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McBride Practicum

Before Assignment: Research Paper

January 10th, 2019

Transportation, Identity and Adaptation:
The Role of Road Systems in Cities From Ancient to Modern
With specific remarks on Rome

Cities, dense pockets of human civilization scattered across the globe, are home to approximately 55% of humans, a figure consistently on an upward trend. Temples of religion, science, politics, economics and trade, cities are quite useful subjects for research on the history of humanity because they are, in essence, living organisms of human prosperity and community, etched into the land by various civilizations over thousands of years. One aspect of cities which exceeds all uniqueness and location are road systems. Uruk, Rome, Beijing, New York, Dubai—every city has streets, whether they be organic or grid, dirt or asphalt, narrow or wide. When analyzing a city via their road systems, a new and somewhat uncommon perspective emerges, one which allows for an understanding of cities not only holistically, but also intimately, in the cracks of pavement and mortar of cobblestone. By taking a closer look at road systems in cities, they are revealed to take on roles grander than an aerial view might portray, including functionality in a city's circulatory nature, identity with neighborhoods and city goals, and adaptability with transformation over time.

When Hippodamus, the Greek urban planner, who lived in the 400's BCE, was designing the street system for various Greek cities, there was one initial motivation: transportation. Over

all other constraints, he had to effectively plan cities navigable by all types of transit. Just as a human body cannot survive without the pumping of its circulatory system, delivering important nutrients and chemicals around the body, a city must be able to transport people and goods from any location to another. This function is essential to a city's efficiency, especially because cities are places of great economic diversity. Cities do not prosper because they are made up similar people with similar jobs. Instead, quite the opposite is true, with bakers, doctors, engineers, politicians, students, and many other groups intermingling in a compact space, using each other's goods, services and ideas to support a higher level of civilization, one where knowledge is better suited in depth rather than breadth. Such is another role for road systems in cities: the circulation of knowledge via people.

The methods by which this circulation occurs has changed with the advancement of technology. Seen in Figure 1, the ancient Romans designed streets to accommodate wagons and pedestrians, made from stone, while modern cities have turned to automobiles as the primary

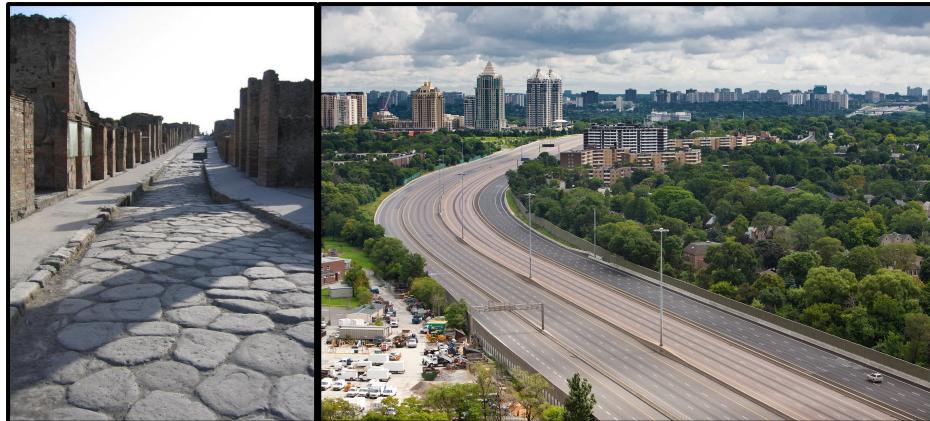


Figure 1: Juxtaposing road types over time

form of transportation, resulting in massive freeways made from asphalt and concrete. This transition to personal transportation, a trend which began in the early 20th century and has propagated throughout the world since, changed the very essence of how a city's circulatory

system works and the role of streets. The suburbs are an example of such an effect of this ever growing independent life style, especially in America (Rose). The road system began to accommodate suburban sprawls with winding streets and cul-de-sac style design. In a paper addressing global street-network sprawl, the authors state that “street-network sprawl will assume an increasingly important role as affluence grows and car ownership and orientation become a choice to more residents” (Barrington-Leigh). The suburbs helped a growing populous live in peace on the outskirts of cities, while still being able to travel into the city-center. Suburbs are extremities and the city-center is the heart; human anatomy once again providing a useful visual and personal analogy. Whether it be cars in the 21st century, wagons in the 15th century, or pedestrians in the 1st century, road systems have always had a functional role in circulation.

In ancient Rome, this functional role of circulation extended also to the transportation of water. “[An] important structural feature of [Roman] streets was the public fountains that were commonly found at intersections” (Aldrete). A utility provided seamlessly by underground pipe-systems in modern cities was the center of many city street designs in ancient times. While aqueducts and other novel technologies of Roman ingenuity were significant in the reshaping of how people lived in cities, still road systems were responsible for connecting such urban inventions to city-dwellers.

As discussed, cities are intricate communities of people interlocked by race, ethnicity, background, profession, class, etc. Therefore, road systems naturally take on roles in individual, group and city identification. In ancient times, Hippodamus recognized the importance of a city based on community, as “he proposed that a city’s land be divided into three distinct parts—public, private and sacred—and then organized in clearly defined neighborhoods” (Rose). Hippodamus’s vision of neighborhoods, while not always as strict as he proposed, can be seen in

cities across the world, especially those with much diversity. No better example exists than New York City, a city made-up of and defined by immigrants over hundreds of years. The famous five boroughs of the city are defined by the road system, the streets giving identity to the communities within. Broadway defines one the largest theater communities in the world. Madison Avenue defines the American world of advertising. Wall Street defines the financial industry. These identities, whether they be professional, social, economic or otherwise, are provided by a road system's simple ability to give a geographic label. Some of these streets, such as the ones just named, even become lifted from mere geographic existence, identifying groups across the world. Outside of such massive and complex cities such as New York City, road systems provide identity to people living in all types of cities. In every address exists the name of a street. Many neighborhoods can be identified by the major intersection within them. In general discussion, much can be deduced by simply using the name of a street: "Our church services people who live north of Colfax"; "Meet us at the café off of Washington street"; "The race begins at Larimer and 52nd Avenue."

Road systems also give a greater identity to cities as a whole. Across the world, cities, whether by planning or organic evolution, are defined holistically by the character of their road systems. New York's bustling streets tell of a city that never sleeps. Tokyo's clean highways tell of a humble culture. Rome's winding and confusing streets tell of an ancient city scrawled in the architecture of a modern city. Beyond the current status of these cities, road systems also define city goals. Hippodamus, via city planning and road design, wished to reach overall goals, including building cities which were "democratic, dignified, and graceful" (Rose). "Medellín calls itself a 'city of life, on the basis of equity, inclusion, education, culture and citizen cohabitation'; Trondheim, Norway, aspires to 'Quality and Equality'; whereas Saskatoon aspires

only to be the ‘Potash Capital of the World’ ” (Rose). These examples show that cities can adopt characteristics and aspirations unique to their visions. Road systems can be tools for conducting such visions, fostering the ideas of city planners such as Hippodamus in Greece, Daniel Burnham in Chicago and Jane Jacobs in America, all leaders in making city goals realities.

Examples of the role of road systems providing identity can also be found to impact cities negatively. In their paper on urban renewal for commercial streets, Mehenna et al. state that “Neglect, too, has led to the loss of the street’s character and identity as part of the city’s historical center, and to many of its functional, urban, visual, and environmental problems, among others.” So, just as a street with a good reputation can highlight a populous positively, so can a street with a bad reputation in infamy. Appearance alone can even mis-identity a community as being impoverished or susceptible to crime. Although accidental at times, road systems label the communities built around them.

The ancient city of Rome offers another example of identity by road system. Rome, a city built in the texture of religious intentions, was shaped by temples of worship. Aldrete describes such religious designs in his book, *Daily Life in the Roman City*: “The most famous street in the city was the Sacra Via, or the ‘Sacred Way,’ which ran from the Capitoline hill through the Roman Forum. A number of important religious and civic rituals included a procession along its course, and, since it lay at the heart of the city, it was the scene of many notable events.” Ancient Rome reveals that a road system possesses value in characterizing people’s beliefs and worship. In the stone of Sacra Via there was a sense of appreciation for the gods, something present in the people and therefore the tissue of the city.

Cities are constantly shifting, transforming and rearranging. Just as organisms, by Darwinian principles, prosper in nature with adaptability in various environments, cities prosper

with adaptability to their people within, whom are always growing, complexifying and changing their ways of life. This ability to adapt comes from many sources, including political reform, economic flexibility and advancement in technology. But, it is in the road system which adaptability can be found in more fundamental forms. Hippodamus used a gridded street network to ensure adaptability in ancient Greece, and since it has become a staple of city planning across the world. The street grid “provided a framework for the independent development of buildings. By creating easily sellable lots, Western cities became profitable real estate ventures” (Rose). As simple as grids are, they provide templates for cities to change overtime, especially as civil construction standards and architectural style change. Empty lots in cities are often seen as scars on the landscape. Instead, they are symbols of a city in flux, possibly adapting to new needs of the people.

Cities, for various reasons, do not always follow the standard grid road network. In the 20th century, cities saw a dramatic shift to automobiles, as discussed previously. The suburban revolution, while adapting to a car-driven world, saw to making cities less adaptable overall. “Most postwar suburbs were served by curving, poorly connected streets ending in cul-de-sacs separated from schools, work, and shopping to such a degree that even a family living right next to a shopping center still needed to get into a car and drive a long, circuitous route to get there. Most suburbs simply weren’t adaptable” (Rose). Rose makes a clear, yet unnerving argument that road systems are incredible tools for city planners, but when immediate function for families in the suburbs is chosen over a more sustainable design, cities suffer the consequences, in time.

Rome, on the other hand, has quite the opposite problem related to cars. The city, built organically for nearly three thousand years, suffers from a somewhat chaotic puzzle of domains. “[The] dominance of the private car is particularly difficult to manage given the urban fabric of

Rome that was not designed to host the automobile. The roads are narrow, uneven, and do not form a grid pattern" (Gualdi). The difference in such cities which were planned with grids and ones that were not can be seen in Figure 2. Chicago and Washington D.C., pictured in the left two panels, were planned cities with obvious grid systems seen throughout. London and Rome, seen in the right two panels, are European cities which are perfect examples of organic growth, with roads existing on nearly every angle.



Figure 2: Gridded and organic road systems. Top Left: Chicago., Top Right: London, Bottom Left: Washington D.C., Bottom Right: Rome. Images provided by Google.

From cobblestone to pavement, wagons to cars, ancient to modern, road systems are essential to the heart beat of a city. They circulate, identify and allow adaptation for a species which, in the last few thousand years, has proven to be capable of building metropoles of impressive scale. But, the research of the role of road systems continues, especially by the use of computers in analyzing such human networks. Hsiang-Yun Wu et al. have propelled urban planning by using models of biological molecular interactions to decompose large networks such as road systems. Graph theory continues to inspire challenging, yet significant algorithmic problems when modeling road systems. Google's pursuit to provide both models and efficient path planning to customers via Google Maps is allowing the average city-goer a chance to contribute to an ever-growing data set of road system characteristics. The Roads to Rome project is untangling "street DNA" by analyzing paths through various cities. A visual result of their work can be seen in Figure 3. In short, road systems have much more to teach about the evolution of civilization. Coming to understand their role in cities is a multi-layered venture into what it means to be human and what it means to live in an urban infrastructure designed by one.

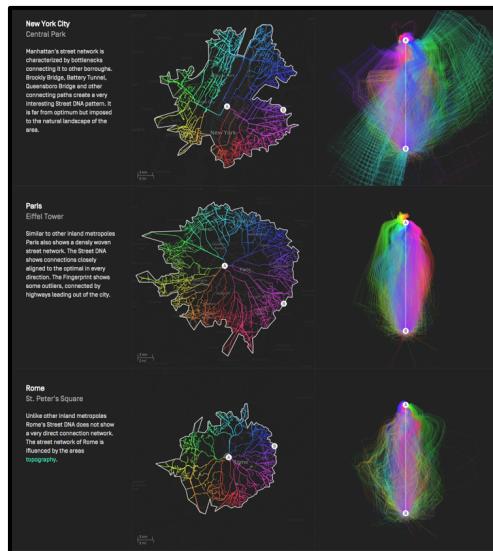


Figure 3: "Street DNA" as created by the moovel lab team. <https://www.moovelab.com/project/roadstorome/about>

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