, the street as an ornament plays a vital role in creating the identity of a city or neighborhood. Additionally, it contributes to the psychological and emotional well-being of people, serving as an essential component of urban design and aesthetics that enhances the overall quality of life for the city’s inhabitants.

Washington D.C. showcases a distinct aesthetic imprint, particularly in its downtown area. However, the prevalence of long and white facades can sometimes result in monotony in the perception of pedestrians. It is important to acknowledge that the presence of grand federal government buildings creates a beautiful harmony in the city and it can lead to a lack of vibrancy and interaction between residents and these monumental structures.

The scale of the city, to some extent, can be overwhelming for human beings. From the rationality of the city’s layout to the towering scale of its buildings, walking through the city may not always be a pleasurable experience.

In light of these observations, it becomes apparent that the street holds the potential to address the mentioned shortcomings and bring vitality to the city. By reimagining and redesigning the streetscapes, incorporating elements of ornamentation, vibrant public spaces, and opportunities for social interaction, cities can create a more engaging and dynamic environment. The street, when thoughtfully designed and adorned, has the power to not only enhance the aesthetic appeal but also foster a sense of community, encourage pedestrian activity, and contribute to the overall livability of the city.
attractor
Street as an attractor is a role that I explore in this research. It is important to say that the principal purpose of current streets is transportation. But if we contemplate the street space as a public building, like Alberti, we can use this huge area to create a better urban environment and generate the desire to live in the city. I explain this aspect using a comparison, between Washington D.C., and Barcelona, Spain. The European city is considered one of the best cities to live in according to several types of research and at the same time, it is well ahead in the field of sustainability.

Starting with similarities, both cities have a rational layout and diagonals to connect important points. In terms of street width, both have wider avenues (120-160ft), and the width of the street regulates the height of the building. Both cities have height restrictions, Barcelona defines areas to control height but the church “Sagrada Familia” is the important element that controls most of the high city. In Washington D.C. is similar, the 1894 Hotel Cairo in Dupont Circle became the highest building in D.C., after the Capitol and Washington Monument, and was the impetus for the Height Act to control building height. In general terms, Barcelona and Downtown Washington D.C. are formed mostly with buildings between nine to eleven levels. We can consider that both have the same space available.

Considering that both cities have the same available space, it is important to highlight some differences between them. According to a report commissioned by the Federal government, Barcelona exhibits a predominately mixed-use character, while downtown D.C. is primarily focused on office spaces. In recent years, the government of Washington D.C. has been actively working on revising land use regulations to better align with the current conditions and enhance urban planning.

After the pandemic, office areas are mostly empty as the availability to work remotely increased dramatically. According to the Washington Post, downtown D.C. in February 2022 reached a record level of office vacancy in downtown, with 9.7 million square feet of vacant office space, and around 17% of office space available. If we consider that the rest of the space (83%) is occupied by hybrid workers, the real available space is enormous.
Another aspect of significance is the remarkable disparity in the variety and quality of urban infrastructure between Barcelona and Washington D.C. Barcelona is widely recognized for its vibrant and high-quality urban environment, boasting pedestrian-friendly streets (paseos), charming plazas, and bustling food markets that contribute to an exceptional quality of life. These urban features greatly enhance the overall appeal and liveliness of the city.

In conclusion, Barcelona has been prioritizing the user experience in the urban space, most streets, so that people choose to live in this city.

Barcelona serves as a remarkable case study from which we can glean valuable lessons and insights. The city's emphasis on prioritizing the user experience in its urban spaces, its mixed-use character, and its exceptional urban infrastructure all contribute to creating a vibrant and livable environment. Learning from Barcelona's successes, we can reimagine our urban landscapes to prioritize the well-being and satisfaction of our communities while creating dynamic and thriving cityscapes.
principles of future urbanism
+
new roles of the street
human-centric mobility
vibrancy and symbolism
ornament
attractor
Summer in La Rambla, Barcelona
https://www.internationaltraveller.com/europe/spain/barcelona/

Pennsylvania Avenue, Washington D.C.
Photograph by Robert Bartley | Aug 6, 2019
PART III
Street as Plaza
Symbolic street

The proposal for Pennsylvania Avenue is to consider the street as a plaza. The design considers establishing a big pedestrian area in the center with a magnificent view of the Capitol Dome surrounded by bike lanes, autonomous car lanes, and drop-off areas servicing the sidewalks.

The use of the central space come from the concept of re-enhancing pedestrian use in the area and at the same time responding to the needs that extraordinary events have.

Reimagining Streets through the Autonomous Car
Pennsylvania Avenue NW has a significant cultural value for Washington D.C. and the whole nation. On this street, the elected president does an inaugural parade to celebrate with citizens, among other important events. The street is surrounded by magnificent white buildings that create a kind of historical atmosphere, and the use of Greco-Roman style transports users to another era. The Capitol Dome is exalted at the end of this street, framing the magnificent view.

Symbolism plays a characteristic role on this street and is the beginning of the design proposal. The balance between these daily and extraordinary uses is important, and the new transportation technology, autonomous cars, holds the key to this design. Autonomous vehicles permit efficiently moving cars using fewer lanes and avoiding the use of off-street parking spots. This new urban framework allows the proposed street to function as a plaza.

The central area, known as the plaza, is 54 ft wide and made of gray stones and concrete perpendicular to the direction of the street, manifesting the idea of transitioning into this space. Through the center, visitors have the opportunity to walk, take pictures with the Capitol Dome behind them, and enjoy food trucks. The plaza pavement enlarges in the intersections to occupy the whole wide street and promote user access to the central space.

Furthermore, users can sit on benches under the shade produced by swamp magnolias planted in the stormwater collectors behind the seating area. Stormwater collectors are covered by mobile planters filled with shrubs, flowers, and gravel, creating eco-friendly spaces.

The design includes bike lanes on both sides of the plaza. With e-bikes and e-scooters, this mobility should be encouraged. These lanes are 12 ft wide and made of smooth rubber ground. In between the bike and automobile lanes, the design contemplates the use of 4 ft wide planters filled with gravel and tulip trees to beautify the street. Trees that enhance the beauty of cities will receive more attention in the future as autonomous car users can appreciate them during their trips, as the vehicles will move without our assistance.

To conclude the design description, the use of drop-off areas instead of off-street parking provides more sidewalk space for pedestrians. Between drop-off areas, the sidewalk is 20 ft wide, including seating areas. Pin Oaks are selected as the main species for the sidewalk space.
Reimagining Streets through the Autonomous Car
The existing street has eight lanes for vehicles and one center bike line protected. In this proposal the new conception of the street is a center pedestrian plaza, with two bike lanes next to the plaza extending the available space for events, and two free lanes for autonomous vehicles and drop-off areas designated for users and at the same time flexible for emergency vehicles.

The proposal contemplates the increase of tree canopy by more than 30% using three types of trees following a sectional pattern: a, tall for the outermost trees by the sidewalk (Pin Oak), ornamental tree between AV and bike lane (Tulip tree) and wet resistant tree for the stormwater area (Swamp Magnolia).

Users are diverse in this type of street as office workers may use the central area for lunch, others for commuting by foot or bike, and tourists visiting important sites. The level of the sidewalk and the street are the same in the intersections enlarging the idea of plaza to the total width and promoting the walkability on the city.

The materiality for this proposal is really important as the ceremonial use defines the hierarchy of the street. The proposed paving is stone and concrete. At the same time, the use of concrete in the vehicle area represents the importance of Pennsylvania Avenue for the city and nation. Mid-block crosswalks are designed in front of current entrances.

Stormwater from the large, central paved plaza drains into a stormwater channel between the plaza and bike line covered with move planters.
Street as Park
Transit street

The proposal for K Street is to create a linear park on the north side utilizing the most solar energy possible and at the same time promote sustainable mobilities through this area. The project considers wide lanes for cyclists or pedestrians and contains different spots to promote community interaction and the use of this park.
Reimagining Streets through the Autonomous Car
K Street serves as an important transportation artery for Washington D.C., connecting the east to the west of the urban area. This street has been a focus in recent years, as most of the surrounding buildings are offices, and the utility after the pandemic is low. The consequences are significant: the street is dominated primarily by cars, and few pedestrians or cyclists use it. The current condition is really bad for pedestrians and cyclists, with around 73% of the space designated for vehicles. The street is 107 ft wide, with just 20 ft wide sidewalks on each side.

Technological innovation in transportation allows the flow of vehicles in four free lanes instead of the eight lanes that actually exist. The antecedent Demo 97’ project demonstrated that connectivity improves the efficiency of space, increasing the flow of cars per hour on a freeway by three times. In this case, an urban street has other elements to be considered. It is reasonable to consider reducing the lanes needed to move connected autonomous vehicles by 50%, along with drop-off areas to avoid conflicts in the flow.

Mass transportation must be considered in this proposal, as K Street is responsible for moving a huge number of passengers daily. In this design, autonomous buses will use the outer lane of the street, directly connected to the sidewalk and the park. Creating an independent line for buses was a possibility, but the connectivity characteristic of autonomous vehicles will enable an efficient flow for massive transport, avoiding potential interference with individual cars.

Furthermore, promoting other types of transportation is key to this proposal, as the use of e-bicycles and e-scooters is growing in popularity. The linear park proposal includes a 16 ft wide bike lane and a similar width for a clearance sidewalk to promote pedestrian use.

The park includes resting areas for workers, dog parks, and playgrounds to promote the community value of this area. Using these attractions allows the design of the bike and pedestrian lanes to follow these spaces in a meandering manner, avoiding a boring path.

The vegetation in the park is of crucial value, and this street is no exception. The main idea is to improve the area of the canopy, reducing the urban temperature and helping to save energy in buildings. Diversity and native trees are other important aspects of this street as a park. Moreover, using permeable areas instead of impervious ones contributes to the environment.
Reimagining Streets through the Autonomous Car
Transit is the big challenge for this street, the existing K Street NW has eight vehicles lanes that in the proposal is replaced for a big lineal park with pedestrian and cyclist lanes and four free lanes for autonomous vehicles with their respective drop-off areas.

Both sides have clearance sidewalks with at least 12 ft to make commuting and walking easy.

The modification in vegetation/pervious area is important as the existing street has less than 5% and the proposal has around 30% of grass/gravel surfaces. The lineal park will include diversity of trees, shrubs and flowers promoting the ecology.

The use of attractors to promote the lineal park is the approach for this proposal. At the same time, sustainable mobilities like bikes, scooters and pedestrians are prioritizing.

The spirit of the design comes from the flow of automobiles with 45 degree angles used for drop-off areas. This detail represents the fact that automobiles shape our urban environment.
Street as Sidewalk
Downtown-type street

In relation to the proposal for 7th Street in downtown D.C., an exciting concept emerges: extending sidewalks to encompass off-street parking lots, considering the anticipated rise of autonomous vehicles utilizing designated drop-off areas. This forward-thinking approach aims to allocate additional space for pedestrians, thereby enhancing the vibrancy and appeal of the area for new users. To address potential conflicts between pedestrians and cyclists resulting from autonomous vehicle drop-offs on sidewalks, the proposal includes the implementation of a central bike lane.
Reimagining Streets through the Autonomous Car
7th Street NW in Washington D.C. is a typical downtown street, 80 ft wide, with buildings ranging from four to six levels, mostly office buildings, although some residential buildings also coexist. In this area, building height restrictions are related to the width of the street. Furthermore, it is worth highlighting that most of the sidewalks in downtown streets are less well-lit than in other urban situations.

This street offers many gastronomic options in the area and serves as an important attraction downtown. Some of the restaurants have tables outside on the sidewalk, although less planned. We can observe that restaurant owners organically attempt to change the use of urban space.

In this proposal, the main goal is to use the street as a sidewalk. Thanks to the automation of vehicles, the space designated for transit will consist of just one free line per direction and drop-off areas serving sidewalks.

The complexity of this design lies in avoiding conflicts between passengers who drop off and pick up from an autonomous vehicle and cyclists. The typical approach to designate a bike lane is to place it between the sidewalk and the street. However, in this case, the proposal allocates a 13 ft wide space for bicycles and scooters in the center of the street. This lane is designated for both directions and includes a 1 ft metal grid that assists cyclists in knowing when they are close to the street, serving as an indicator.

As previously mentioned, the expanded sidewalk is central to this proposal. Considering that autonomous vehicles will flow during the day and that we only need drop-off areas, most of the 60% of the space designated for off-street parking is available for human use. In this case, gastronomic establishments will be able to extend their interior space to the outside, improving the vibrancy of this area. Furthermore, some public infrastructure, like sitting areas, will occupy some spots in this sidewalk extension.

To conclude this description, it is important for the project to use shrubs and small plants to separate the vehicle area from the sitting area, ensuring that users feel comfortable in this sidewalk extension.
The alternatives to modified transit role with autonomous cars in this proposal is challenging for the space. In this case the proposal is simple, one central bike line, two automobiles free lanes and drop-off areas. The proposal is symmetrical and both sidewalks are 12 ft wide.

The use of shrubs, flowers and gravel between sidewalk and street has two purposes, firstly separate users and vehicles and secondly increase the permeable surface to the street.

Sidewalk extensions promote the social interaction of design, sitting areas and the street will be supported by major extension of the sidewalk to promote the use of this area for public infrastructure like benches, planters and gardens.

Public infrastructure is accommodated with a four foot swatch of underground utilities. Creating a programming resolution for this urban challenge.
Street as Yard

Neighborhood-type street
The proposal for Corcoran Street introduces a pioneering approach that encourages us to rethink traditional urban elements, made possible by the remarkable advancement in vehicle automation. It presents an innovative concept where sidewalks and streets seamlessly merge, creating a dynamic shared space that transcends conventional boundaries. This visionary idea leverages the automation of vehicles to reimagine the urban landscape, unlocking new possibilities for urban design.
Despite streets having less city in terms of volume, rethinking challenge. Corcoran wide traditional neighborhood importance for the transportation this street was a big Street is a 54-foot-street lined with row
The transit is a new concept for this street as vehicles and people will share the same space. Autonomous cars are safer than current cars and this type of street should promote community values. Autonomous cars should use the street just to move neighbors and at low speed always.

The increment of permeable surface is notable as the new street/shared space will contain different uses and the principal ground surface will be pervious pavement.

The principal role for this type of street is create identity, community and integration of the neighborhood. It is for that reason that the shared space will have different types of activities.

Each use will define the shape of shared/street area where Atvs will use to move. At the same time, drop-off area is included in this shared space as the flow of this street should to be low and it is not necessary contemplate independent drop-offs spots.

The proposal aims to utilize 20% of the current parking spots for private ATVs exclusively for neighboring residents. The main focus is to encourage the utilization of the street as a public space for neighbors. This initiative also seeks to promote the flow of autonomous cars while minimizing the need for on-street vehicle parking.
pedestrians is really poor, as sidewalks are 12 ft wide. However, in this space, urban facilities (signs, hydrants, mailing boxes, etc.) and trees coexist. Walking through these narrow spaces presents a challenge.

The proposal brings disruption, as the street as we know it disappears, and the whole space becomes a shared space where humans and autonomous vehicles coexist. The path where cars can flow is designated as a shared space, the same space where people can board or exit autonomous vehicles like a cab. The restricted speed limit is 5-10 miles per hour in this shared space, as neighbors can use it.

The pavement for this area is permeable; the use of concrete blocks and grass allows the flow of vehicles and provides numerous ecological benefits. Concrete areas are designated for parking spaces, especially at night, and for kids who need smooth surfaces for bikes, tricycles, etc. The assumption is that only 20% of neighbors will have their own autonomous vehicles, while the rest will utilize the technology like a taxi. It is for this reason that the proposal considers a limited number of designated parking spots per block.

The key to transforming this street into a vibrant community space is to promote community value. The design incorporates various uses on the street to attract neighbors, such as urban agricultural spots, playgrounds, dog parks, and sitting areas. By promoting these values, people may choose to live in urban environments instead of sprawling suburban areas, which have a negative impact on the ecosystem. Promoting urban life is one of the important aspects of utilizing energy more efficiently and controlling the advance of nature.

Life in this new neighborhood street will be significantly different from what we have today, as the main space will be occupied by humans and not by vehicles. Furthermore, cars should prioritize human activities and avoid disrupting them, becoming a secondary concern.
Reimagining Streets through the Autonomous Car
conclusion
In conclusion, the advent of autonomous cars presents a remarkable opportunity to positively transform the urban environment, particularly when human beings are placed at the center of this paradigm shift. The street, in this future scenario, emerges as a pivotal element in the development of better cities and the promotion of vibrant urban life.

Taking inspiration from the writings of Leon Batista Alberti, who described the street as a public building and emphasized its role as an ornament, it becomes imperative for us to explore how we can apply these timeless concepts to our present reality. By embracing the potential of autonomous vehicles while honoring the principles of inclusive and aesthetically pleasing street design, we can collectively work towards creating cities that prioritize the well-being and enjoyment of their inhabitants.

As we move forward, let us recognize the significance of the street as a vital component in shaping our urban environment. By integrating these timeless concepts into our modern reality, we can create streets that not only fulfill their functional purpose but also enhance their aesthetic appeal, fostering a sense of pride and delight for residents and visitors alike. Embracing this vision, we can pave the way toward a future where our streets truly serve as the heart and soul of vibrant urban life.

“Yet, when we look around at the quantity and the variety of buildings, it is easy to understand that they were not all developed for this first purpose, nor indeed for the other reasons, but that the range of different works depends principally on the variation within human nature.”

54v-56v-, Book IV, Leon Batista Alberti

The rise of autonomous vehicles presents an opportunity for us to reimagine our streets as shared spaces that prioritize the needs of people over vehicles. As stewards of our urban environment, it is our responsibility to design streets that foster social interaction, accessibility, and safety for pedestrians, cyclists, and other modes of transportation. By taking this responsibility seriously, we can create a more inclusive and people-centric urban landscape that benefits everyone.
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thank you